



**Proceeding:
1st International Recent Trends in
Engineering, Science and
Technology Conference
(IRTESC 2019)**

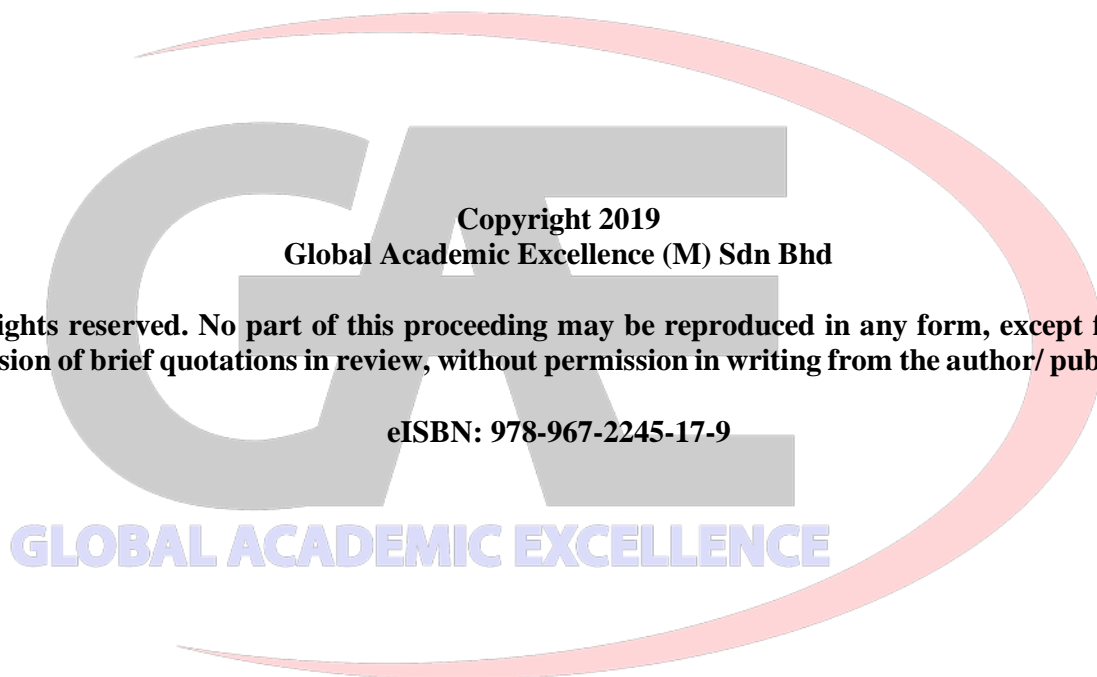
**TH Hotel Kota Kinabalu, Sabah, Malaysia
25-26 August 2019**

Published By:



eISBN 978-967-2245-17-9

**International Recent Trends in Engineering, Science and Technology
Conference 2019 (IRTESC 2019)
eISBN 978-967-2245-17-9
TH Hotel Kota Kinabalu, Malaysia
25th-26th August 2019**



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eISBN: 978-967-2245-17-9

GLOBAL ACADEMIC EXCELLENCE

**PUBLISHED BY:
GLOBAL ACADEMIC EXCELLENCE (M) SDN BHD
(1257579-U)
KELANTAN
MALAYSIA**



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VISUAL INSPECTION OF HERITAGE MOSQUES USING UNMANNED AERIAL VEHICLE (UAV) AND CONDITION SURVEY PROTOCOL (CSP) 1 MATRIX: A CASE STUDY OF TENKERA MOSQUE AND KAMPUNG KLING MOSQUE, MELAKA

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Abstract. *Heritage buildings have unique architectures. According to the National Heritage Department, the concept of conservation of the heritage accepted and practiced universal is 'Authenticity in Heritage Conservation'. The dilapidated study is the practice of identifying and recording building defects by means of photographic and digital documentation prior to conservation work. The objectives of this study is to identify the roof and mosque tower conservation methods and to visually record and analyze information in order to know the type of defect or damage that occurs in the heritage mosque structure. The use of Unmanned Aerial Vehicle (UAV) was used for roof and tower inspection at Tengkeri Mosque and Kampung Kling Mosque which later the images were generated using Pix4D Mapper. The CSP1 Matrix Assessment Protocol is used as a rating tool because it is ideal for a variety of structures to classify data based on the circumstances and the assessment of its harm. There are 13 defects area at Kampung Kling Mosque and 11 defects at Tengkeri Mosque consisting paint faded, vegetation growth, and crack. From results obtained in this study, a thorough maintenance can be done.*

Introduction



The heritage mosque here is a mosque built before the arrival of foreign invaders to Malaysia while the vernacular architecture is related to the availability of materials, craftsmen and technology that existed before the colonial era [1]. The Kampung Kling Mosque and the Tengkeri Mosque, Melaka are among the historical mosque found in Malaysia [2]. In the context of conservation of heritage buildings, the most important aspect is ethics rather than aesthetics. Consequently, in conservation, beauty is not a measure but how to return a building as it was originally [3]. Building inspection is a process for identifying and recording the situation or building defect levels. Survey of building conditions and damages experienced known as the dilapidated study. The dilapidated study is the practice of identifying and record building defects by means of photographic and digital documentation before work conservation [4]. In order to identify defects and damages, visual inspection is required to determine the condition of the building, disability and cause [5]. The work of conservation of historical buildings should be carried out carefully to minimize disturbance to the structure and fabric of the building. Large trucks, special elevating platforms or scaffolding on buildings cause high logistical efforts and costs as well as high personnel costs for the specially trained machine operators [6]. Therefore, during dilapidation survey, the used of UAV can be considered as an alternative tool in visual inspection. Visual inspection is one of the process of dilapidation survey in obtaining information about the defects and damages of the building [7]. Normally, the tools used during the visual inspection of the building by using binoculars and camera [8]. Previously, the inspection is usually done from very limited naked eye observation. UAV has being used as alternative way for collecting data visually for the exterior structure [9].

Photogrammetry UAV is one of the alternative technologies that introduce real-time application, more detailed and low-cost data [10]. The study focuses on the structure of mosque roof and tower using the DJI Phantom 4 micro UAV aircraft at Kampung Kling Mosque and Tengkeri, Melaka. UAV Photogrammetry opens a wide range of new applications within various close domains, incorporating aerial and land photogrammetry. After recording each defect, the assessment of the building condition is made using the CSP1 Matrix Assessment Protocol as a rating tool because it very suitable for a variety of structures to classify data based on the seriousness and assessments of its defects [11]. The system gathers two sets of data which is, building conditions and the seriousness of building defects, which can be analyzed to provide ratings the overall state of the building. The CSP1 matrix has also been developed to shorten the process of interpreting data which will then help shorten the checking time in place. Although the breakdown of the elements of each building may vary from building to building, this does not prevent the matrix format from being able to cope with any working conditions of the survey [12]. Therefore, the aim of this study is to identify the conservation methods done at the roof and mosque tower later to record and analyze information visually using micro UAV aircraft to know the type of defect or damage that occurs in the structure of the mosque. By achieving this study objectives, conservation for a heritage mosque can be made to ensure this mosque can be preserved from being swallowed by a time that we did not realize this legacy building can contribute to national development.

Materials and Method

There are two main stages in the evaluation of the conditions of the building. The first stage is a visual inspection using UAV, while the second stage is a state evaluation using CSP1 Matrix. UAVs for visual inspection at Tengkeri Mosque and Kampung Kling Mosque were carried out in three phases: planning, data observation, and image processing.

Data Capture

The flight direction planning must first be determined to simplify the process of data collection and to avoid unforeseen events. The direction of flight is horizontally on the mosque's roof, while the vertical direction for the mosque tower [13]. The flight method uses the concept grid as a reference to identify damage and defects. In this study, Pix4D Capture is used to record the images and identify the defects for the mosque roof and DJI Go is used to record the images for the mosque tower closely. The time to fly the UAV at Kampung Kling Mosque is 3 minutes and Tengkeria Mosque is 4 minutes while the altitude to fly the UAV for both mosques is 30 meters. Figure 1 and Figure 2 show the flight direction using the grid as the reference position image at the Mosque Tengkeria show the direction that use the grid as the reference position image in the Kampung Kling Mosque.



Figure 1. Tengkeria Mosque

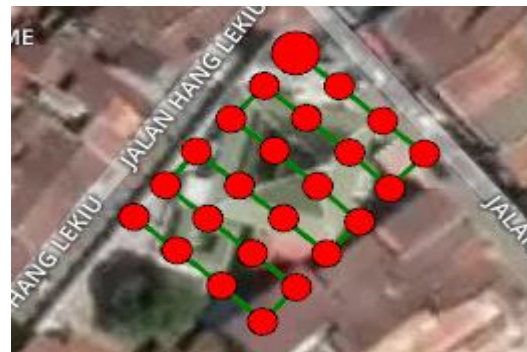


Figure 2. Kampung Kling Mosque

To conduct this study, one will remotely control UAV and two others will give instructions and notify the controller of the aircraft's position so that the controller can follow the observer's direction to the UAV controller. The UAV micro-aircraft operator should always communicate with the observer in order to maintain a distance of 2 meters from the roof and a clearer visual tower [14]. For Tengkeria Mosque, there are 57 points and 21 points measured for roof and tower respectively whereas at Kampung Kling Mosque, 15 and 10 points were identified for roof and tower.

Images Processing

Once the image has been processed, the image is transferred to the Pix4D Mapper software for Tengkeria Mosque and Kampung Kling Mosque to obtain the defects and damages coordinates. The Pix4D Mapper software tool is used to analyze similar image content structures, called matching points, in two or more images and link them together based on these points in order to create a map for the both mosques, which in turn can produce 3D models. These stitching or mosaicking methods are based on pattern recognition techniques which analyze The panorama creation software [15] analyzes the input data under the assumption that images recorded are made only by pivoting without changing the camera's position. Figure 3 and Figure 4 show the images being processing using the Pix4D Mapper at Tengkeria Mosque and Kampung Kling Mosque.

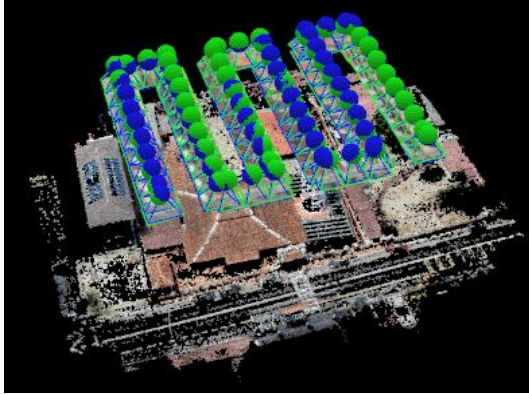


Figure 3. Tengkerah Mosque

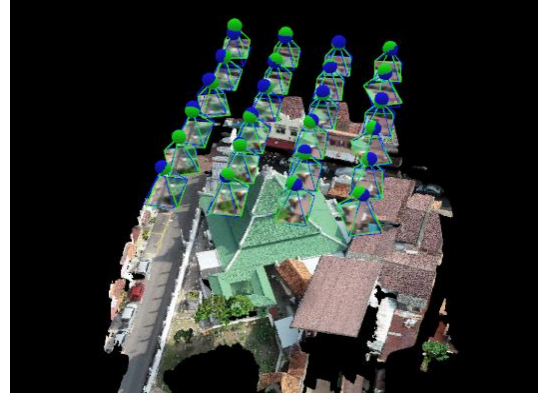


Figure 4. Kampung Kling Mosque

Result and Discussion

From image processing, the total number of defect can be identified. Figure 5 and Figure 6 show the location of the roof and tower defects of the Kampung Kling Mosque and Tengkeru Mosque that has been marked. Therefore, defects will be easily identifiable and referenced.

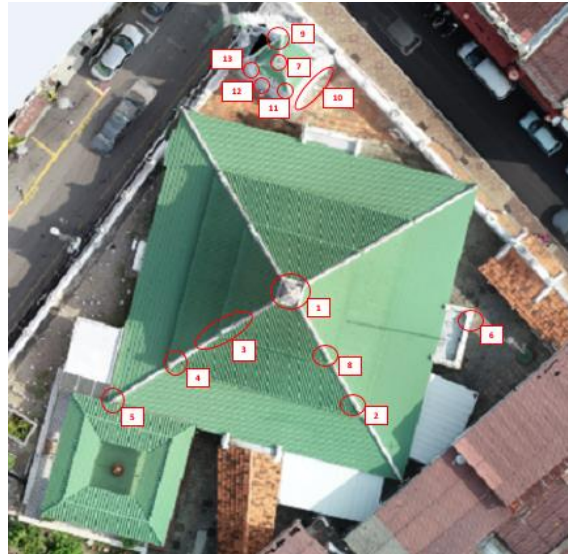



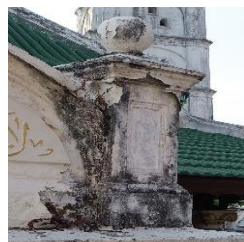
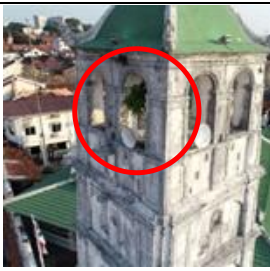
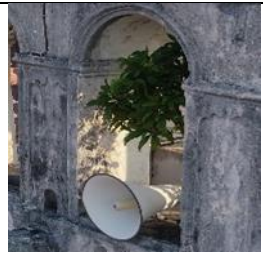
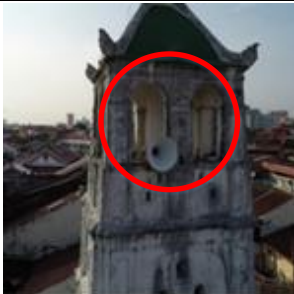



Figure 5. Kampung Kling Mosque

After each defect is recorded, an overall assessment of the condition of the building is made, which summarizes the condition of the building. The building will be evaluated on the basis of the overall average score. The full score is used to give the building an overall rating: Good, Fair or Dilapidated. Table 1 and Table 3 show four examples of analysis of defects.

Table 1. Example of analysis of defects at Kampung Kling Mosque

No of defect: 4					
Condition	Priority	Matrix	Colour		
3	3	9		Element / component : EL/CS 24 (Wall) Defect description: DS/CS 27 (Vegetation growth) Recommendation: Conduct periodic cleaning work Location : 193810.06, 243088.06, 9.84	
No of defect : 6					
Condition	Priority	Matrix	Colour		
3	3	9		Element / component : EL/CS 24 (Wall)	

Defect description : DS/CS 08 (Damage) Recommendation : Scrape and re-paint the wall Location : 193830.72, 243091.37, 7.34										
No of defect : 13 <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <tr> <th style="width: 25%;">Condition</th> <th style="width: 25%;">Priority</th> <th style="width: 25%;">Matrix</th> <th style="width: 25%;">Colour</th> </tr> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;">3</td> <td style="text-align: center;">9</td> <td style="background-color: yellow;"></td> </tr> </table> Element / component : EL/A 14 (Roof) Defect description : DS/CS 27 (Vegetation growth) Recommendation: Conduct periodic cleaning work Location : 193817.69, 243107.32, 19.40	Condition	Priority	Matrix	Colour	3	3	9			
Condition	Priority	Matrix	Colour							
3	3	9								
No of defect: 10 <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <tr> <th style="width: 25%;">Condition</th> <th style="width: 25%;">Priority</th> <th style="width: 25%;">Matrix</th> <th style="width: 25%;">Colour</th> </tr> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;">3</td> <td style="text-align: center;">9</td> <td style="background-color: yellow;"></td> </tr> </table> Element / component : EL/A 14 (Roof) Defect description : DS/CS 13 (Corrosion) Recommendation: Repaint the building Location : 193820.22, 243108.85, 14.49	Condition	Priority	Matrix	Colour	3	3	9			
Condition	Priority	Matrix	Colour							
3	3	9								

Overall, 13 damage images were detected. All of the information gathered for the CSP1 Matrix is recorded in Schedule of Building Condition form for reporting purposes, the CSP1 Matrix comprises an executive summary as shown in Table 2. The type of defect and the total defect can be recognized and categorized according to the section of the building. Wall damage, vegetation growth and corrosion are among the types of damage involved. It can conclude that Kampung Kling Mosque in a fair condition which is the building classification rating is 6.4 using d/e formula.

Table 2. Schedule of Building Condition form at Kampung Kling Mosque

No.	Component	Defect	Condition	Priority	Matrix
			assessment	assessment	analysis
			(a)	(b)	C= (axb)
1	Roof	Corrosion	3	2	6
2	Roof	Vegetation growth	3	2	6
3	Roof	Corrosion	2	2	4
4	Roof	Vegetation growth	3	3	9
5	Roof	Corrosion	2	1	2

6	Roof	Damage	3	3	9
7	Roof tower	Corrosion	2	1	2
8	Roof	Vegetation growth	2	3	6
9	Wall tower	Vegetation growth	2	3	6
10	Wall tower	Corrosion	3	3	9
11	Roof tower	Vegetation growth	3	3	9
12	Wall tower	Vegetation growth	2	3	6
13	Tower	Vegetation growth	3	3	9

Total, d = 83

Total matrix, d = 83

Total defect, e = 13






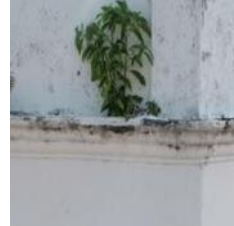
Building classification rating, $d/e = 83/13 = 6.4$



Building rating = Fair



Figure 6. Tengkeru Mosque

Table 3. Example of analysis of defects at Tengkeru Mosque

<p>No of defect : 2</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 10px;"> <thead> <tr> <th style="width: 25%;">Condition</th> <th style="width: 25%;">Priority</th> <th style="width: 25%;">Matrix</th> <th style="width: 25%;">Colour</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;">2</td> <td style="text-align: center;">6</td> <td style="background-color: yellow;"></td> </tr> </tbody> </table> <p>Element / component : EL/A 04 (Decorative elements) Defect description: DS/A 05 (Cracks) Recommendation : Paste back using mortar cement Location : 192099.08, 243898.18, 40.18</p>	Condition	Priority	Matrix	Colour	3	2	6		 
Condition	Priority	Matrix	Colour						
3	2	6							
<p>No of defect: 3</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 10px;"> <thead> <tr> <th style="width: 25%;">Condition</th> <th style="width: 25%;">Priority</th> <th style="width: 25%;">Matrix</th> <th style="width: 25%;">Colour</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;">2</td> <td style="text-align: center;">6</td> <td style="background-color: yellow;"></td> </tr> </tbody> </table> <p>Element / component : EL/A 04 (Decorative elements) Defect description: DS/A 05 (Cracks) Recommendation : Paste back using mortar cement Location : 192101.57, 243905.51, 40.28</p>	Condition	Priority	Matrix	Colour	3	2	6		 
Condition	Priority	Matrix	Colour						
3	2	6							
<p>No of defect : 10</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 10px;"> <thead> <tr> <th style="width: 25%;">Condition</th> <th style="width: 25%;">Priority</th> <th style="width: 25%;">Matrix</th> <th style="width: 25%;">Colour</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">2</td> <td style="text-align: center;">2</td> <td style="text-align: center;">4</td> <td style="background-color: green;"></td> </tr> </tbody> </table> <p>Element / component : EL/CS 24 (Wall) Defect description : DS/CS 27 (Vegetation growth) Recommendation : Conduct periodic cleaning work Location : 192114.63, 243898.84, 48.39</p>	Condition	Priority	Matrix	Colour	2	2	4		 
Condition	Priority	Matrix	Colour						
2	2	4							

No of defect: 11					
Condition	Priority	Matrix	Colour		
2	2	4			
Element / component : EL/A 04 Decorative elements Defect description : DS/A 19 Vegetation growth Recommendation : Conduct periodic cleaning work Location : 192113.68, 243897.53, 49.67					

Overall, 11 damage images were detected. Based on the building section, the type of defect and the total defect can be recognized from the table. Wall damage, vegetation growth and corrosion are among the types of damage involved. All the information collected for the CSP1 Matrix is recorded for reporting purposes in the Schedule of Building Condition form, the CSP1 Matrix comprises an executive summary as shown in Table 4. It can conclude that Kampung Kling Mosque in a good condition which is the building classification rating is 2.82 using d/e formula.

Table 4. Schedule of Building Condition form at Tengkeru Mosque

No.	Component	Defect	Condition assessment (a)	Priority assessment (b)	Matrix analysis C= (axb)
1	Roof	Rust effect	1	1	1
2	Roof	Cracked	3	2	6
3	Roof	Cracked	3	2	6
4	Roof	Vegetation growth	1	2	2
5	Roof	Rust effect	1	1	1
6	Roof	Missing	1	2	2
7	Roof	Cracked	1	2	2
8	Towers	Others	1	1	1
9	Towers	Cracked	1	2	2
10	Towers	Vegetation growth	2	2	4
11	Towers	Vegetation growth	2	2	4

Total, d = 31

Total matrix, d = 31

Total defect, e = 11

Building classification rating, $d/e = 31/11 = 2.82$

Building rating = Good



Conclusion

In conclusion, maintenance works and preservation of heritage buildings in Malaysia are very important to ensure the value of national assets and the heritage mosque's architecture can be maintained in addition to provide a conducive and comfortable atmosphere for worship visitors and mosque users. Although there are defects and minor damage to the roof and mosque towers, the mosques of the heritage are still in good condition and function as desired. In this study, damage and defects to the roof and mosque tower are caused by various causes and worse damage is also caused by unstable preservation. Therefore, the responsible party should undertake periodic inspection and early prevention measures to minimize the risk of further damage or failure. In addition, civil engineering focuses more on inspections, repairs, restoration, and conversion of existing structures in the interests of the environment, the economy, and society. This study shows the importance of UAV applications for image production and information in more detail to support evaluation of the conditions of the building structure. The use of UAV should be encouraged, particularly in the scope of high structural inspection, and the use of Pix4D Capture, Global Mapper and DJI Go in civil engineering should be expanded as it help to minimize the cost of operation, reduce time and friendly user.

Acknowledgements

Authors wishing to acknowledge TIER1 (H166) Universiti Tun Hussein Onn Malaysia for the financial support.

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THE SHORELINE BATHYMETRY ASSESSMENT USING UNMANNED AERIAL VEHICLE (UAV) PHOTOGRAMMETRY

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Abstract: *The shoreline is the boundary between land and sea. The shoreline has an irregular nature and change due to tidal conditions. Shoreline changes occur due to human activity and natural environment that results in eradication of erosion and sediment in the shoreline. UAV as a tool used to identify the shoreline change. However, the measurement of large-size reclaimed land using terrestrial survey methods, such as total station and GPS requires a huge number of efforts in terms of time and labour spending. Although the current method is good in airborne sampling, but it is quite expensive and more complicated to handle. The objectives of this study is to identify the shoreline change from the image taken by using Unmanned Aerial Vehicle (UAV) and to analyse the data using pix4Dmapper and Global Mapper. Planning flight plans for UAV is necessary in this study. The shoreline changes is visibly clear during low tide from July to October 2018. Total length of erosion for three months from July to October 2018 is 8.428 m. Since the aim of this study was successfully achieved, using UAV photogrammetry could be applied in many fields and in determining and identifying the shoreline change.*

Keywords: *UAV, Shoreline change, erosion*

Introduction

The shoreline and coastline is the area of the boundary between land and sea and has an irregular to changes due to coastal process and tidal condition such as move of the sand by the wave currents and wind by the supply of sand [1]. Shoreline movement is manipulated by the changes of short-term and long-term relative sea-level. The changing of ocean level with respect to the land and the expansion and decline in sand movement to the coast that reason the



shoreline withdraw or growth over a period around 50 years or more [2]. The long-term rise in relative sea level along the upper. Relative sea-level rise has additionally constrained sand supply to the coast by drowning ancient river valleys and forming the coastal bays. Shoreline change that occurs over a decades or less and that may be in the opposite directions of the long-term trend is difficult to understand and predict. These short-term shoreline changes can also be quite variable alongshore. One element of the coast might also be experiencing shrink back while just a few kilometers away stable or advancing conditions may prevail. However, it is important for coastal residents to recognize that even though a particular beach may have been advancing or stable over the last several years, then retreat will eventually continue if it has been retreating for the previous decades [3].

Tides are rising and decreasing level due to Earth's rotational and gravitational attraction of the Moon. These tides occur in the coastal estuary area, typically two times raising and two times decreasing per day. The prevailing tide causes a shoreline change. The evaluated shows that 60% of the world population are dwelling in the coastal erosion problems [4]. Despite the fact that the coastal front condition can hold some level of normal character, expanded human alteration reduce the "instinctive nature" [5]. The area of the shoreline and changing position of this limit through time are of natural significance to the seaside scientist, managers and engineers [6].

The increasing of wave from 1.5m to 2.5m causing the occurrence of various tide and tendency to increase [7]. There is 5 factor that makes shoreline mapping is difficult to analyse because of constantly changing conditions. The 5 factors are sea level change, sediment supply, wave and current process, human activities and coastal geology and morphology [8]. There are several methods to determine the shoreline change. Ground survey technique and aerial photo is conventional method to monitoring shoreline which were expensive and time-consuming [9]. Unmanned Aerial Vehicle (UAV) classified aircraft that fly without a pilot. The unmanned aerial system is easy to use, can be cheap, on-demand technology for gathering remote sensing data [10] [11]. The current methods are good in airborne sampling but more complicated to use and more expensive compared to UAV Dji Phantom [11]. Hence, the UAV Dji Phantom is a great advantage with low operational costs in determining shoreline changes and conduct modelling three-dimensional (3D). Other than that, Unmanned Aerial Vehicle (UAV) is also widely used to monitor the small area and also provide results faster and usually higher spatial resolution [11] [12].

Literature Review

The geographic interface of the shoreline, the limit amongst land and ocean, alongside different land utilizes, and different impacts of topographical and hydrodynamic phenomena and their belongings have made shoreline changes a standout amongst the most widely common process in coastal areas [13]. Malaysia is located between latitudes 1° and 7° north and longitudes 107° and 119° east. It comprises two regions, Peninsular Malaysia and the state of Sabah and Sarawak (collectively referred to as East Malaysia) on the northern part of the Borneo Island, which is separated by 640 km of South China Sea. The total land area is $330,400 \text{ km}^2$ while the shoreline totals approximately $4,809 \text{ km}^2$ [7] [14].

Almost all the coastal state face with the issue of the coastal erosion. Coastal erosion and accumulation have dependably existed and added to the forming of the present coastline [15]. Coastal erosion is a process whereby a coastal area loses its subaerial land part (dunes, bluffs, beaches or cliffs) resulting in a net sediment imbalance and subsequent retreat. This process consists of an extensive range of processes such as wind, water currents, wind-induced waves, amongst others that are acting at different temporal and spatial scales, and that are usually self-

related [15]. The coastal sediments, besides those arising from upcountry erosion and transported seaward by rivers, are decentralized on the coast, providing material for dunes, beaches, marshes and reefs [4]. Erosion could also be amplified throughout the monsoon period when high water levels, related to this season, lead to waves breaking directly against the scarp, inflicting loss of material. Although some of this material could come back to the shore by swells once the monsoon, the number came back is often abundant less; hence the net result's erosion [16].

Coastline changes may give impact to the environment such as flora and fauna and also will effect to human social life. The impact of coastline changes can be categorized into two part which is the impact to socioeconomic and the impact on the natural environment [17]. Shore or a shoreline is the fringe of land at the edge of a large body of water, such as lake, sea and ocean. In physical oceanography, a shore is the wider fringe that is geologically modified by the action of the body of water past and present, while the beach is at the edge of the shore, representing the intertidal zone where there is one. An idealized definition of shoreline is that it coincides with the physical interface of ocean and land [18]. The stability of shorelines is ceaselessly beneath threat due to changes to the natural environment caused by the wind, waves, tides, currents, and also because of human intervention that ends up in changes in the dynamic equilibrium prevalent at a given coastal stretch. it is documented that anthropogenic structures amendment the natural flow of currents and sediments inflicting alterations within the local sediment budget and hence in the patterns of current sediment or erosion [19].

The drawback of the ground-based surveying techniques in the growth of interest in aerial photogrammetric surveying using UAV which can easily reliable spatial information for tremendously large scale measurement [20]. Most of the popular UAV that has been used is multicopters UAV. Multicopter UAV is easy to handle and their use is restricted to easy-to-access environment [11]. UAV is will potentially improve option for mapping, surveying and monitoring coastal zone [21]. The latest developments in new generation image matching algorithms including sensor detectors, and better battery technology have resulted in the use of Unmanned Aerial Vehicle (UAVs) in the various field [22]. UAV has been used in coastal areas to map the river channels [23]. UAVs have turned out to be more affordable and simpler to work and provide coastal research specialists with an apparatus that beats a significant number of the restrictions of conventional data collection method; specifically, cost and spatial and temporal resolutions [24].

Methodology

Figure 1 shows the flowchart of this study to be carried out to obtain the result. While Figure 2 shows the study location part of coastal area at Pantai Punggur, Batu Pahat, Johor.

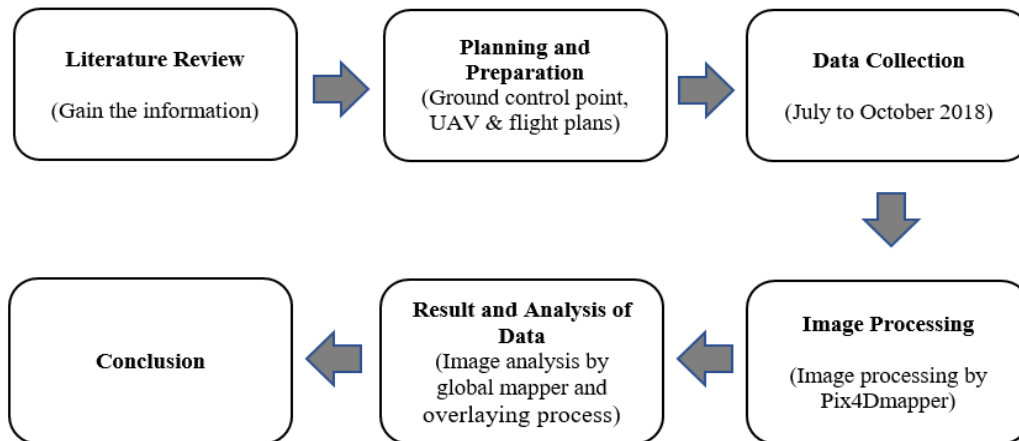


Figure 1: Flowchart of study



Figure 2: View of Pantai Punggur (the 600m is marked with red line)

Flight plans

The flight of UAV have were planned carefully to avoid rainy weather to get the best result. The data were taken during low tide because shoreline can be seen during low tide. Tide data obtained from Department of irrigation and Drainage (DID) was used in this study in order to plan proper timing for UAV flight during low tide. Table 1 shows the flight plan from July to October 2018.

Table 1: The flight plans from July to October 2018

Title	Date	Tides	
Fly 1	27/7/2018 (Friday)	0.61m (low tide) – 4.54PM	2.77m (high tide) – 10.04PM
Fly 2	12/9/2018 (Wednesday)	0.12m (low tide) – 6.13PM	2.80m (high tide) – 11.28AM
Fly 3	25/10/2018 (Thursday)	0.21m (low tide) – 5.03PM	2.98m (high tide) – 10.13AM

Image Capturing

Dji Phantom 4 Pro is used to capture the image from the atmosphere region. The image data were taken three times in July, September and October to identify the shoreline change. Photogrammetry was used to replace the measurement such as levelling, theodolite, measuring tape and others. Photogrammetry is described from three words, that is photo-light, gram-something drawn, and metry-measurement [25]. The concept used by photogrammetry is triangulation. At least two different locations are used to capture the image “lines of sight” can be created the points on the object. Figure 3 shows the process of photogrammetry and elevation modelling. While Figure 4 shows the drone capture the image on each point in map by using Pix4d capture application to create grid for 2D maps.

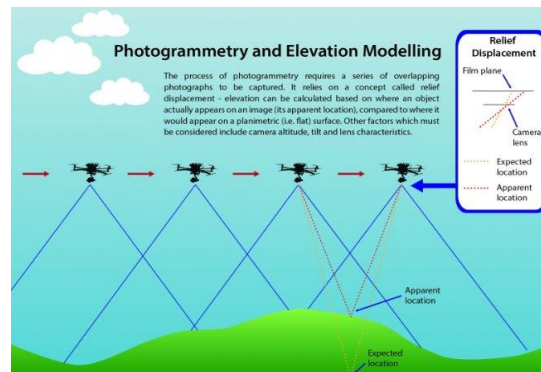


Figure 3: Photogrammetry and elevation modelling

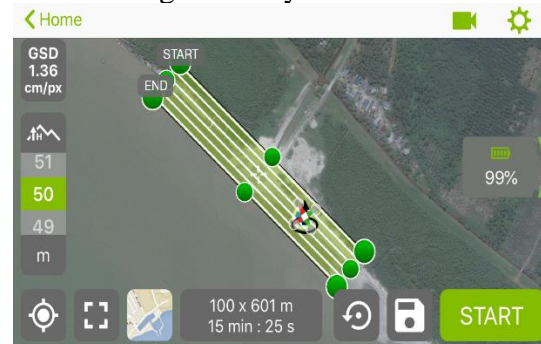


Figure 4: The drone captures the image

Image Data Processing by Pix4Dmapper and Global mapper

The UAV has recorded total 365 of images and processed by Pix4Dmapper to create the orthophoto or one big 3D image. The duration to process the image was two days based on the number of the image taken. After complete the process in Pix4Dmapper, it will be transferred into the Global Mapper. By using the Global Mapper, all of the image were overlaid to draw the line of shoreline to identify the shoreline changes. Figure 5 shows the interface of Pix4Dmapper and Global Mapper software.

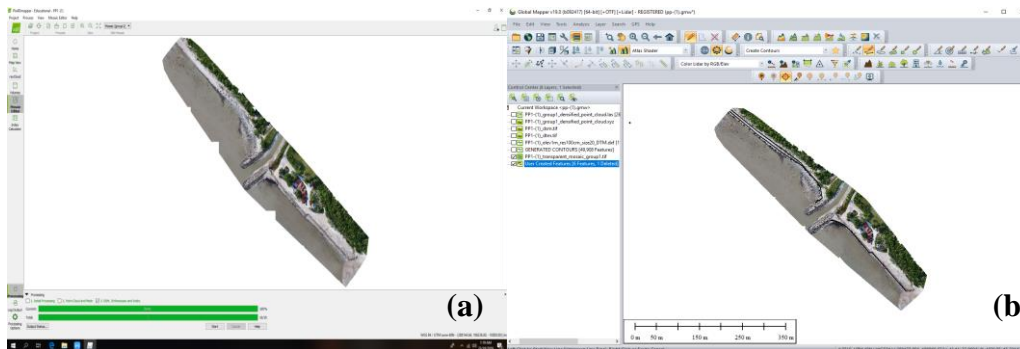


Figure 5: Processing image in (a) Pix4Dmapper (b) Global Mapper

Results and Discussions

Figure 6 shows the overlaid image for three months of data to identify the shoreline changes. Figure 6(a) shows the left side of Pantai Punggur while Figure 6(b) shows the right side of Pantai Punggur. This shoreline change is visible seen eroded from July to October. The right side of the coastal site not detected any changes of shoreline because the revetments built along the beach. However, shoreline changes were clearly seen on the left side of Pantai Punggur. Based on data analysis the coastal area indicates a significant change in the environment that can affect in the future.

The blue line in Figure 6 represents the shoreline in July. The red line represents the shoreline in September and the yellow line represents the shoreline in October. The blue line used as a reference to identify the shoreline change that occur.

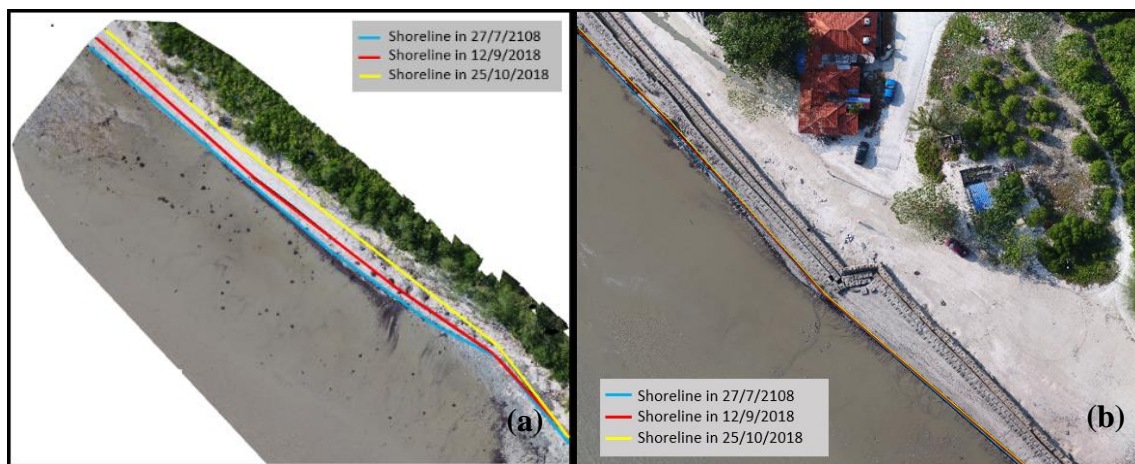


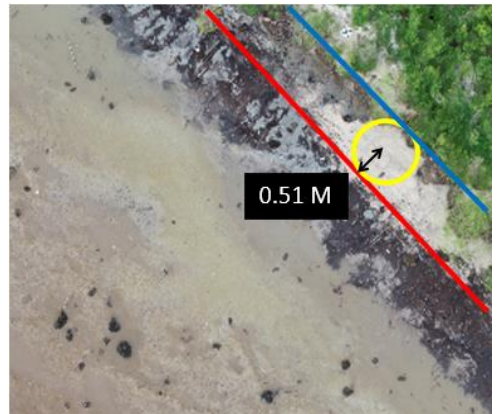


Figure 6: (a) Left side of Pantai Punggur (b) Right side of Pantai Punggur

The tidal effect to coastal area

Table 2 shows the tidal effect to the coastal area from July until October 2018. The tree on the image are used as a reference to marking a point for measuring the length from the line of shoreline to the tree.

Table 2: The tidal effect to the coastal area







	<p>Fly 1 (27/7/2018)</p> <p>The red line represents of shoreline. The blue line represents of coastline. The yellow circle is the area of the tree and used as reference point. The black line represents the length of erosion from the reference point to shoreline. Length from tree to shoreline is 8.938 m</p>
	<p>Fly 2 (12/9/18)</p> <p>The seconds fly shows the length of erosion from reference point to the shoreline is 4.58 m.</p>
	<p>Fly 3 (25/10/18)</p> <p>The 3rd fly shows the erosion has increased and the length from reference point to shoreline is decreased to 0.51 m.</p>

In this study. It clearly shows the occurrence of erosion at Pantai Punggur. Total length of erosion that occurs in three months is 8.428 m. This erosion has been identified through the analysis using Global Mapper.

Erosion at Pantai Punggur

The erosion occurs at Pantai Punggur area where it can be seen from the observation by the naked eye and compared with the image from drone. Table 3 shows the effect of the erosion that causes the shoreline changes.

Table 3: Erossion effect at Pantai Punggur

Date	Image Taken Using Drone	Image Taken Using Mobile Phone
Fly 1 27.7.18		
Fly 2 12.9.18		
Fly 3 25.10.18		

The difference image taken by drone and image taken using mobile phone in three months from July to October 2018. To differentiate the situation for three months data, the first flight data shows that a tree is used as a reference to identify the erosion. The second fly data shows that the tree is falling due to erosion while the third fly data shows that the tree is completely eroded. Figure 7, Figure 8 and Figure 9 shows the erosion that occurred along the left side of the coastal area.



Figure 7: Erosion effect at coordinate 1;41;15.152200, 103;5;44.929999



Figure 8: Erosion effect at coordinate 1;41;13.886499, 103;5;46.335399



Figure 9: Erosion effect at coordinate 1;41;10.059000, 103;5;50.598500

Figure 7, Figure 8 and Figure 9 were taken during the last flight of data. Many factor that cause of erosion. The tidal is one of the factor that cause of erosion. Other than that, the factor of revetments built along the right side of coastal site can reduce and control the erosion for continuously happen. In fact, these changes are coming up fast without warning.

Conclusions

This study is introduced the use of UAV as a tools to gathered information and identifying the shoreline changes. Besides, this method also can be used to identify coastal erosion in different

area. This study on shoreline change is very important and helps to plan ahead to control the erosion from continuing happen. The shoreline changes visible clear happen as it eroded between July to October 2018. The shoreline change in Pantai Pungur is critical and may affect the other coastal area in future. This method can be widely use in future research as a tool for monitoring and identifying the shoreline change, coastal erosion, inspection of building and others. By using this method its successfully achieved the objective of this study. This method can be done and implemented for future research and UAV is the great tools to determine the shoreline change and other coastal problem.

Acknowledgement

The authors would like to express their appreciation to all parties who have contributed to this research, especially to Research Grant TIER 1 Vote U921, Research Management Centre (RMC), Universiti Tun Hussein Onn Malaysia

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ADVANCED TECHNIQUES IN AS-BUILT SURVEY BY USING UAV TECHNOLOGY

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Abstract. *As-built surveys are needed to record variations from original Engineering plans to what is actually built and the final set of drawings produced at the completion of a construction project. As-built surveys are required by many agencies to prove the location of a structure at a point in time. These are especially important for maintenance and future development of the site. To handle this task conventionally, total station was used, but it is more costly, time consuming and more skilled surveyors are required to conduct a total station survey. Purpose of this study is to investigate the Unmanned Aerial Vehicles (UAV) system for comparison of the proposed drawing of UTHM Pagoh Campus with the as-built orthomosaic images and to carry out the mapping based on imaged by UAV. Therefore, a method of mapping by UAV, the application of camera-equipped for visually monitoring construction and operation of buildings was used to collect all the information directly on the site which is on the study area. It is also to carry out the mapping based on imaged by UAV. The data collections show that method to earn all information required for this study is by using UAV equipment, Pix4D and Global Mapper software to generate the images. The result of the study is proved that the ability of the UAV in production of as-built survey mapping is can be achieved and it also ease the as-built survey work due to saving time and skilled surveyors are not required. Thus, UAV is very suitable for engineering work purposes*

Introduction

In this technology advanced era, many new technologies that have been developed to ease the work of surveyor in geomatics field. The most accurate traditional method of doing an “as-built” survey is by using a Total Station, but it is more costly, time consuming and required the surveyor's skill to handle the total station survey. Currently, Unmanned Aerial Vehicles (UAV)

is increasingly used for different applications such as mobile surveillance, environmental monitoring and as-built surveys in the construction field. The UAV is light, small size, easy to controlled, it spend less time and less energy to fly across a wide area or long distance.[1] This UAV technology allows each project to retrieve data at an appropriate accuracy level, using relative accuracy for information gathering or absolute accuracy for design engineering and construction phases. Accuracy in an aerial mapping project is essential to get professional results. In elements of accuracy for UAV technology, as camera resolution has improved, so has the ability to digitize the world in greater accuracy than ever before [2]. A previous work by [3] found that the application of UAV is able to become an alternative in creating an orthophoto map due to more economical and less time consuming.

In this study, the proposed research had covered effective strategies to make as-built surveys by using UAV. This study is focusing more on the comparison of an as-built survey with the image mosaic of UTHM Pagoh Campus based on UAV. Universiti Tun Hussein Onn Malaysia (UTHM) Pagoh Campus was the proposed site of this project and a comparison was made based on the proposed drawing and the actual development on the site. This study is very crucial to bring the advantages of UAV system for as-built survey field. Thus, this study can help to reduce the manpower, time and cost for the management of the site. It's also improved the quality and quantity on the data acquisition by using UAV system. This UAV technology is unique in that inspections and surveys can be accomplished in record time, while the data retrieved is at premium quality. To put it another way, a most common use for UAV, is in measuring locations where vehicles and personnel cannot otherwise access. Surveying roadways, flooded areas or congested city landscapes are perfect assignments for UAV technology. The technology offers a cost-effective alternative to surveying hazardous sites, in a matter of hours compared to days or weeks. Therefore, UAV is very important in helping to conduct as-built survey. In addition, the equipment and software that will be used for this study are based on technology and hence, by using this alternative way, not only removing the time consuming, it could reduce the cost of the as-built survey work.

Literature review

UAV system and reviews the main civilian applications of UAV. There is plenty of definition of the unmanned aerial vehicle (UAV) in the literature. The UAV is an aircraft with no pilot on board. It can be remote controlled aircraft or can fly autonomously based on pre-programmed flight plans or more complex dynamic automation systems. There are many different classifications of UAV based on different aspects, some classified UAV according to its function, some UAV were classified based on their size, and some were classified according to their flights altitude, endurance limit, etc [4].

Table 1. The certain classifications of UAV [4]

Category	Max. Flight Altitude (m)	Missions	Systems
Micro/Mini UAV	150-300	Surveying inside building, agriculture, pollution measurements	Black Widow, Microstar, Microbat, Fancopter

Tactical UAV	3,000-8,000	Mine detection, search and rescue, weapons delivery, communications relay	Phantom, Copter 4, Mikado, Robocopter 300
Strategic UAV	15,000-20,000	Communications relay, boost phase interrupt launch vehicle, airport security	Global Hawk, Raptor, Condor, Helios, Predator-IT
Special Task UAV	20,000-30,000	Anti-radar, anti-ship, anti-aircraft, anti-infrastructure, aerial and naval description	Mali, Harpy, Lark, Marula, Pegasus, Flyrt

DJI Phantom 3 Advanced

DJI Phantom 3 Advanced is a quadcopter manufactured by Chinese producer of flying and camera stabilization systems DJI. Phantom is a small quadcopter that weights 1.3 kg with battery and propellers included. It has a 12.4 megapixel camera with 94° field of view lens. UAV’s main characteristic is its permanent integration with the camera. These devices are considered as low-cost and low-power sensors and that is why they are commonly used in cheaper equipment like commercial drones [5].



Figure 1. DJI Phantom 3 Advanced [5]

Pix4D Mapper

There are many different types of photogrammetry software on the market. The ones that appear to be popular with some UAV operators are Pix4Dmapper, Dronedeploy and Agisoft Photoscan require all images to be uploaded to the software company’s server for the processing which we considered to be inappropriate for sensitive accident site imagery. With the company-owned app DJI GO, the UAV can be controlled manually [6]. An input of a fixed flight path, which the UAV should follow, is not possible before the start of the flight. The software starts by identifying key points in a series of overlapping images. A key point is a point of interest, like the corner of a vehicle that Pix4D can identify in multiple images.

Knowing the camera position as shown in Figure 2, orientation and camera properties like focal length, it then projects a line from the camera through a key point. It then repeats this for the next image, resulting in a triangulated position of that key point in 3D space, which is used to create a point in the 3D point cloud. Ideally you want to take sufficient overlapping images so that a single key point can be identified in 4 or 5 different images [7].

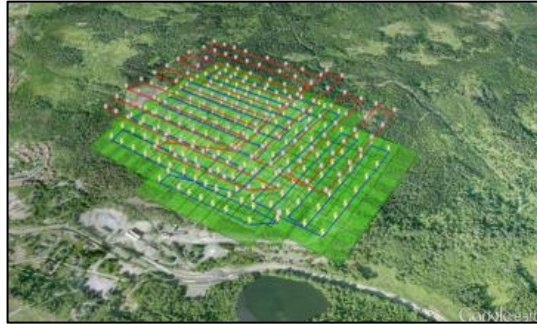


Figure 2. Orientation and camera properties [3]

Global Mapper

Global Mapper is the go-to application for filtering point cloud data to create accurate, bare-earth Digital Terrain Models (DTM). These DTM allow the criteria to generate customized contour lines that can be exported in shape file or virtually any other vector format. Global Mapper’s powerful cut and fill analysis capability and volumetric calculation tools are used to precisely measure volumes, providing Drone Mapper’s clients in a variety of industries with site-specific intelligence that is essential for efficient project management as highlighted in [8].

As-Built survey

Most, if not all, construction contracts require the contractor to produce as-built drawings. However, slight information is found in industry literature about as-built and the as-built survey process. In addition, the work scope often changes over the course of the construction project. Beyond executing the change in the field, changes need to be documented to show what was actually constructed. Hence, the owner usually requires a final record to show all changes or, more specifically, any change that modifies the tangible portions of the completed work. The end product of this effort is what the industry terms as-built drawings, or more simply, “as built” [9].

Methodology

The method of the study starts with the site preparation and planning that include site review of UTHM Pagoh Campus and training sessions of UAV as in Figure 3.

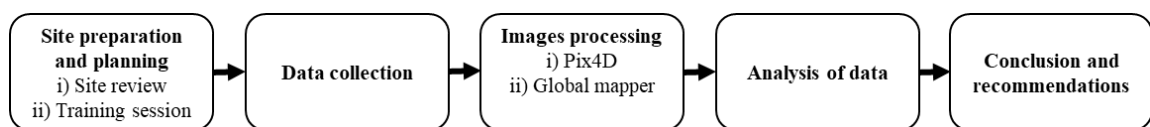


Figure 3. The Methodology Flow Chart

Site review acknowledges the situations and positions of each buildings on the campus. Training Session divided into two (2) stages which were before and during the flight. Before flights are the planning and preparation which acquire with the planning area of flight and training session under supervision. This is involved with the flight direction that is planned to start from the Share Facilities parking and proceed to the main gate of UTHM Pagoh Campus as shown in Figure 4. While during flights are the images collecting that obtained the capturing images of UAV and checking for any defective of the pictures. The smartphone or any devices such as tab must be connected to the controller of UAV before activating the DJI Go or Pix4DCapture as Figure 5.

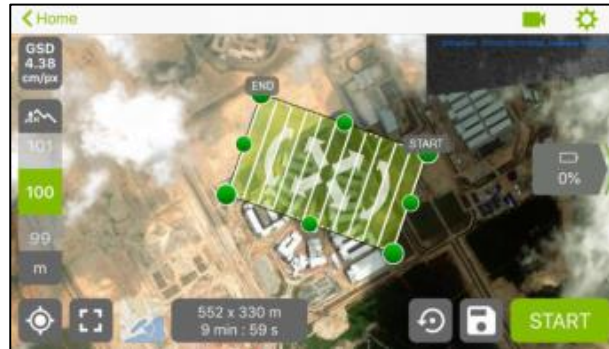


Figure 4. UAV flight direction from the Share Facilities parking to the main gate of UTHM Pagoh Campus



Figure 5. The controller is ensured to be connected with the smartphone and the UAV.

During the process of collecting images as shown in Figure 6, the flight of UAV must be under the observations of the pilot and the pilot must aware of any flight failure. This is also to facilitate communication for keeping a safe distance from the wall structure of building even though with anti-collision. The weather must be suitable for the flight of UAV to be fly and the most suitable time preferred to be is in the morning with adequate exposure.



Figure 6. The positions of the pilot while fly the UAV.

Images processing

Images processing was comprised of Pix4Dmapper and Global Mapper software. The stages of the image processing of Pix4Dmapper is:

- 1) Images from UAV are downloading to the Pix4dMapper software. Transfer all the images that have been taken from the UAV flight from study area by using the USB cable to *Windows XP* computer that is obtained at Geomatic Laboratory UTHM Pagoh Campus.
- 2) The images need to be run in three (3) stages of processes which is Initial Processing, Point Cloud and DSM, lastly Orthomosaic and Index.
- 3) Next, proceed the images processing by clicking on the processing tabs and click tick on the initial processing which is the first process and unclicks the second and third processing as shown in Figure 7. Let the images being sort out and the time necessary to finish the first process are about 40 minutes.
- 4) Unclick the initial processing and click on the start button to lead the images processing as shown in Figure 8.



Figure 7. Initial Processing of the images

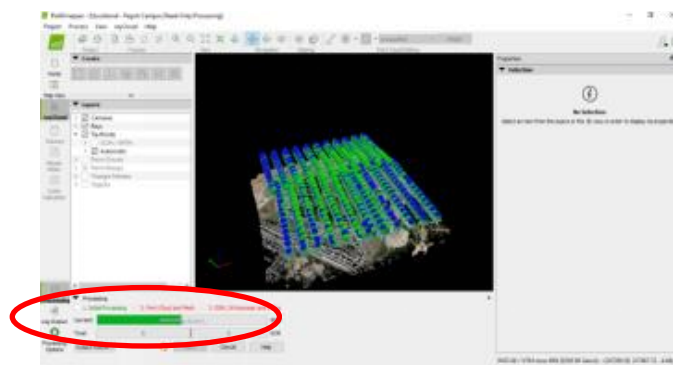


Figure 8. Point Cloud and DSM, Orthomosaic and Index images processing

Completed with Pix4Dmapper, then proceed to the Global Mapper. This data is compulsory for the analysis purposes to gain the information for the accuracy of the dimensions of the UAV flight images processing with the purpose drawing plan of the UTHM Pagoh Campus. Used the data that obtained from Pix4Dmapper and transfer the file into the Global Mapper tool, it takes photos with overlapping coverage and generates a 3D point cloud output using photogrammetry methods of Structure from Motion (SfM). This technique uses overlapping photographs to derive the three-dimensional structure of the landscape and objects on it, producing a 3D point cloud images as shown in Figure 9.

For UAV-collected data, one of the most powerful and commonly used terrain-based functions is volume calculation. Global Mapper offers a variety of tools for this purpose from simple measuring the components in the UAV flight. As for this study, road, basketball court

and certain building were measured to define the comparisons between purposes drawing plan with the actual build on the site. The terrain analysis that will be used are Digital Terrain Model (DTM) and Digital Surface Model (DSM).

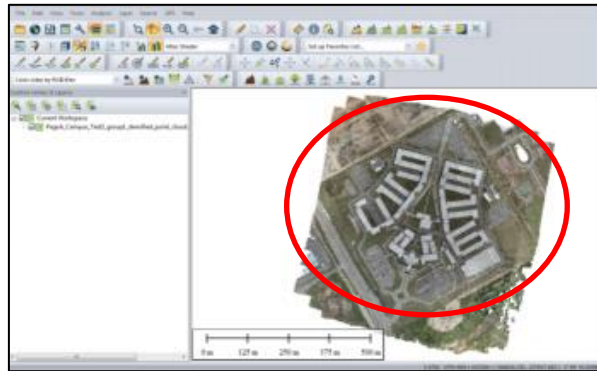


Figure 9. 3D point cloud image.

Results and Discussions

All the images captured from the UAV flight require to process with using the application of Pix4Dmapper to produce the product of photogrammetry orthomosaic images. From the products that has been processed from the application Pix4Dmapper and Global Mapper, information such as the data of the area and the measurement of the component in UTHM Pagoh Campus are obtained.

Images processing

Getting the photo from the air with using Unmanned Aerial Vehicle (UAV) as the primary medium for this study to produce information of comparisons between the proposed drawing of UTHM Pagoh Campus with the images that obtained from the flight of. Each photo from the air that is produced is having the quality of 12 Megapixel and already adjusted with the flight of UAV with 100m altitudes from the ground with ground control point that is already allocated to make sure that each of the UAV photo completed with attitude coordinate of longitude and latitude. Each UAV photo needs to be processed by using the application of Pix4Dmapper to produce a complete orthomosaic images that meet the requirements for mapping purposes. Figure 10 shows the result of complete orthomosaic images of UTHM Pagoh Campus with the detail of the images.



UTHM Pagoh Campus images detail:

Camera Model Name: FC300S_3.6_4000x3000 (RGB)

Number of images: 329

Flying altitude: 100m

Average Ground Resolution: 4.32 cm / 1.70 in

Area Covered: 0.489km²

Coordinate System: WGS 84 (EGM 96 Geoid)

Figure 10. Orthomosaic images of UTHM Pagoh Campus

Proposed drawing of study area

With the aid of AutoCAD in gaining the data about the study area before constructed is intended to obtain the accurate data of dimensions and measurements to be compared with the orthomosaic. The data analysis process in the application of AutoCAD is done with by open up the purpose drawing plan as shown in Figure 11 that is acquired and make an analysis measurement by undertaking the dimensions part.

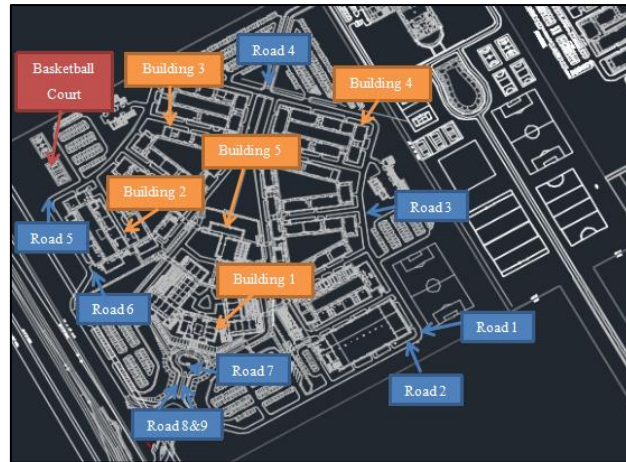


Figure 11. Proposed drawing of UTHM Pagoh Campus

Measurement Analysis

Using the data that has been generated from the Pix4Dmapper and transfer to the Global Mapper, the mosaic images will be used to determine the comparisons of measurements between what actually built on site instead what has been proposed before constructed of UTHM Pagoh Campus. The measurement analysis was divided into four parts which were road measurement, basketball court measurement, building measurement and non-existent facilities.

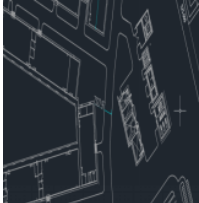








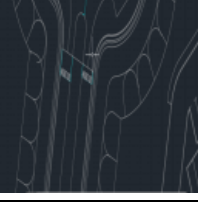


Road measurement.

Based on Table 2, it shows that Road 1, locations on Block G are having the most accurate data for road measurement. The differences are $\pm 0.002\text{m}$ between global mapper and as-built. This is proved that data from the UAV images can be used for as-built survey mapping.

Table 2. The measurement data

Feature Name	Location	AutoCAD	Global Mapper	As-Built	Differences Global Mapper vs As-Built
Road 1	Block G	7.327m	6.728m	6.730m	$\pm 0.002\text{m}$
Road 2	Block B	7.300m	6.665m	6.700m	$\pm 0.035\text{m}$
Road 3	Block A1	8.707m	8.614m	8.650m	$\pm 0.036\text{m}$
Road 4	Block A1	4.000m	3.986m	3.950m	$\pm 0.036\text{m}$
Road 5	Block A1	4.000m	3.954m	3.970m	$\pm 0.016\text{m}$

Table 3. The images of proposed drawing, orthomosaic and as-built

Types of Component	Proposed Drawing (AutoCAD)	Orthomosaic (Global Mapper)	As-Built
Road 1 (Block G)			
Road 2 (Block B turn)			
Road 3 (Block A1)			
Road 4 & 5 (Block A1)			




Basketball court measurement.

Based on Table 4, it can be said that the width of the basketball court, locations on Block B are having the most accurate data for basketball court measurement. The differences are $\pm 0.033\text{m}$ between global mapper and as-built. This is proved that data from the UAV images can be used for as-built survey mapping.

Table 4. The measurement data

Feature Name	Location	AutoCAD	Global Mapper	As-Built	Differences Global Mapper vs As-Built
Length of the basketball court	Block B	34 m	36.379 m	36.3 m	$\pm 0.079\text{m}$
Width of the basketball court	Block B	19 m	21.12 m	21.45 m	$\pm 0.033\text{m}$

Table 5. The images of proposed drawing, orthomosaic and as-built

Types of Component	Purpose Drawing (AutoCAD)	Orthomosaic (Global Mapper)	As-Built
Length and width of the court (Block B)			



Building measurement.

Based on Table 6, it clearly shows that Building 1, locations on PBL are having slightly common data for building measurement. The differences are $\pm 0.050\text{m}$ between global mapper and proposed drawing. It is proved that data from the UAV images can be used for as-built survey mapping.

Table 6. The measurement data

Feature Name	Location	AutoCAD	Global Mapper	Differences between AutoCAD and Global Mapper
Building 1	PBL	36.657m	36.707mm	$\pm 0.050\text{m}$



Table 7. The images of proposed drawing, orthomosaic and as-built

Types of Component	Purpose Drawing Plan (AutoCAD)	Orthomosaic (Global Mapper)
PBL		

on-existent facilities

After the processing images completed, the comparisons were made with the purpose plan drawing of UTHM Pagoh Campus. There are non-existent facilities that are being caught by the UAV.

Table 8. The images of proposed drawing, orthomosaic and as-built

Types of Component	Purpose Drawing Plan (AutoCAD)	Orthomosaic (Global Mapper)
Block B		

UAV characteristics ability in as-built mapping

From the data that have been processed until obtained the measurements' analysis of UTHM Pagoh Campus with the proposed drawing plan and the as-built orthomosaic images, this is proved that the ability of the UAV in production of as-built survey mapping can be achieved and it also ease the as-built survey work. Table 9 shows the characteristics ability of the UAV that is used to accomplish this study.

Table 9. Characteristics ability of UAV

Characteristics	Ability/Capability Limit
i. Flight Duration	10 until 15 minutes each flight
ii. Altitude	Maximum until 500m from ground level
iii. Camera Quality	12 Megapixel picture as well as 2.7K resolution Video

Based on this study, the used of UAV are very suitable because of the characteristics ability as state above meets the requirement throughout the processing data at the field. With the use of UAV can reduce the time consumption to gather all the data and required information needed for this study.

Conclusion

Based on the analysis of this study, the completion of as-built survey mapping at UTHM Pagoh Campus with using UAV can provide a several results which can be applied for a more detailed study on the ability of the mapping in UTHM Pagoh Campus, especially in as-built survey area. The outputs that resulted from the process analysis such as a file of Pix4Dmapper, orthomosaic images of UTHM Pagoh Campus, complete proposed drawing plan and the details as well as UTHM Pagoh Campus site layout plan elevation that can be accommodated.

From the result of the analysis, it can be applied for different purposes of work and more detailed depending on the job requirements. For instance, the Pix4Dmapper file and the orthomosaic images that resulting from this study can be used to form an actual 3 dimensions images with precise surface rate including the locations of infrastructures or even the gradient on some surfaces. Also, the resulting files from the application of Pix4Dmapper can be used as the propose image to be update on certain area in the Google Earth. If viewed in the Google Earth nearby the UTHM Pagoh Campus, show that there is still no road pavement.

From the analysis of this study, it is proved that the method choose which is UAV for the as-built survey mapping are convenient with the purpose of this study. There are various benefit using this method compared to the existing method. The choosing of UAV methods for mapping devices purpose is a wise selection because it gives benefits to any party. Especially in terms of less manpower needed, a cheaper cost as well as saving more time on the research site. Furthermore, it is suitable for the latest technology needs.

Acknowledgments

This research was supported by the Centre for Diploma Studies, Universiti Tun Hussein Onn Malaysia. We would like to thank the Registrar Office and Research Management Centre, Universiti Tun Hussein Onn Malaysia for all forms of financial aid.



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68 MHZ FUNDAMENTAL REPETITION RATES FOR MODE-LOCKED ERBIUM DOPED FIBER LASER BASED CARBON NANOTUBE SATURABLE ABSORBER

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Abstract. A carbon nanotube thin film as saturable absorber in a cavity design of mode-locked fiber laser is reported in this work. Measured by power dependent absorption setup, 22% modulation depth of the saturable absorber is estimated which is ideal for stabilizing the mode-locked operation. Based on the scanning image from atomic force microscope (AFM), Single wall carbon nanotube components are identified existed in the thin film. The laser cavity employed a ~40 cm long erbium doped fiber as a gain medium which corresponds to the laser wavelength of 1550 nm (telecommunication wavelength region). Total length cavity of the fiber laser is about 3.1 m where shorter cavity design is required for higher repetition rate. This proposed system result in a firm soliton spectrum at centre wavelength of ~1561 nm with ~0.7 mW average output power and pulse duration of 410 fs. The pulses are generated at fundamental repetition rate of 68 MHz without any distortion and excellent spectral quality.

Introduction

Laser technologies had been improvised, and more advanced over decades of years as there is growth of demand for laser applications in certain fields. Many techniques had been developed and demonstrated to achieve better laser performance. One of the techniques is passively mode-locked laser, where it had extensively explored and reported due to its potential applications for ultrashort optical pulses generation in picosecond and femtosecond region [1–3]. Numerous application in fundamental research areas that involved short pulsed laser systems including medical and industrial fields are; time resolved studies in chemistry [4], optical frequency metrology [5], terahertz generation [6], and optical coherence tomography [7].

A saturable absorber introduced in the laser cavity can caused the laser to change its operation from continuous mode into a pulsed mode. The pulse often initiated by intensity

dependent of nonlinear optical elements that response to support optical pulsation over continuous wave lasing. Also the proposing of fiber technologies had upgraded the technology in laser where difficulty and sensitivity of the solid state laser alignments can be reduced. Erbium doped fiber is mostly utilized as a gain medium as it is low cost and enables laser generation in communication wavelength of 1550 nm. Particularly, the applications of carbon nanotubes (CNTs) as nonlinear saturable absorbers (SA) for passively mode-locked fiber lasers [8–11] is extremely attractive due to its optical performance, at once acquaint with new nanomaterials of wonderful physical and optical characteristic which triggered the study of new 2-D materials as well. CNTs ultrafast response time is influenced by packs of semiconducting and metallic CNTs that entangled together. The photons cause the electrons to excite in semiconducting CNTs couple to metallic CNTs, thus resulting in ultrafast recovery time of semiconducting CNTs shorter than 1 ps. This is one of the advantages of the CNTs. Other than ultrafast recovery time, the CNTs are advantage as it has wide absorption band [12]. In order to generate ultrashort pulses in femtosecond regime, a wide saturable absorption band is required to be inserted in the passively mode-locked laser cavity.

In this paper, we present the dynamics of a mode-locked Erbium fiber laser, which employs a CNT thin film as the mode-locking element. The laser produces ~410 fs pulse duration but at repetition rate of ~68 MHz. Detailed spectral is recorded at different pumping levels and the operation of the laser is linked to the characteristics of the CNTs saturable absorber.

Experimental Method

CNT-SA Preparation and Optical Characterization

The carbon nanotube thin film in shape of polyvinyl alcohol (PVA) composite is merged onto the fiber ferule and sandwiched with another fiber ferule (connector) as in figure 1. The index matching gel is used to adhere the film onto the fiber ferule as well as to match the index of the ferule and the thin film. A topography image of carbon nanotubes is then obtained from a scanning probe microscope (SPM), SmartSPMTM-1000 (AIST-NT). The semi-contact atomic force microscopy (AFM) technique was selected since this technique shown a quite obvious advantage against the contact AFM if any poorly fixed nanometer sized objects like carbon nanotubes was measured by AFM. Afterward, Raman spectroscopy with laser excited at wavelength 532 nm (2.33 eV) is conducted to show the difference between energy of absorbed and reemitted photons which indicates the energy needed to excite a molecule to a higher vibrational energy band.

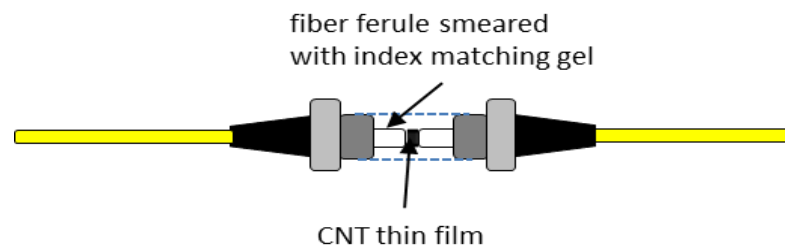


Figure 1. Assemble of saturable absorber by sandwiched CNT thin film with two fiber FC/PC connector.

Mode-Locked of Fiber Laser Setup

Setup of passively mode-locked erbium doped fiber laser is constructed in ring shape as depicted in figure 2. A 40 cm length of highly doped erbium fiber with absorption of 80 dB/m at wavelength of 1540 nm is pumped by a 980 nm laser diode through a wavelength division multiplexing (WDM) coupler. A polarization-independent isolator is employed in the cavity to

ensure the unidirectional of the ring cavity as well as to help prevent the back-reflection in the cavity. Via a fiber output coupler, 90% of the light emissions are allowed to pass the CNT-SA and feedback into the ring cavity while 10% of the intra-cavity optical power is tapped as the output of the generated mode-locked laser. In this cavity, no polarization controller is acquired to match the round-trip polarization state in the fiber ring cavity as the light state polarization in the cavity is good enough to produce stable short pulse laser. The total cavity length of the fiber laser is measured at around 3.1 m. The 40 cm EDF has a dispersion of $12.6 \text{ ps}^2 \text{ km}^{-1}$ at 1550 nm while the remain cavity has 2.5 m single mode fiber (SMF) with an anomalous dispersion of $-22.8 \text{ ps}^2 \text{ km}^{-1}$ and the 1 m HI-1060 fiber with dispersion of $6.75 \text{ ps}^2 \text{ km}^{-1}$. Thus, the net cavity dispersion gives a negative value of -0.016 ps^2 . The output is divided by 3 dB splitter, in order to simultaneously observe the pulse train and optical spectrum, where they are connected to the optical spectrum analyser (OSA) and oscilloscope through photodetector respectively. A radio frequency spectrum analyser (RFSA) with photodetector is employed to characterize the pulse train in frequency mode while the pulse width of the output laser is captured by an auto correlator.

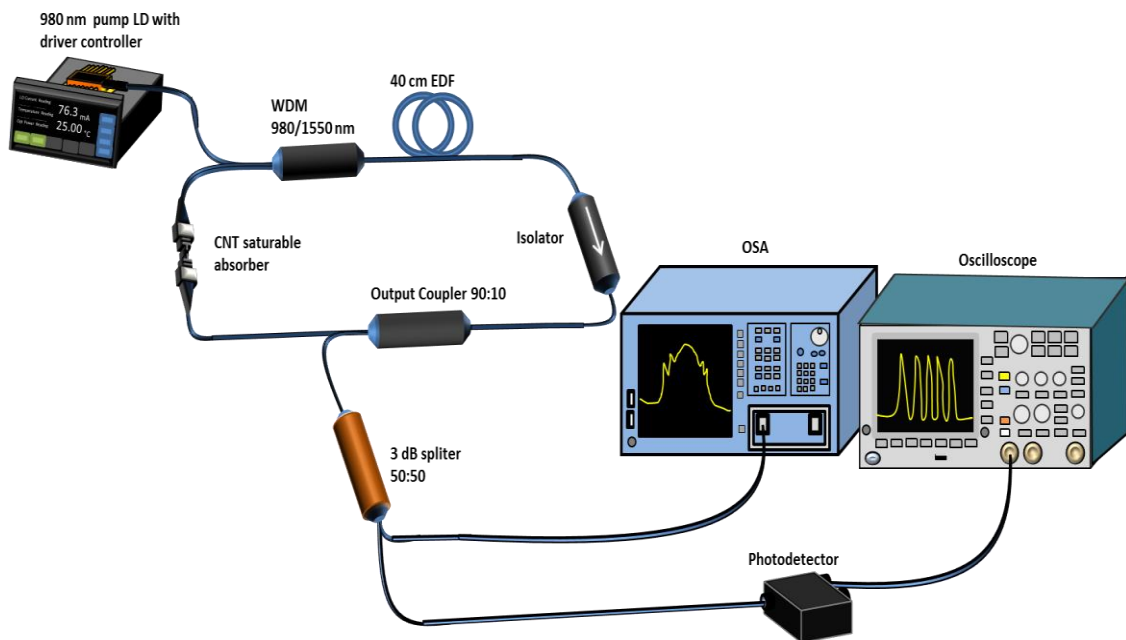
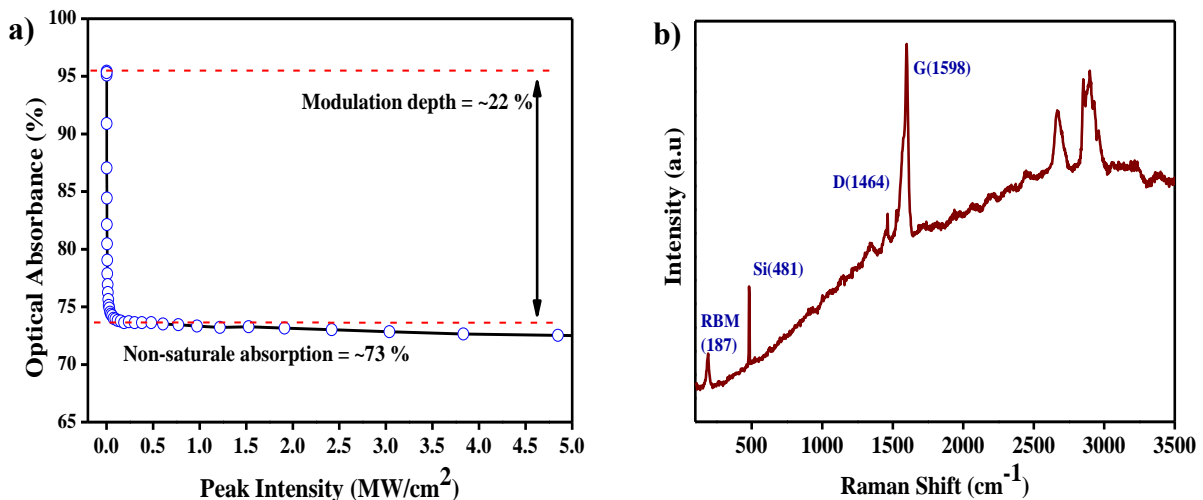


Figure 2. Ring cavity configuration of fiber laser incorporating carbon nanotube thin film as saturable absorber. (LD: laser diode, WDM: wavelength division multiplexer, EDF: erbium doped fiber, OSA: optical spectrum analyser)

Results And Discussions

Figure 3a) shows the CNT-SA properties of the nonlinear absorption measurement where the plotted graph resulting in $\sim 22\%$ of modulation depth, $\sim 0.003 \text{ MW/cm}^2$ of saturation intensity, and 73 % of non-saturable absorbance that correspond to the peak intensity of 0.15 MW/cm^2 . The modulation depth of the CNT in this work is slightly higher with difference around 5-8% compared to other works [13,14]. A better mode-locked fiber laser operation can be achieved if modulation depth normally more than 10 % is obtained [15]. Thus, this saturable absorber is suitable in generating better pulse shape laser. Additionally, high modulation depth indicates that the saturable absorber is quite thick [16] and the relatively large value of the non-saturable absorbance of the CNT is due to the film thickness which contributed to the fiber-to-fiber

spacing [13,14]. However, this high non-saturable absorbance (non-saturable losses) specifies high power losses thus minimize the efficiency of the laser output power. Raman spectrometer of the CNT thin film is shown in Figure 3b). The spectrum shows peaks of D and G-bands at wavelength shift 1464 cm^{-1} and 1598 cm^{-1} respectively. The silicon (Si) peaks is observed at 481 cm^{-1} while the radial breathing mode (RBM) is at 187 cm^{-1} . Another peak that essential and showed the existence of CNTs is known as Tangential mode or G mode (from graphite) which is observed around 1598 cm^{-1} . In this CNTs thin film, up to six Raman peak are observed which prove that the CNTs is a single-walled carbon nanotubes (SWCNTs) that give rise to a multi-peak features [17]. Besides G-band, there is low peak intensity of disorder-induced D-band that represents the resonance condition of the material. Commonly, 50% of Raman spectra from SWNTs exhibit observable D-band signals with low intensity. SWCNTs is in good resonance if strong signal with low signal to noise ratio (practically no D-band) is showed while large D-band peak intensity compared to the G-band peak in SWCNTs indicates the amorphous carbon presences thus showed the spectra is in bad resonance conditions with high signal to noise ratio. In this work, the peak is observed at $\sim 1464\text{ cm}^{-1}$ which near to the D-band peak ($\sim 1450\text{ cm}^{-1}$) obtained in [17]. It has very low intensity similar to other SWCNTs features observed between the RBM and G-band peaks. Consequently, this verified that the saturable absorber employed is SWCNTs thin film. Figure 3c) is the AFM topography image resulted from the SmartSPMTM-1000 (AIST-NT) scanning probe microscope. The scan area showed that the CNT is observed spiking out from the surface and dispersed in-homogenously into non-uniform Island like structure while the smooth background is the uniform thin film. This in-homogenous dispersion of the CNT has also been obtained in other research works include [18,19]. Thus, this confirmed the CNT existence in the thin film. Additionally, this CNT is categorized as single walled carbon nanotubes (SWNT) due to the tabulated spiking CNT on the thin film are lower and less dense compare to the multi-walled carbon nanotubes (MWNT) [20].



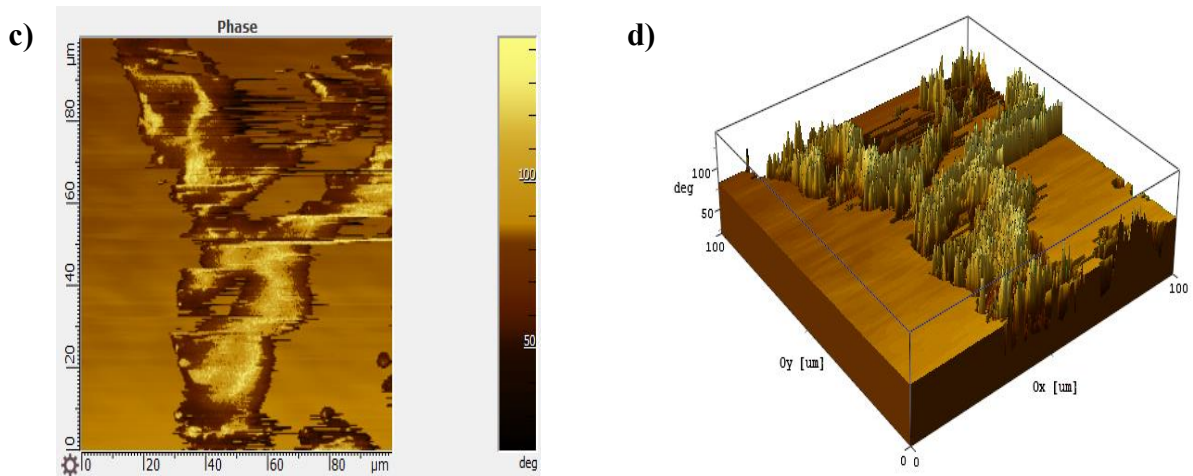


Figure 3. Optical characterization of the CNT-SA. a) nonlinear optical absorption measurement of CNT thin film, b) The Raman spectrum of CNT thin film, c) AFM topography images of CNT thin film

In order to achieve high fundamental repetition rate, the gain medium of highly absorbance erbium doped fiber with 40 cm length is employed. This is one of the methods used to manage the cavity dispersion of the fiber laser and decrease the total cavity length. The characterizations of the mode-locked fiber laser outputs are observed commonly for its spectrum profile, pulse train repetition rate and frequency, also the laser pulse width. The results are illustrated in figure 4, where figure 4a) is the stable mode-locked spectrum profile obtained when the pump power applied at 63.5 mW and the average power of the mode-locked laser is measured at around 0.7 mW. The mode-locking fiber laser threshold is obtained at pump power of 52.6 mW. Similar to other works on CNTs thin film mode-locked fiber laser [13,18,21], this threshold power of the mode-locking fiber laser spectrum is in reasonably low power. Given that, only low input power is required to generate mode-locked laser spectrum in this fiber laser cavity. Also from figure 4a), the 3 dB bandwidth spectrum obtained is 10.54 nm at central wavelength of 1561 nm where the spectrum profile shows low intensity of Kelly-sidebands. The sideband or known as chirped soliton is relatively large in the normal group velocity dispersions (GVD), thus we can assumed that this cavity is in anomalous dispersion regime which lead to less perturbation (chirp/Kelly sideband) to be occurred [22]. This cavity regime is also equivalent to the calculated cavity dispersion. Figure 4b) shows the autocorrelation trace of the full-width half-maximum (FWHM) of the pulse width which is 0.41 ps with fitted curve by sech^2 function. The time bandwidth product (TBP) of the laser is calculated to be 0.477, and the value near to the transform limited sech^2 pulse minor deviation of about 0.162. Then, corresponding to the fiber laser fundamental repetition rate of ~ 68 MHz, the total length of the laser cavity is calculated and estimated to be 3.1 m which is slightly difference from the measured cavity length (3.9 m). The pulse interval of the mode-locked fiber laser is measured by an oscilloscope at value of 15.4 ns as shows in figure 4c). Afterward, in the figure 4d) depicted the radio frequency (RF) spectrum profile for the generated pulses train in span of 120 MHz and 1.4 GHz (inset) with radio bandwidth (RBW) of 10 kHz. A ~ 68 MHz RF signal is observed at 49.5 dB with the suppressed background noise from the main peak. The wide span RF spectrum verifies stable operation of the mode locking without any Q-switching instability (inset of figure. 4d).

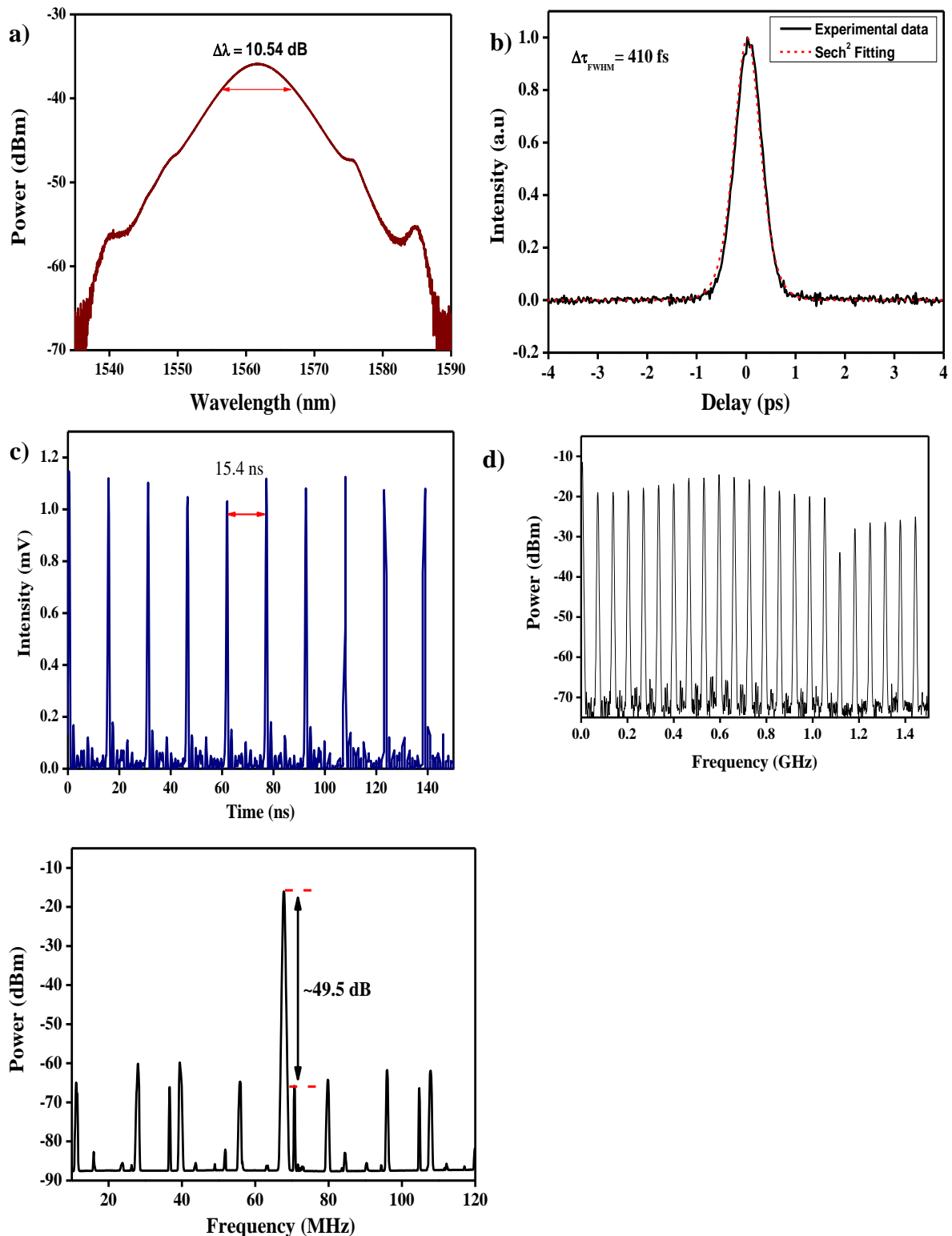


Figure 4. Mode-locking erbium doped fiber laser based on CNT-SA performance with 45 cm length of erbium doped fiber as gain medium. a) Optical spectra of the generated dissipative solitons at threshold power ~ 63.5 mW, b) the oscilloscope tracings for repetition rate ~ 65 MHz (c) the pulse width profile from auto correlator; (d) the radiofrequency spectral profile and insert: the wideband RF spectrum.

The mode-locked fiber laser is varied by the input pump powers, and the maximum pump power limited by laser pump source is 75.3 mW. Figure 5 shows the plotted of average power of fiber laser against the pump power source. Hence, the maximum average output power of the mode-locked fiber laser is 1.28 mW. The pulse energy and peak power obtained are considered to be at 0.019 nJ and 48.1 W respectively. This average power has low efficiency of 1.9 % but no power dropdown is obtained and we can assume that CNT-SA thin film can withstand strong laser illumination up to ~200 mW. The damage to the CNT-SA can be mitigated in the cavity as the gain medium of erbium doped fiber with highly absorbance is employed, thus reducing the light-matter interaction while propagating through the CNT-SA. Therefore, this cavity design provides an effective approach to the optical damage problem on the CNT-SA thin film. It also shortens the total length cavity needed and high fundamental repetition rate of the mode-locked laser can be achieved.

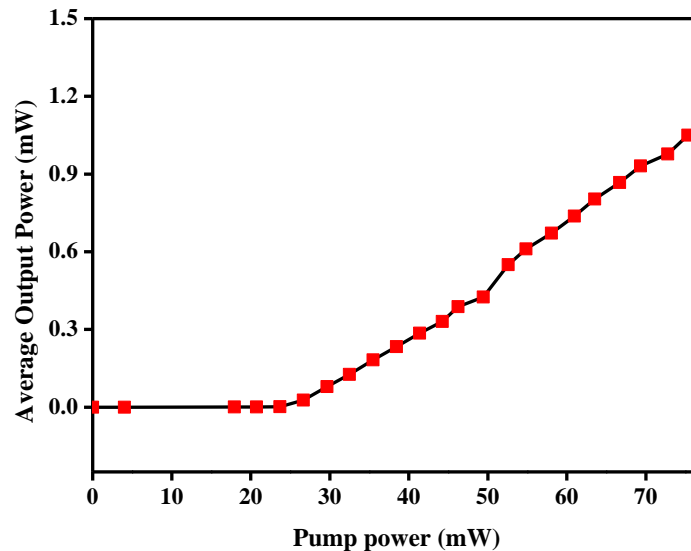


Figure 5. Average power of fiber laser against the pump power source

To the best of our knowledge, this is the first observation of Er-doped fiber laser using sandwiched CNT-SA thin film that can achieved fundamental repetition rate up to ~68 MHz without any distortion compared to the previous study [8,23–25] . Mostly, the study of mode-locked fiber laser are focused from the techniques in fabrication of the CNT-SA to the variation of saturable absorber material in order to enhanced the characterization of the mode-locked laser [26–28]. However in our study, we demonstrated the simple technique of CNT-SA and cavity shortened of the fiber laser which gives good advantage in term of low cost, effective and compact devices.

Conclusion

In summary, we demonstrated passively mode-locked erbium-doped fiber operation at the anomalous dispersion regime of fiber lasers based on a CNT-SA thin film through sandwiched interaction technique. The nonlinear optical properties demonstrated the possibility of CNT-SA as a saturable absorber in a passive mode-locked fiber laser. A fiber ring cavity of high absorption of erbium doped fiber is constructed as a gain medium to achieve high repetition rate. Successively, a stable and robust mode-locked pulse is generated with a spectral bandwidth of 10.54 nm at 1561 nm, 410 fs pulse duration, and ~68 MHz repetition rate.



Acknowledgements

We would like to thank University of Malaya for the facilities and equipment provided, in collaboration with by Universiti Teknologi Malaysia and Universiti Tun Hussein Onn Malaysia. Special thanks to the Ministry of Education Malaysia for supporting this research under Fundamental Research Grant Scheme Vot No. FRGS/1/2016/STG07/UTHM/03/1.

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EFFECT OF DIFFERENT COMPLEXING AGENT ON SURFACE MORPHOLOGY AND MICROSTRUCTURE OF CU-SN-ZN COATINGS ELECTRODEPOSITED FROM LESS HAZARDOUS ELECTROLYTE

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Abstract. *In the present work carbon was electrochemically coated with Cu-Sn-Zn ternary alloy coatings from an electrolyte containing copper chloride, tin chloride and zinc chloride. The morphology and chemical composition of the deposits were examined by means of scanning electron microscopy (SEM) and energy dispersive X-ray spectrometry (EDS), respectively. The results exhibited that Cu-Sn-Zn coatings with 5,5-dimethylhydantoin as complexing agent contain a large amount of copper. It is found that sodium formate was the suitable complexing agents in production of Cu-Sn-Zn ternary alloy due to its uniform and smoothly depositions coated on substrate.*

Introduction

Electroplating is the process in which layers of material are coated on top of substrate due to the application of an electric current to the system. The substrate is immersed in an electrolyte containing metal salts which when dissolved is the source of the positively charged metal cations to be deposited. A negative charge is then applied to the substrate which acts as the cathode attracting the metal cations towards the substrate. The metal cations are reduced and deposited at the substrate surface. Brass is electroplated from a mixed copper and zinc, bronze, speculum alloy can be electroplated to achieve some of advantages of each constituent and good corrosion protection. In industry, soldering of Cu-Sn-Zn alloys are commonly formed as a result of interfacial reactions that occur between the solder (Sn-Zn) and the copper as substrate [1]. Electroplating of alloy is used extensively in a variety of industrial applications including electroforming, electrorefining, and as an undercoat for other deposits to protect basis metal or to promote adhesion, soldering and printing rolls [2].

Copper and its alloy have many technical applications based on their properties to be applied such as electrorefining, automotive and electronics for the purposes of appearance, special surface protection and mechanical properties. Cu-Sn-Zn ternary alloys exhibit better cyclability, due to the nanostructured nature of Cu-Zn alloys and large capacities due to the high capacity of Cu-Sn alloys [3]. These ternary alloys are more attracting than binary copper alloy from a decorative view, because the deposits obtained from the ternary alloys present better mechanical resistance. These alloys also can be electroplated from alkaline cyanide solution and the acid sulphate solution bath. The most common bath used in the electronic applications is cyanide solution while for the purpose of decorations and appearance applications the acid sulphate solutions was chosen [4]. The use of cyanide salts in the electroplating of Cu-Sn-Zn has turn out to be environmentally disfavoured because of the ecological considerations [5][6]. Hence, in this paper, the effect of different complexing agents was studied on the microstructures properties of Cu-Sn-Zn ternary alloy produced with less hazardous electrolyte via electroplating.

Experimental

Substrate preparation

All solutions in this work were prepared using analytical grade reagents and deionized water. All experiments were carried out in 250 ml electrolyte prepared with deionized water. The electrolyte was prepared by adding reducing agent and complexing agent, respectively into a solution containing CuCl_2 , SnCl_2 and ZnCl_2 , which were chosen as the source of copper ions, zinc ions and tin ions. The substrate used was carbon with dimension 45 mm length, 0.9 mm thickness and 1.8 mm width was served as cathode and graphite was act as anode. Substrates were heated at 500 °C for 45 minutes to remove any impurities. The substrates were then degreased in acetone solution. Prior to electroplating, the substrates were activated in 10% sulfuric acid (H_2SO_4) solution to produce a highly clean active surface [5]. After each of these pre-treatment process, the substrate was cleaned in distilled water.

Electrodeposition of Cu-Sn-Zn

Plating proses via electroplating was performed for 30 minutes in less hazardous electrolyte containing copper chloride, tin chloride and zinc chloride with the help of reducing agent and complexing agent as shown in Table 1. The bath was agitated mechanically with current density range from 0.5 to 4 Adm^{-2} . The solution bath was placed on the heater with the temperature monitored by a contact thermometer. The electrolyte pH was adjusted with sodium hydroxide acting as a buffer and agitation was set constantly.

Table 1. The composition of electrolyte and plating condition

Composition	Function	Concentration
CuCl_2	Cu metal source	0.17 M
SnCl_2	Sn metal source	0.13 M
ZnCl_2	Zn metal source	0.23 M
Sodium hypophosphite	Reducing agent	0.45 M
	Complexing agent	0.20 M
pH		7 – 9
Temperature		45 – 55 °C
Plating time		30 min

Surface morphology and composition analysis.

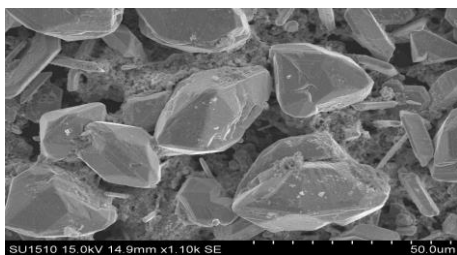
In order to study the surface morphology and compositions of the electroplated layers deposited from less hazardous electrolyte bath, scanning electron microscope (SEM) equipped with energy dispersive x-ray (EDX) spectroscopy (JEOL, JSM-6380LA) were used. The thickness was measured by the following formula:

$$t = \frac{(m_2 - m_1)}{A \times \rho} \tag{1}$$

Where m_2 and m_1 are respectively the mass of alloy plating and substrates; A is the area of the coated specimen; $\rho = \sum \rho_w$ (w is the mass fraction of Cu, Sn and Zn in alloy).

Results and Discussion

The morphologies of the Cu-Sn-Zn ternary alloy on carbon substrate in the study of the effect of different complexing agents were examined by SEM presented in Figure 1(a-d). It is clearly shown that the grain structures of the Cu-Sn-Zn deposited on carbon is strongly affected by the type of complexing agents. In the deposition of Cu-Sn-Zn developed with sodium formate as complexing agent as shown in Figure 1(a), the large agglomerates were observed. These large sized granules are composed of strong hydrogen and sodium oxylate generated by decompositions of sodium formate [7]. In the production of Cu-Sn-Zn ternary by using sodium acetate as complexing agent as presented in Figure 1(b), the obtained deposited is rigorous and it was perpendicular to the surface. This can be explained by the presence of carbonic acid function in its structure that are produced by the decompositions of sodium acetate. Sodium acetate also acts as buffer to keeps a relatively constant pH level of electrolyte and to stabilize the metal ions in alkaline bath [8]. Figure 1(c) shows the surface morphology of Cu-Sn-Zn ternary alloy deposited in the presence of D-sorbitol in electrolyte as complexing agent. The deposits is regular and becomes denser due to refining actions of D-sorbitol [4]. In this work, 5,5-dimethylhydantoin was selected as one of the complexing agent to be studied in the effect on the properties of microstructure Cu-Sn-Zn alloy. 5,5-dimethylhydantoin (DMH) is the most in demand available as complexing agent for metal electroplating with heterocyclic structure organic molecule and gives a good solubility and stability in alkaline solution. Its derivatives also acts as more stable complexing agent for metal ions [9]. As seen in Figure 1(d), fine deposits were obtained with 5,5-dimethylhydantoin compared to others complexing agents. However, the presence of porosity was also noticed for each study. This was due to the release of hydrogen gas at working electrode during electroplating process even though a continuous stirring supposed to prevent such condition. Hence, it will produce a less homogenous and less durable surface finish [10].



(a) sodium formate 50.0 μm



(b) sodium acetate 50.0 μm

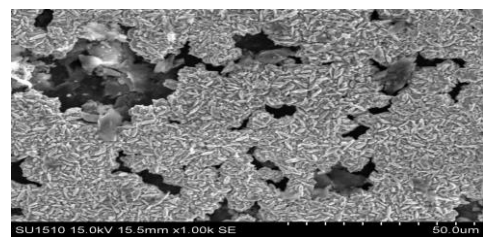
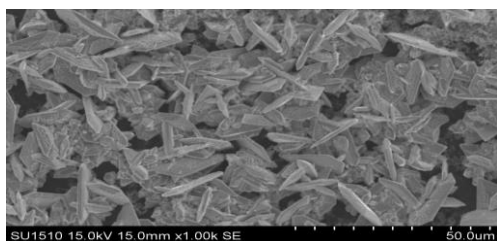


Figure 1. SEM micrographs of Cu-Sn-Zn layer sodium formate, (b) sodium acetate, (c) D-sorbitol and (d) 5,5-dimethylhydantoin as complexing agent in production of Cu-Sn-Zn ternary alloy via electroplating.

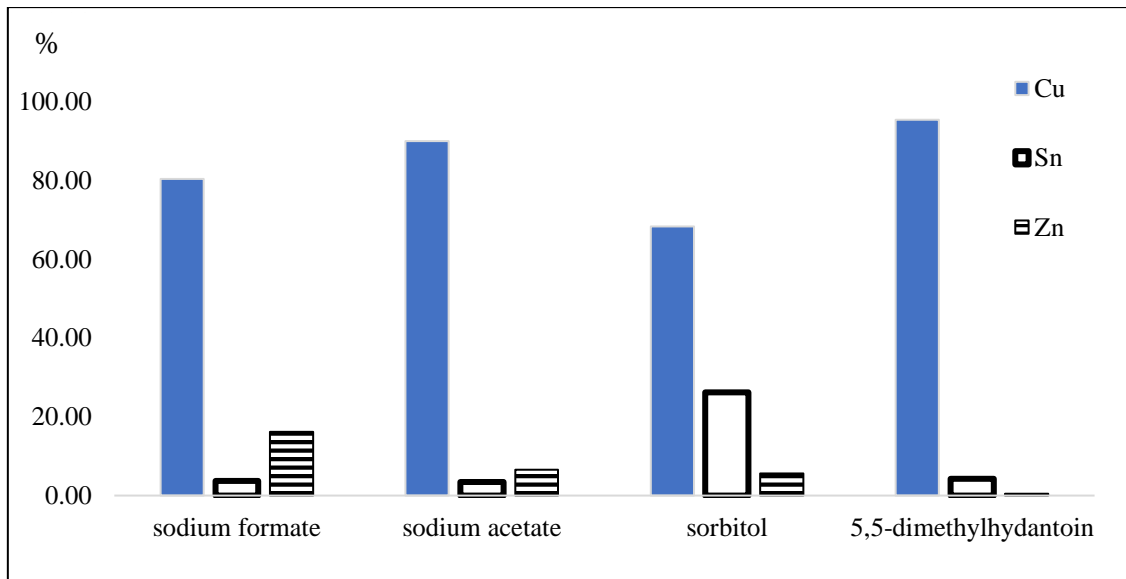


Figure 2. Atomic compositions of Cu-Sn-Zn coatings electrodeposited from electrolyte with different complexing agents.

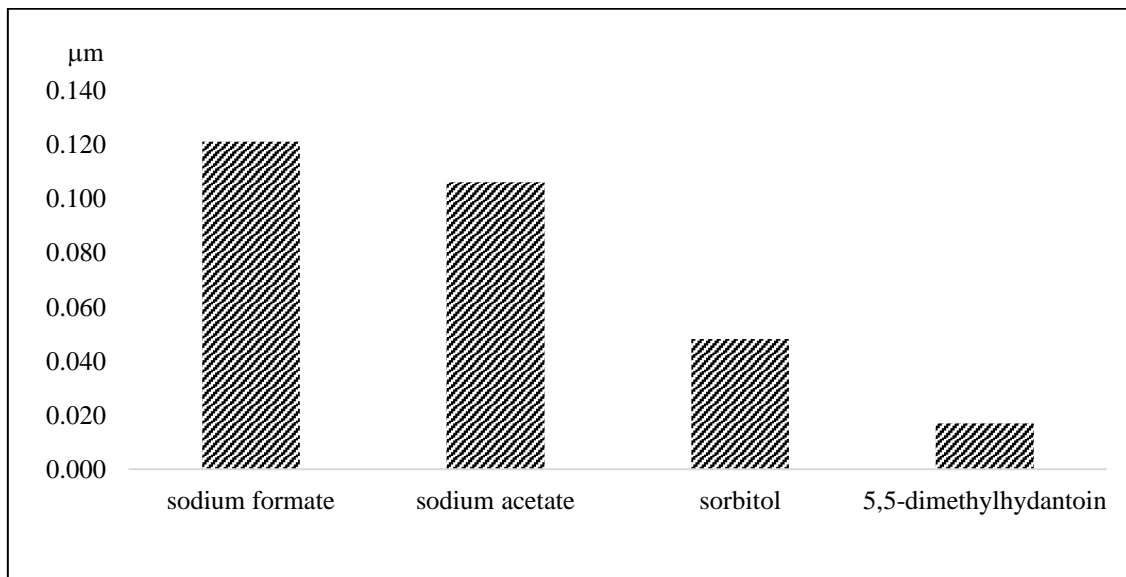


Figure 3. Thickness of Cu-Sn-Zn Ternary Alloy Deposited in The Effect of Different Complexing Agents

The compositions of Cu-Sn-Zn deposited on carbon by using different complexing agents was investigated using energy dispersive x-ray (EDX) analysis. As illustrated in Figure 3, the content of Cu deposited with 5,5-dimethylhydantoin as complexing agent is relatively high (95.27 %), This is because Cu^{2+} is easier to obtain electrons provided by reducing agent in depositing of Cu-Sn-Zn alloy on carbon substrate. However, the deposition Zn with the same complexing agent is relatively low, which is only 0.52 %. The presence of Zn in smaller amount in the deposited alloy with respect to amount of Zn in the electrolyte might be due to the thermodynamic instability of alloy system. The amount of Cu and Sn deposited in electroplating using sodium formate and sodium acetate are in the same range, on average containing approximately 85 % and 3.5 %, respectively. Cu-Sn-Zn deposited via electroplating with D-sorbitol as complexing agent exhibit almost similar content as white bronze which are 68.22 % Cu, 26.18 % Sn and 5.68 % Zn, respectively. However, the obtained deposits were mostly powdery

Complexing agents affects not only on the coating surface morphology but also the thickness of Cu-Sn-Zn deposited layers. Figure 3 demonstrates the relationship between the types of complexing agents and Cu-Sn-Zn ternary alloy coating thickness. It is noticeable that Cu-Sn-Zn ternary alloy is easily electrodeposited on carbon substrate with sodium formate and sodium acetate as complexing agent. The deposits obtained were brownish and uniformly coated on substrate. However, the deposits obtained on carbon with D-sorbitol and 5,5-dimethylhydantoin as complexing agents, were powdery and tended to peel off from the substrate.

Conclusion

Cu-Sn-Zn ternary alloy coatings may be successfully achieved by electrodeposition from less hazardous electrolyte with addition of appropriate complexing agent. The addition of proper amounts of sodium formate to the electrolytic bath results in the formation of uniform, and smooth Cu-Sn-Zn ternary alloy coating.

Acknowledgement

This research is supported by the Ministry of Education Malaysia under the Fundamental Research Grant Scheme (FRGS) Vot FRGS/1/2016/SRG07/UTHM/03/1 and partially sponsored by Universiti Tun Hussein Onn Malaysia.

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QUALITY IMPROVEMENT USING SIX SIGMA METHOD AND COST EVALUATION IN NFA2XSY-T 3X150 MM² PRODUCTS AT PT. XYZ

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Abstract. *An electric cable is a medium that is in the form of a conductor and insulator to deliver electric current from the area of origin to the destination. The quality of a cable is very much determined by the medium of transmission, the delivery material can be copper or aluminum. PT XYZ Tbk is one of the companies engaged in the electrical cable that produces bare conductors. One type of product produced by PT XYZ Tbk is medium voltage cable. Medium voltage cable is a type of cable that can deliver electricity to 35 kV. But among various types of medium voltage cables, NFA2XSY-T products have the highest fail rate among other types of medium voltage cable, which makes the frequency of rework and repair of these products higher. Based on historical data for three months, from June to August 2018, it is 21%, while the company's target is 1%. Therefore, in this study a quality improvement was carried out to minimize the level of defects with the six sigma method with the Define Measure Analyze step. Improve Control.*

In the Define stage, it is done by identifying the type of defect, step Measure evaluates the stability of the process and identifies the quality costs associated with defects that occur, in the Analyze stage, by analyzing the causes of the dominant defect, in the Improve phase, improvements are made by making standard operating procedures, then at the control stage, it is attempted to compare between DPMO and Sigma Level before and after implementation. Based on data processing obtained DPMO of 77,585, and Sigma Level of 2.9, with total quality costs of Rp. 21,260,413 / day, after implementation DPMO was obtained at 55,556 and Sigma level of 3.9 with a total cost of Rp. 14,049,757 / day

Keywords: *Six Sigma, DMAIC, Cost of Quality*

Introduction

In order to win the competition in the business world, a company should always maintain the quality of products or services produced, the higher of a product quality, then the demand of product will be find so high, if the demand increases, it automatically increases the company's sales that have an impact on increasing profit. PT XYZ is a company in the cable

industry that produces fiber optic cables, low voltage, medium voltage, high voltage. One that is produced by the company is a type of cable with a type of medium voltage that can deliver electricity to 35 kV. The NFA2XSY-T product is one type of medium voltage cable with the highest failure rate among other cable cables such as: NA2XSEYBY, CUXLPECWS, NA2XY, CU / XLPE / CTS / ALT / PVC / SWA / PVC-AT / FR-UV and according to historical data collected in June-August 2018, it has a failure / defects rate of 21%, and the other side targeted of the company is 1%, therefore on improving quality to minimize defects with the Six Sigma. Six Sigma is a method that can be used to improve quality in stages by reducing variations between the specified standards. And according to Mongtomery [1] that quality is inversely proportional to its variation, if the variation approaches the predetermined standard / target, the quality will increase, otherwise the quality will be decrease. The stages carried out in this study are Define, Measure, Analyze, Improve and Control

At the define stage, it is done by identifying the types of defects that occur from the product While the products that are the focus of this research are NFA2XSY-T, with the following meanings: The NFA states that the conductor is made of Aluminum (Al), 2X states that the insulation process uses XLPE raw material, S states that the screening process uses copper (Cu) wire, Y states that the outer sheathing process uses raw materials PVC and T states that the cable is twisted. The measure phase is to evaluate the current production process, whether the process has been stable or not, and identify quality costs associated with defects and defective. The Analyze stage is a step to analyze the dominant causes of defects using the Pareto diagram, followed by the Ishikawa diagram. Improve phase is the stage of improvement that is used to correct defects that occur while Control is a stage used to evaluate whether the improvements made have succeeded or not.

Literature study

Six Sigma as a method of improving business processes that aims to find and reduce the factors that cause of defects, reduce cycle times and operating costs, increase productivity, meet customer needs better and get better returns on investment in terms of production and service [2]. The six Sigma business target consists of three fields, namely increasing customer satisfaction, reducing cycle times and reducing defects. Sigma values in quality are interpreted as how often defects might occur. Six Sigma is a method that serves to reduce the number of defective products with statistical and scientific assistance. In an effort to improve the quality associated with Six Sigma, it is done using the *DMAIC* methodology (*Define, Measure, Analyze, Improve, Control*). *DMAIC* function to improve existing processes to produce zero defect performance [2].

MAFMA (Multi Attribute Failure Mode Analysis)

Multi Attribute Failure Mode Analysis (MAFMA) is a method that integrates conventional Failure Mode and Effect Analysis (FMEA) by considering expected costs. This method can be applied by identifying process functions, identifying potential products and failed processes, analyzing effects, identifying causes of failure and variables in the process, and each ranking failure in determining priorities for corrective action, and documenting results [2].

Cost of Quality

Quality costs are costs arising from poor quality. This definition states that quality costs are associated with two subcategories related to quality-related activities namely control activities and failure activities [3]. The things that cause quality raises costs are all actions included in the category do not carry out activities properly. Quality is measured based on cost of quality,

which includes non-conformation costs or failure due to wrong activities. There are four categories of quality costs, namely preventive costs, appraisal costs, internal failure costs, and external failure costs.

Methodology

The research methodology carried out in this study, is to take a sample of 30 pieces $n = 30 \leq N$, during the month of August 2018, which is examined every single unit of cable. As for the defect obtained is the outer lekop layer, the perforated outer layer of the outer layer, the outer layer is bloated, the outer layer is knotted, the outer layer is pinnate, the outer layer is crusted (see Figure:1)

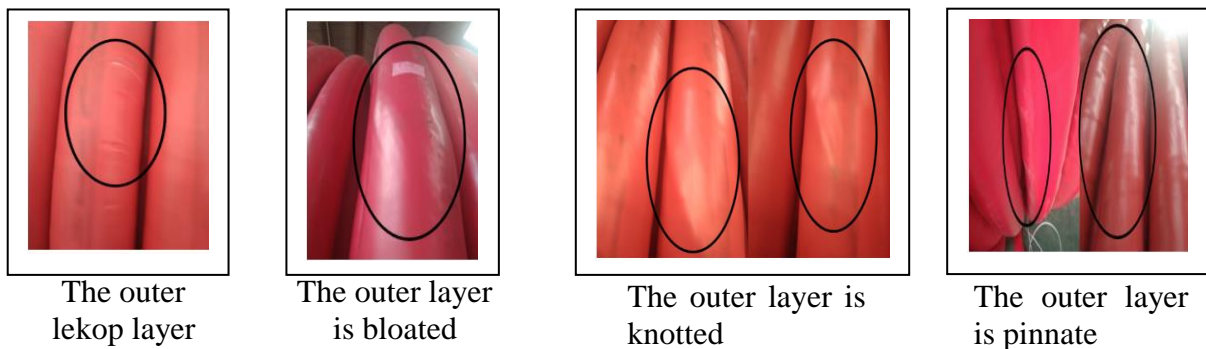


Figure 1: The kinds of defects

to check whether the production process is stable or not used C charts. Then the level of defects is accumulated. From the most dominant defect level, an Ishikawa diagram is analyzed, then proceed to convert to the Failure Mode and Effect Analysis (FMEA) table along with the calculation of the Risk Priority Number.

Furthermore, RPN sequencing is carried out from the highest to the lowest level accompanied by a mapping of the causes of defects of each RPN calculation. To obtain the most dominant weight in terms of severity, Occurrence, ease of detection and expected cost, used Analytical Hierarchy Process (AHP).

Then to find out the most dominant weight of the cause of defects, a comparison is made in pairs with the expected cost, after the highest weight is known, the priority for handling the problem must be obtained, after the consultation process with the production manager is carried out. The proposed improvement is to make an *Standard Operating Procedure (SOP)*, after which *Defects per Million Opportunities (DPMO)* evaluation, Sigma Level is accompanied by quality costs before and after implementation

Result and discussion

Define Stage

Critical to Quality (CTQ) identification which consists of attribute quality characteristics and variable quality characteristics is carried out. Based on the results of observations and interviews, attribute quality characteristics consist of an outer layer that is bloated, bumped, pinned, twisted, marked with lakop and holes. Variable quality characteristics, namely dimensions, eccentricity and nonstandard resistance conductors. After identifying CTQ, the next step is to make a SIPOC diagram to know input and output processing.

Measure stage

Inspections carried out on NFA2XSEY-T products are carried out on each product produced. So that no sampling is taken of these products. Based on the historical data of the company, the percentage of defects in NFA2XSY-T products in August was 30%. 30% of the cable products are handled by rework and repair. This type of attribute defect consists of an outer layer that is bloated, bumped, pinned, twisted, marked with lakop and holes.

Data from product inspection consists of the number of defects and the number of defects with each product inspection. So that in processing the data, a control C charts, is created. Before making a control chart, a pareto diagram was made to find out the focus of defects to be discussed, visuals ranked first as the cause of the defect of NFA2XSY-T products with a percentage of 94.4% with 29 events during June to August.(figure:2)

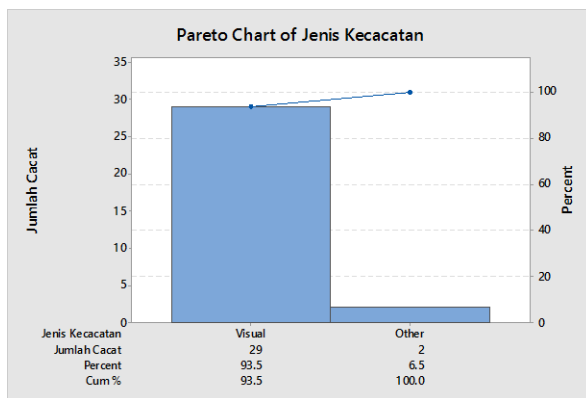


Figure 2: Pareto chart

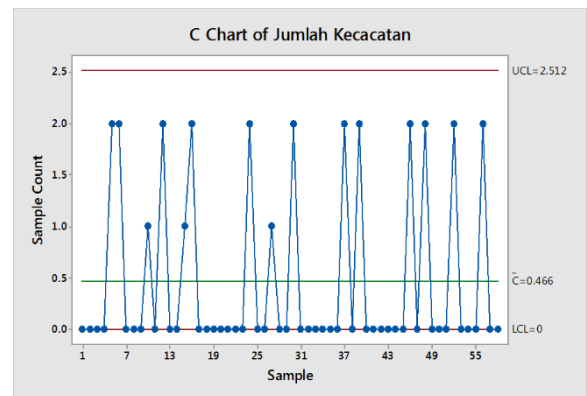


Figure 3: C chart

After calculating the C control map by making a revision once by removing 2 data out of control. The following are the CL, UCL LCL and capillary values of the visual defect data.

C chart

$$CL = \bar{c} = \frac{\sum ci}{k} = \frac{27}{58} = 0.466$$

$$UCL = \bar{c} + 3\sqrt{\bar{c}} = 0.466 + 3\sqrt{0.466} = 2.512$$

$$LCL = \bar{c} - 3\sqrt{\bar{c}} = 0.466 - 3\sqrt{0.466} = 0$$

Process Capability

$$S = \sqrt{\bar{c}} = \sqrt{0.466} = 0.683$$

$$CP = \frac{UCL - LCL}{6s} = \frac{2.512 - 0}{6(0.683)} = 0.613$$

$$CPU = \frac{UCL - \bar{c}}{3s} = \frac{2.512 - 0.466}{3(0.683)} = 0.998$$

$$CPL = \frac{\bar{c} - LCL}{3s} = \frac{0.466 - 0}{3(0.683)} = 0.227$$

$$CPK = \min(CPU, CPL) = 0.227$$

Defect per Million Opportunities (DPMO) calculation:
the number of products examined = 58

Total disability (D) = 27

$$\text{Defect per Unit} = \frac{D}{U} = \frac{27}{58} = 0.466$$

$$\text{Defect per Opportunity} = \frac{D}{U \times CTQ} = \frac{27}{58 \times 6} = 0.077$$

$$\text{Defect per Million Opportunities} = DPO \times 1000000 = 77586$$

If DPMO conversion to Sigma level = 3.43 σ

Based on the above calculations, obtained DPMO of 77,586 which means there are 77,586 defects in one million possibilities. The DPMO value is then converted into a sigma level which is equal to 3.43 σ . After measuring the sigma level, the quality costs incurred in the production process of NFA2XSY-T are calculated which consists of preventive costs, appraisal costs, internal failure costs and external failure costs.

Table 2: Initial cost of quality

Preventive Cost				
	Unit	Cost	Costpermonth	Costperday
Salary permonth for em-ploy	7	Rp	Rp 26.600.000	Rp 1.108.333
Oil Gear Box Total Carter	15 drum	Rp	Rp 43.890.000	Rp 1.828.750
Filter	15 m	Rp 600.000	Rp 900.000	Rp 375.000
Subtotal Preventive Cost			Rp79.490.000	Rp 3.312.083
Appraisal Cost				
Salary permonth for em-ploy	4	Rp	Rp 15.200.000	Rp 633.333
Inspection cost :				
Cost determine of tools	60 x	Rp 26.107	Rp 1.566.420	Rp 65.268
Jelly resistor	60 pcs	Rp 20.000	Rp 1.200.000	Rp 50.000
Polypropylene per meter	10 m	Rp 2.300	Rp 23.000	Rp 958
Internal Failure Cost				
Rework:				
PVC (1.1617 m/kg)	8.500 m	Rp 34.585	Rp 293.972.500	Rp 2.248.854
Repair				
Sand paper 240	40 m	Rp 4.800	Rp 192.000	Rp 8.000
Scrap				
Alluminium Rod EC	500 m	Rp 88.311	Rp 44.155.500	Rp 1.839.813
Inner Semiconductive	500 m	Rp 7.464	Rp 3.732.000	Rp 155.500
Outer semiconductive	500 m	Rp 10,350	Rp 5.175,	Rp 215.625
XLPE	500 m	Rp 46.065	Rp 23.-28.000	Rp 959.500
Copper tape	500 m	Rp 14.573	Rp 7.286.500,	Rp 303.604
Non conductive water	500 m	Rp 3.960	Rp 1.980.000	Rp 82.500
Semi conductive water	500 m	Rp 5.350	Rp 2.675.000	Rp 111.458
Sub Total Internal failure cost			Rp 382.196.500	Rp
External Failure Cost				
Service cost	1 x	Rp 800.000	Rp 800.000	Rp 33.333
Copper tape	500 m	Rp 14.573	Rp 7.286.500	Rp 303.604
Non conductive water	500 m	Rp 3.960	Rp 1.980.000	Rp 82.500
Semi conductive water	500 m	Rp 5.350	Rp 2.675.000	Rp 111.458
PVC	500 m	Rp 34.585	Rp 17.292.500	Rp 720.521
Shipment	1x	Rp 540.000	Rp 540.000	Rp 22.500
Sub Total External Failure			Rp 30.574.000	Rp 1.273.917

Total Quality Cost

Rp 510.249.920 Rp

Can be seen from table 2, the total cost of quality per month is Rp. 510,249,920 and per day is Rp. 21,260,413. Total preventive costs per month are Rp. 79.49 million, - the total appraisal cost per month is Rp. 17,989,420, -, the total internal failure cost per month is Rp. 382,196,500, - per month and the total external failure costs per month are Rp. 30,754.00, -

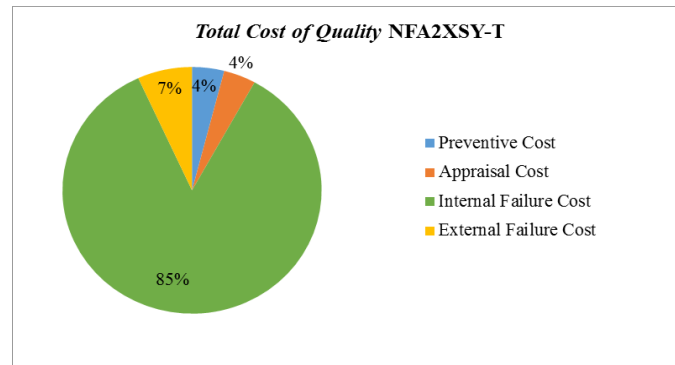


Figure 4: Proportion of quality cost

Based on Figure 4, it can be seen that 85% of quality costs are internal quality failure costs which are costs of failure originating from the production floor. So by minimizing defective products NFA2XSU-T can minimize the cost of internal failure.

Analyze Stage

The first step in the analyze stage is identifying the most dominant type of defects using the Pareto Chart.

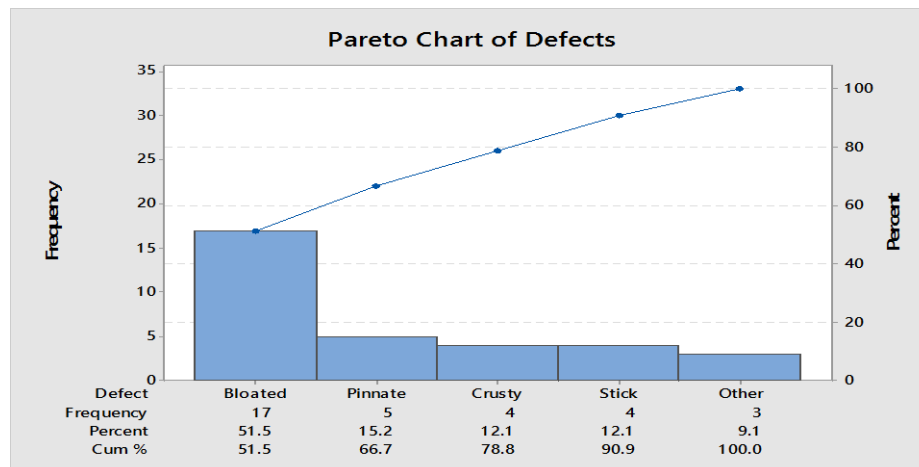


Figure 5: Pareto chart of defects

Can be seen in Figure 5, Pareto diagram shows that 80% of disability is caused by 4 types of disability, namely the outer layer is bloated, pinnate, stick and crusty. So that the identification of the causes of the 4 types of disabilities is done using the Ishikawa diagram

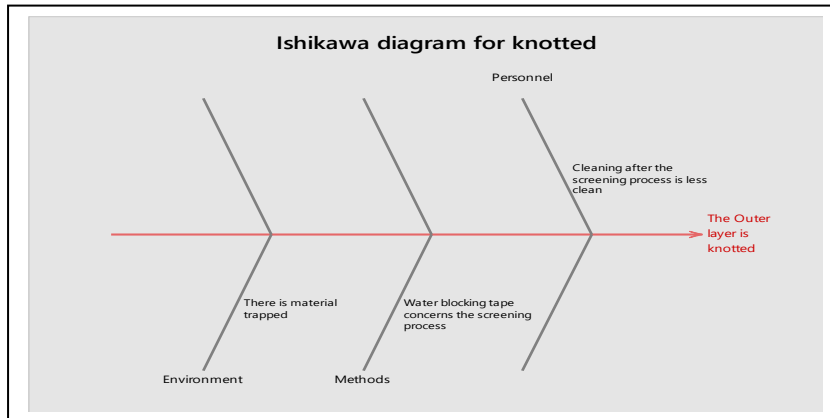


Figure 6: Ishikawa diagram for knotted

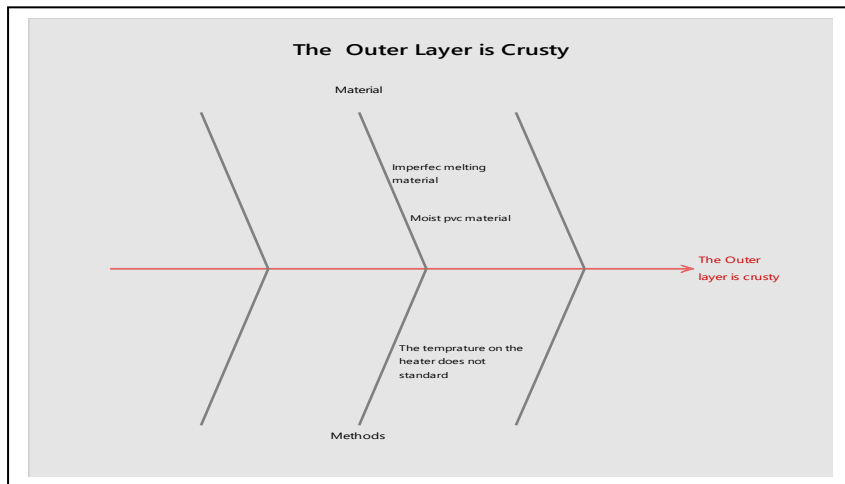


Figure 7: Ishikawa diagram for the outer layer is crusty

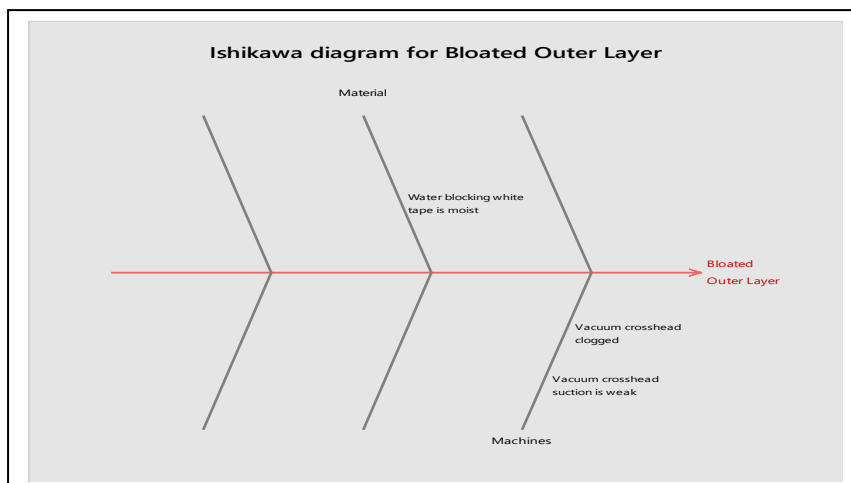


Figure 8: Ishikawa diagram bloated outer layer

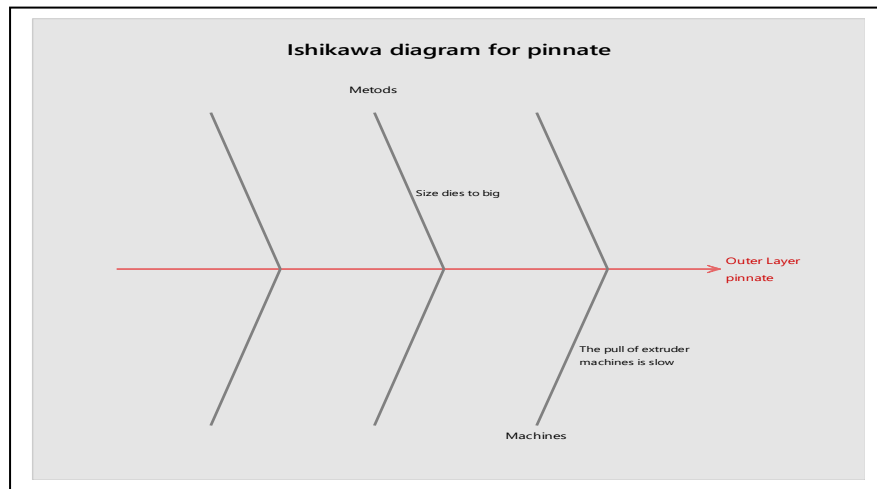


Figure 9: Ishikawa diagram pinnate

After identifying the causes of disability using the Ishikawa diagram, the next step is to identify the causes of failure using the FMEA method.

Table 3: FMEA Types of defects

Failure Mode	Potential Effects of Failure	Severity (S)	Potential Cause of Failure	Occurences (O)	Current Control for Prevention	Detection (D)	Risk Priority Number (RPN)
Bloated outer layer	Defective product	7	Water blocking moist white tape	9	Not available	6	378
			Vacuum crosshead suction is weak	8	Pressure indicator supervision by the operator	6	336
			Vacuum crosshead clogged	7	Periodic cleaning of the machine	6	294
The outer layer is knotted	Defective product	7	Cleaning after the screening process	9	Pressure indicator supervision by the operator	3	189
			There is foreign material trapped	6	Not available	6	252

			Water blocking tape concerns in the screening process	4	Supervision by supervisor when operating a screening machine	3	84
Outer Layer pinnate	Defective product	7	The pull of the extruder machine is slow	4	Periodic cleaning of the machine	6	168
			Size dies too big	5	Dies arrangement is carried out according to the correct SOP	3	105
The outer layer is crusty	Defective product	7	The melting material is not perfect	4	The operator checks the temperature on the heater	2	56
			The temperature on the heater is not standard	3	The operator checks the temperature on the heater	2	42
			Moist pvc material	7	Not available	6	294
			Termocouple errors	6	Periodic cleaning of the machine	7	294

Based on the calculation of the RPN value, the highest value of the RPN is in the cause of failure of the bloated outer layer, namely the moist white waterblocking tape with an RPN of 378. Furthermore, the entire potential causes of failure are identified using the pareto diagram.

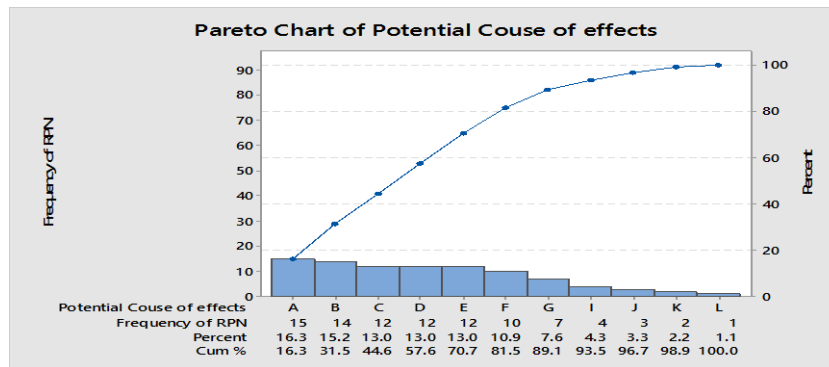


Figure 10: Pareto chart for defects

Pareto diagram shows that 80% of the causes of bloated outer layers are A: moist white water blocking tape, B: vacuum crosshead suction power is weak, C: moist PVC material, D: thermocouple error, E: vacuum crosshead clogged, F: foreign material trapped and G: cleaning after the screening process is not clean. So that the seven causes of failure will be the focus in solving problems using the *MAFMA* method with priority selection using the *AHP* (*Analytical Hierarchy Process*) method to compile the Criteria, interviews with production managers of medium voltage cables and work station operators were conducted

Table 4: Matric interviews

	Severity	Occurrence	Detection	Expected
Severity	1	Equally		
Occurrence		1	Equally	
Detection			A little more	
Expected cost				1

Table 5:Expert judgment is converted in numeric value and calculates its priority

	Severity	Occurrence	Detection	Expected	Total	Priority
Severity	1	1	0.333	0.2	0.5081	0.0992
Occurrence	1	1	1	0.2	0.6687	0.1306
Detection	3	1	1	0.333	1	0.1953
Expected	5	5	3	0.333	2.9428	0.5748

$$\begin{array}{c} \text{Initial matrix} \\ \left| \begin{array}{cccc} 1 & 1 & 0 & 0 \\ 1 & 1 & 1 & 0 \\ 3 & 1 & 1 & 0 \\ 5 & 5 & 3 & 1 \end{array} \right| \times \begin{array}{c} \text{Priority} \\ \left| \begin{array}{c} 0.099 \\ 0.131 \\ 0.195 \\ 0.575 \end{array} \right| = \begin{array}{c} \text{Result} \\ \left| \begin{array}{c} 0.4099 \\ 0.5401 \\ 0.8151 \\ 2.3097 \end{array} \right| \Rightarrow \end{array} \end{array}$$

$$\begin{array}{c} \text{Result} \\ \left| \begin{array}{c} 0.4099 \\ 0.5401 \\ 0.8151 \\ 2.3097 \end{array} \right| : \begin{array}{c} \text{Priority} \\ \left| \begin{array}{c} 0.0992 \\ 0.1306 \\ 0.1953 \\ 0.5748 \end{array} \right| = \begin{array}{c} \text{Eigen} \\ \left| \begin{array}{c} 4.132 \\ 4.136 \\ 4.174 \\ 4.018 \end{array} \right| \end{array} \end{array}$$

Amount of eigenvalues
= 4.132 + 4.136 + 4.174 + 4.018 = 16.46

Average eigenvalue
= $\frac{16.46}{4} = 4.115$

$$CI = \frac{\bar{x} \text{ nilai eigen} - n}{n - 1} = \frac{4.115 - 4}{4 - 1} = 0.0383$$

$$CR = \frac{CI}{RI} = \frac{0.0383}{0.9} = 0.04$$

After calculating the eigenvalues of each factor by multiplying the initial matrix with priority values, then dividing the results with priority values, consistency index (CI) will be calculated. Based on calculations, the CI value obtained is 0.0383, then the CR (Consistency Ratio) value obtained from dividing the CR with the RI value (Ratio Index) is 0.04, which means that $CR < 0.1$ means that the value of the pairwise comparison matrix is consistent

Next, we calculate the alternative criteria weight for the expected cost criteria. The calculation of the consistency of the alternative matrix is based on criteria by compiling an assessment of criteria with numerical values based on interviews and then calculating the priorities of each cause.

- Cause A = Water blocking white moist tape
- Cause B = Vacuum crosshead suction power is weak
- Cause C = The crosshead vacuum is blocked
- Cause D = Moist PVC material
- Cause E = Termocouple error
- Cause F = There is foreign material trapped
- Cause G = Cleaning after the screening process is not clean

Table 6: pairwise comparison matrix

Expected cost	Cause A	Cause B	Cause C	Cause D	Cause E	Cause F	Cause G	Total	Priority
Cause A	1	1	3	1	0.33	3	3	1.3678	0.1881
Cause B	1	1	1	3	1	3	1	1.3678	0.1881
Cause C	0.33	1	1	1	1	1	1	0.8548	0.1175
Cause D	1	0.33	1	1	0.33	1	1	0.7306	0.1004
Cause E	3	1	1	3	1	1	1	1.3687	0.1881
Cause F	0.33	0.33	1	1	1	1	1	0.7306	0.1004
Cause G	0.33	3	1	1	1	1	1	0.8548	0.1175

	Initial matrices		Priority		Result																																																
<table style="border-collapse: collapse; border: none;"> <tr><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">3</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">0.3</td><td style="border: none; padding-right: 5px;">3</td><td style="border: none; padding-right: 5px;">3</td></tr> <tr><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">3</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">3</td><td style="border: none; padding-right: 5px;">1</td></tr> <tr><td style="border: none; padding-right: 5px;">0.3</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td></tr> <tr><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">0.3</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">0.3</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td></tr> <tr><td style="border: none; padding-right: 5px;">3</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">3</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td></tr> <tr><td style="border: none; padding-right: 5px;">0.3</td><td style="border: none; padding-right: 5px;">0.3</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td></tr> <tr><td style="border: none; padding-right: 5px;">0.3</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td><td style="border: none; padding-right: 5px;">1</td></tr> </table>	1	1	3	1	0.3	3	3	1	1	1	3	1	3	1	0.3	1	1	1	1	1	1	1	0.3	1	1	0.3	1	1	3	1	1	3	1	1	1	0.3	0.3	1	1	1	1	1	0.3	1	1	1	1	1	1	X	=	⇒	
1	1	3	1	0.3	3	3																																															
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0.3	0.3	1	1	1	1	1																																															
0.3	1	1	1	1	1	1																																															

Result	Priority		Eigen
1.5455	0.1881		8.2164
1.4017	0.1881		7.4519
0.8747	0.1175		7.4443
0.7493	0.1004	=	7.4631
1.5771	0.1881		8.3844
0.7493	0.1004		7.4631
0.8747	0.1175		7.4443

Total eigenvalue = 8.2164 + 7.4519 + 7.4443 + 7.4631 + 8.3844 + 7.4631 + 7.443 = 53.8675

Average eigenvalue :

$$= \frac{53.8675}{7} = 7.6953$$

$$CI = \frac{\bar{x} \text{ nilai eigen} - n}{n - 1} = \frac{7.6953 - 8}{7 - 1} = 0.1158$$

$$CR = \frac{CI}{RI} = \frac{0.158}{1.32} = 0.087$$

The CI value obtained is 0.1158, then the CR (Consistency Ratio) value obtained from dividing the CR with the RI value (Ratio Index) is 0.087, which means that CR < 0.1 means that the value of the pairwise comparison matrix between criteria is consistent. After calculating the criteria and weights of alternative criteria for the expected cost criteria, then proceed by calculating the value of local priority for each criterion obtained from the FMEA calculation for severity, occurrences, detection and calculation calculations using paired comparisons for the expected cost criteria. After getting the local priority value, then do the calculation to get the total priority value obtained from the multiplication between the priority weights with the local priority of each cause of failure.

In the final stage of MAFMA calculation, the total priority value of each failure is summed so that the final result of the MAFMA method is obtained

Table 7: Total Value and Rank

Total mafma value			
No	Causes of failure	Total	Rank
A	Moist white water blocking	0.1702	1
B	Vacuum crosshead suction weak	0.1675	2
C	Vacuum crosshead clogged	0.1243	3
D	Moist pvc material	0.1145	4
E	Termocouple error	0.1662	5

F	There is foreign material trapped	0.1118	6
G	Screen cleaning process is not clean	0.1177	7

The first sequence of causes of failure based on the total value of MAFMA is occupied by the cause of the white water blocking tape which is moist. Therefore, problem solving will focus on the causes of failure. To explore the causes of moist white water blocking tape, the cause of failure will be identified using the Ishikawa diagram

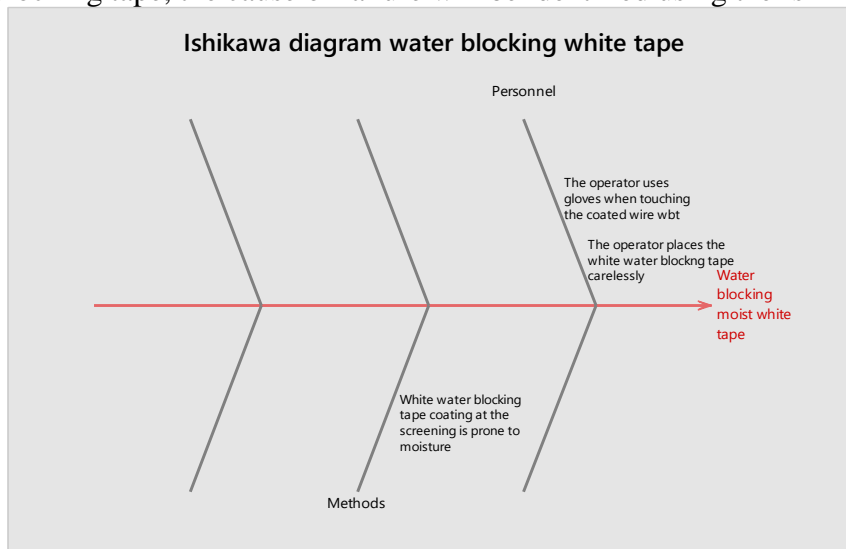


Figure 11: Ishikawa diagram for water blocking moist white tape

Based on Ishikawa diagram the cause of moist water blocking tape, found 3 causes, namely white water blocking tape coating in the screening process is prone to moisture, operators put water blocking tape carelessly and the operator does not use gloves when touching cables that have been coated with water blocking tape.

Improve step

As explained in table7, it turns out that there are three causes that must be corrected. The first is the white blocking tape that is moist, the second is the weak vacuum crosshead power and the third is the thermocouple error,

and after analyzing with the Ishikawa diagram, what needs to be improved is as follows:

a. The human factor for water blocking tape is that it is moist.

This is due to the negligence of operators who put cables that have been coated in water blocking tape carelessly and do not use gloves, the proposal used is to make changes to the standardization of more informative work.

b. Environmental factors for dirt buildup in vacuum motors

The accumulation of dirt on the vacuum motor so that the suction power of the weak crosshead vacuum is to add a cyclone filter that functions to filter out the sucked dirt. As for the cyclone filter chosen by the company is the brand Super Dust Deputy XL 6' Cyclone

c. Proposal made on thermocouple error

The cause of the thermocouple error is that there is no work instruction for the thermocouple calibration process, because it is necessary to conduct a calibration process, among others, by cleaning the thermo couple regularly and visually checking the thermocouple before calibration.

Control stage

The control phase carried out in this study is to compare the sigma six metrics before and after implementation. Implementation is carried out from January 14 to January 31, 2019, with data collection as many as 31 observations.

The results obtained are as follows:

Table 8: Indicators of Six Sigma success

Indicators	Before implementation	After implementation	(%)	Remarks
DPMO	77.585	55.558	28.39 %	De-crease
Sigma Level	2.92	3.09	5.82 %	In-crease
Cost of quality	Rp 21.260,413	Rp 14.049,757	33.91%	De-crease

Conclusion

The conclusions that can be drawn from this study are:

1. The type of disability in cable products is a visual defect that consists of an outer layer that is bloated, bumped, pinnate, marked lacop, berbolong - hollow and crusty.
2. The production process of NFA2XSY-T cables has a DPMO value of 77586 which is equivalent to 3.43 sigma, and the total cost of quality is Rp. 510,249,920 per month or Rp. 21,260,413 per day.
3. Proposed improvements to improve quality and reduce product quality costs. Make changes to work instructions that are more informative, add cyclone filters to the vacuum motor and make work instructions for the calibration process.
4. After implementation of the company, it turns out that DPMO has decreased by 28.39%, Sigma level has increased by 5.82% and Cost of Quality has decreased by 33.91%

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THE EFFECT OF MOISTURE CONTENT AND CURING ON THE PROPERTIES OF THE INTERLOCKING COMPRESSED BRICK

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Abstract. *The moisture content and curing condition affect the compressive strength of the interlocking compressed brick (ICB). Higher strength of ICB can only be achieved when the moisture content is at the optimum level and under proper curing method. However, the moisture content of soil is varied and difficult to be identified. In addition, there is no standard of curing method was established for ICB. Therefore, this study investigates the effect of moisture content and types of curing on the compressive strength and water absorption of the ICB samples. Two (2) different moisture contents were investigated, which are the 11% and 18%. All ICB samples were cured under three (3) different curing conditions and tested for the compressive strength, water absorption and density tests. The findings showed that all ICB samples containing 18% of moisture exceeded the minimum requirement of compressive strength (7 N/mm²) based on MS76:1972. Meanwhile, ICB cured under Curing B condition has shown the highest compressive strength and lower water absorption. This indicates that sufficient moisture and proper curing method can produce good ICB brick for use in the building construction.*

Introduction

The emission of toxic elements from the manufacture of conventional clay bricks lead to the air pollution problem. To overcome this problem, a greener brick which is known as interlocking compression brick (ICB) has been produced through the compression method. With no burning process, this ICB brick is an energy efficient product and therefore, gives no harm to the environment. The raw materials for ICB production are mainly of sand, cement and clay soil. By controlling these raw materials, strength of the ICB can be designed to suit its application in the construction. Other factors such as moisture content and curing type also play important factor in affecting strength of the ICB brick. However, the moisture content of soils is varied and is difficult to be controlled. Improper control of moisture content during the production process will affect the properties of the ICB brick produced. Lower moisture content decreases the compressive strength of the ICB [1], but if too high moisture added to

the mix, it will cause difficulties in the ICB production, especially during the demoulding process. Hence, the moisture content must be kept optimum. Most researches suggested the optimum moisture content of the ICB mixture must be within 10 – 13% [2].

On the other hand, the curing process done on the ICB is to overcome excess evaporation which normally results in loss of water, a situation that may disturb the hydration process of cement, with the consequences of reduced strength, durability and cracks arising from early rapid drying and shrinkage [3]. In addition, the ICB needs to be cured in a sufficient period of time to avoid reduction in the compressive strength [4]. Insufficient moisture content and improper curing method will produce low strength ICB. However, there is very limited information has been published which related to the moisture and curing effect on the properties of the ICB. In addition, there is still no proper guidelines in the production of ICB in construction. As a result, the properties of ICB produced at the production plant is varied. In order to produce good ICB, the effect of moisture and curing on the ICB must be monitored and controlled during the production process. Hence, this study investigates the effect of moisture content and curing on the properties of the ICB produced at the ICB Teaching Factory in Universiti Malaysia Sabah (UMS), Malaysia. Findings of this research can be used as reference in the production of good strength ICB brick for use in the low-cost housing construction in Sabah.

Materials and Methods

Materials, methods and mix design

The materials used to produce the ICB were sand, ordinary Portland cement (OPC), and clay soil. The clay soil was obtained from the UMS area. The properties of the clay soil are shown in table 1. To determine the optimum moisture content (OMC), the Proctor test was performed. The optimum moisture content referring to the moisture of the ICB mixture at which a given soil type will become most dense and achieve its maximum dry density. This test was performed on the soil, and combination of clay soil, cement, and sand (ICB mixture). The soil sample was compacted in a mould for 27 blows using rammer which dropped from height of 300 mm above the soil. The density of the compacted soil was then determined, and after demoulding, the moisture content was measured. This process was repeated for different moisture content. The graph of dry density against moisture content was then plotted. The mix design ratio of the ICB is shown in table 2.

ICB production

All ICB samples were produced at the ICB Teaching Factory, UMS under three (3) main stages; (1) Preparation, (2) Mixing, and (3) Moulding (figure 1 – figure 5). In the preparation stage, the soil was first dried and then crushed using the crushing machine. Other materials, such as sand, cement and water were weighed based on the mix ratio shown in table 2. After that, the raw materials were fed into the mixer for the mixing process. The raw materials were first mixed in dry condition, then water was gradually added to the mixture until it was homogeneous and uniform in colour. The wet mixture was then conveyed to the compressor for moulding process. The compression force to produce the ICB brick is 43 MPa. After compression, the fresh ICB samples were carefully removed from the compression mould and placed at a temporary area for 24 hours.



Figure 1. Drying of clay soil.



Figure 2. Mixing of ICB raw materials.



Figure 3. Moulding process.



Figure 4. Placement of ICB at a temporary area after moulding.



Figure 5. Hardened ICB sample.

Table 1. Properties of the clay soil sample.

Properties	Clay soil
Liquid Limit (%)	44
Plastic Limit (%)	25
Plasticity Index	19

Table 2. Mix design ratio of the interlocking compressed brick.

Curing	Mix Ratio Cement: Sand: Soil	Water (%)
ICB11	1: 2: 2.66	11
ICB18	1: 2: 2.66	18

Curing

After 1-day production, the hardened ICB samples were placed at an open area under the roof enclosure for curing process. The ICB samples were arranged to have at least 5 cm gap between each other. The curing process was performed using different methods as stated in table 3.

Table 3. Curing types of interlocking compressed brick.

Curing	Description
A	Sprinkling with water in the morning and evening for 28 days.
B	Sprinkling with water in the morning and evening for 7 days, and thereafter cover with tarpaulin until day 28.
C	Complete cover with tarpaulin for 28 days.



Figure 6. Metal plate used for compressive strength test.



Figure 7. Rough surface of ICB18.



Figure 8. Covering the ICB with tarpaulin (Curing C).

Testing on the ICB

All ICB samples were tested to determine its density, compressive strength, and water absorption at 14-day and 28-day curing. The density test was carried out based on ASTM C20. In this test, the dimension and weight of each brick were measured. The density of ICB was calculated by dividing the mass of ICB (in kg) to its volume (m^3).

Testing of the ICB samples was performed in accordance to ASTM C109. The ICB was capped at both sides (top and bottom) using metal plate (figure 6) to create a flat surface during testing. The loading rate of the test was $5 (N/mm^2)/s$. The crushing load force corresponding to the failure load for each brick was then recorded. The compressive strength was obtained by dividing the maximum crushing force (N) with the sectional area (mm^2) of the ICB.

Water absorption was conducted to determine the amount of water absorbed within 24 hours. In this test, the ICB sample was first dried in the oven for 24 hours. The oven dried ICB was then immersed in the water for 24 hours. Water absorption of the ICB was calculated using Eq.1.

$$\text{Absorption} = 100 \times (\text{wet mass} - \text{dry mass}) / \text{dry mass} \quad (1)$$

Results and discussions

Optimum moisture content

The Proctor Compaction test was performed to determine the amount of water required to obtain the maximum density of soil. The optimum moisture contents of soil and the ICB mixture (combination of soil, sand and cement) are shown in figure 9 and figure 10, respectively. From figure 9, the optimum moisture content for the soil is 18%. At this value, the maximum dry density is 1689 kg/m^3 . Meanwhile, the combination of cement, sand and the clay soil (ICB mixture) required much lower moisture content to produce maximum dry density (1785 kg/m^3), which is 11% (figure 10). This indicates that the air voids inside the ICB mixture after compaction was lower than the clay soil.

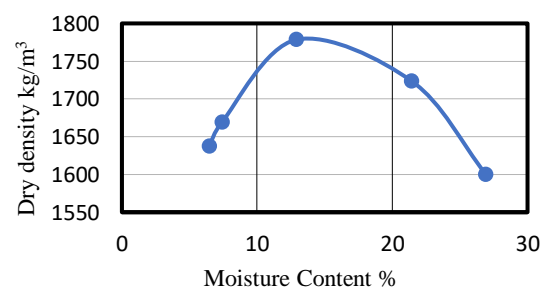
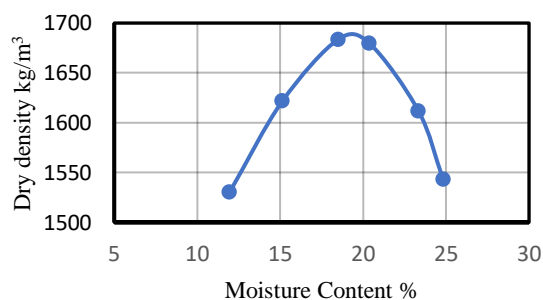


Figure 9. The optimum moisture content for soil.

Figure 10. The optimum moisture content for ICB mixture.

Density of the interlocking compressed brick

The densities of the ICB18 and ICB11 were determined at 14-day and 28-day age of testing. The results are shown in figure 11 and figure 12. Figure 12 depicts that all ICB samples show higher density as the curing age increases to 28 days. The use of OPC cement as stabilizer promotes to the formation of the calcium silicate hydrate (CSH) within the ICB samples [5]. This process is also known as hydration. As the age of curing increases, more hydration products were produced and filled in the voids within the ICB microstructure. Hence, at later age (28 day), the ICB was denser and the density increased.

From figure 11 and figure 12, it is clearly seen that the highest density is given by the ICB18 samples, especially for ICB18 which cured under the Curing B. Since ICB18 has more water than the ICB11, the amount of water to take part in the chemical reaction with the cement was sufficient to produce more hydration products. In addition, Curing B prolonged the hydration process since it prevented the evaporation of water after curing for 7 days. The hydration product not only gives good bonding between the ICB particles, but it is also able to fill in voids within the microstructure and make the brick more pack and denser.

The effect of moisture content on the compressive strength of the interlocking compressed brick

The results of compressive strength are shown in figure 13 and figure 14. Regardless of the curing condition, all ICB samples containing 18% (ICB18) and 11% (ICB11) of moisture content showed higher compressive strength when the curing duration increased from 14 days to 28 days. The development of strength against the age of testing is due to the formation of hydration product, which increases the bonding of sand and soil within the ICB [6].

As aforementioned in section 1, the optimum moisture content suggested from the previous researcher were in the range of 10 – 13%. However, in this research, it was found that all ICB18 samples have shown higher compressive strength compared to ICB11 at all ages and curing conditions (figure 13 and figure 14). For example, ICB18 samples cured under Curing A, Curing B, and Curing C have higher compressive strength, which are 11% – 27% higher than the ICB11 at 28 days curing. This is supported by the results obtained in Section 3.2 (figure 11 and figure 12), where ICB18 samples have the highest densities, which indicates that the samples have high compressibility and denser than ICB11. With sufficient amount of water, the development of ICB strength improves due to high degree of hydration. Hence, the bonding between the sand and soil was also improved, resulting in the increase of the compressive strength.

On the contrary, higher moisture content causes the ICB18 brick to have poor appearance. During the production process, it was observed that all ICB18 brick samples were difficult to be moulded compared to ICB11. After moulding, the surface of ICB18 tends to have rough and crumble surface (figure 7). Meanwhile, ICB11 has shown a smooth surface and good in terms of aesthetic value. Nevertheless, at 28 days testing, all ICB11 and ICB18 bricks have exceeded the minimum requirement stated in BS3921:1985 (5 N/mm²) [7]. The ICB18 can also be used as load-bearing brick with strength satisfying the minimum requirement in MS76:1972 (7 N/mm²) [8].

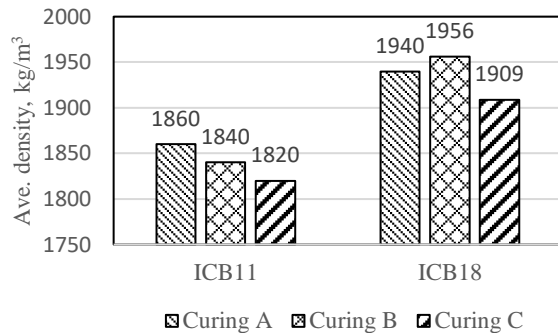


Figure 11. The densities of ICBs at different moistures and curing conditions for 14 days testing age.

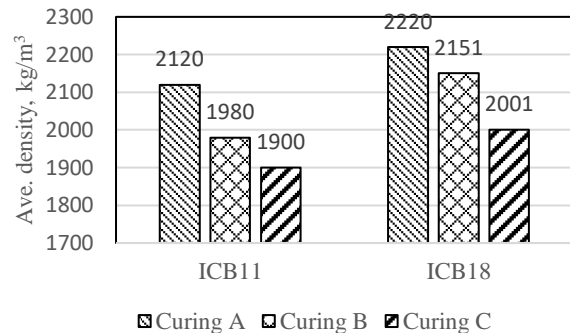


Figure 12. The densities of ICBs at different moistures and curing conditions for 28 days testing age.

The effect of curing types on the compressive strength of the interlocking compressed brick

Figure 13 and figure 14 show the compressive strength of ICB18 and ICB11, respectively under three (3) different curing conditions for 14 days and 28 days. It was noticed that the compressive strength of both ICB18 and ICB11 showed similar trend when cured under Curing A, Curing B and Curing C. At 14-days curing, both ICB18 and ICB11 showed higher compressive strength after been cured under the Curing C method (complete cover with tarpaulin) (figure 8). This is followed by ICB cured in Curing B (sprinkling with water in the morning and afternoon for 7 days and covered with tarpaulin until 28 days) and Curing A (sprinkling with water in the morning and afternoon for 28 days). The same result was also reported by [7] where the compressive strength was higher when brick was completely covered with the tarpaulin. Complete covering the ICBs with the tarpaulin causes less evaporation of the bricks, therefore the hydration process was able to proceed. However, as the curing duration increases, the moisture reduced as most of the water has been used for the hydration process. Hence, at 28 days curing, the rate of hydration of ICB under Curing C was reduced due to insufficient water for the chemical reaction to occur.

Interestingly, at 28 days curing, the ICB18 cured under Curing B has shown higher compressive strength with 11.8% and 15% higher than Curing A and Curing C, respectively. Similarly, ICB11 also showed similar trend. Sprinkling of water for 7 days is important since it promotes development of strength through the hydration process at early age. The method of covering ICB after 7 days sprinkled with water controlled the evaporation rate, hence there was still enough water for hydration to proceed after the brick hardened. For Curing A, the compressive strength was slightly higher than Curing C but still lower than Curing B. Even though ICBs were continuously sprinkled with water for 28 days, the evaporation of moisture from the brick can still occur. In addition, rate of evaporation depends on the temperature of the surrounding. Therefore, with improper control of water evaporation, the hydration process might be disturbed and slower down the strength development process.

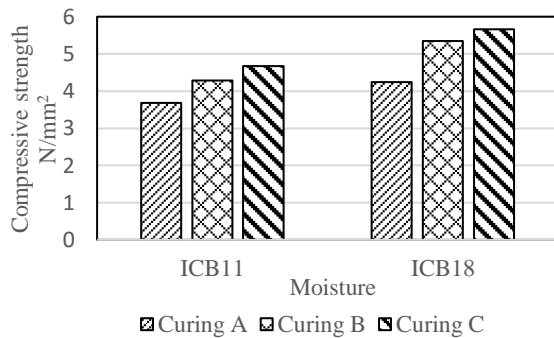


Figure 13. The compressive strength of ICBs at different moistures and curing conditions for 14 days testing age.

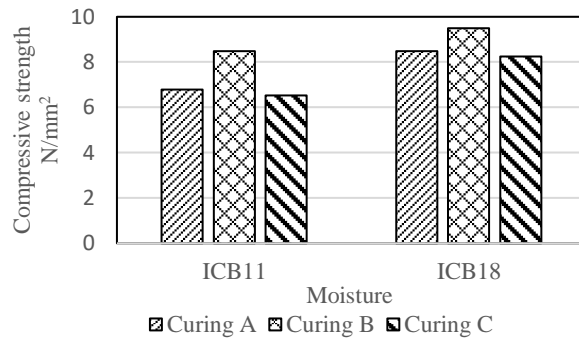


Figure 14. The compressive strength of ICBs at different moistures and curing conditions for 28 days testing age.

Water absorption of the Interlocking Compressed Brick

The results of the water absorption of ICB18 and ICB11 are shown in figure 15 and figure 16, respectively. As expected, all ICB bricks have shown lower water absorption at 28 day compared to 14 days of curing. Formation of the hydration products, which filled pores within the brick has led to the improvement of the ICB's microstructure.

It was also observed that all ICB18 bricks cured under Curing A, Curing B, and Curing C have lower water absorption compared to ICB11. This is understandable since both density and compressive strength of ICB18 samples showed better performance compared to ICB11. Higher density is an indication that the microstructure is more compact and denser. As a result, the compressive strength increased, and the water absorption reduced.

Comparing between types of curing in both figure 15 and figure 16, samples cured under Curing B have shown the lowest water absorption. This result was also aligned with the compressive strength and density results, where all ICB samples cured using Curing B method have shown higher compressive strength and higher density. Since density, compressive strength and water absorption has proportional relationship, therefore it is obvious that with high density and compressive strength, the water absorption will be reduced. Higher density reduces pore volume of the ICB due to formation of CSH, which filled in voids within the brick.

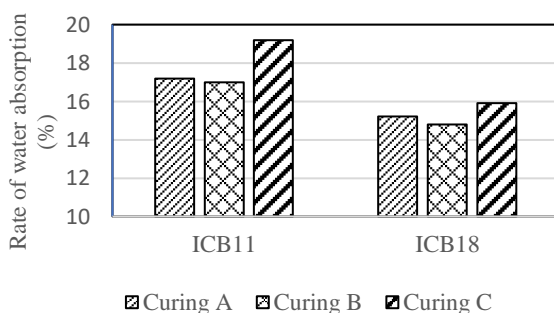


Figure 15. The water absorption of ICBs at different moistures and curing conditions for 14 days testing age.

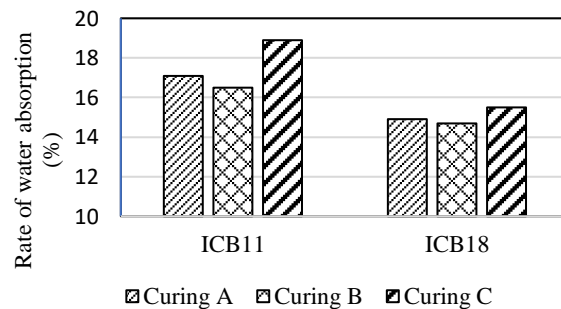


Figure 16. The water absorption of ICBs at different moistures and curing conditions for 28 days testing age.

Conclusions



- The optimum water content for the ICB production is 18%. With this amount, the ICB has better properties compared to ICB containing 11% water content. However, the mouldability of ICB18 was more difficult than ICB11.
- ICB18 has higher density and compressive strength compared to ICB11. A sufficient amount of water promotes better hydration. The hydration products produced were able to fill in the voids within and make the ICB more compact and denser.
- ICB18 has low water absorption compared to ICB11. High density of ICB18 indicates that the voids within the brick is low due to its high compressibility. With lower voids, the water absorption is reduced.
- ICB cured under Curing B has high density, compressive strength and low water absorption compared to other curing methods.
- The method used in Curing B is more suitable for the ICB production. Sprinkling the ICB with water for 7 days and covering it with the tarpaulin until 28 can control the water evaporation. This ensures that the hydration process can proceed for the strength development of the ICB.
- All ICB11 and ICB18 exceeded the minimum requirement stated in BS3921:1985 (5 N/mm²). The ICB18 can also be used as load-bearing brick with strength satisfying the minimum requirement in MS76:1972 (7 N/mm²).

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Acknowledgement

The authors gratefully acknowledge the financial support for this research from Ministry of Higher Education Malaysia research grant (LRGS 0008-2017).



ELECTRICAL TECHNOLOGY STUDENTS IN VOCATIONAL COLLEGES: ARE THEY HEALTHY MENTALLY?

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Abstract. *Distraction such as depression, anxiety, and stress in mental health problem can influence academic achievement to students, including vocational colleges' students. Hence, the main purpose of this study was to determine the mental health profiles of Electrical Course students in Vocational Colleges. The difference in mental health level in terms of gender, hometown, and years of study were also be investigated. Besides, the level of mental health elements implementation by teachers in teaching and learning was also determined. This study was employed a survey method as research design that involved of 132 respondents from three vocational colleges in the southern zone. The respondents were selected using strata sampling technique. The instrument of this study was Malay version DASS-21 item inventory. This inventory measures three elements of mental health problem, namely depression, anxiety, and stress through 21 items. Questionnaires for level of mental health elements implementation by teachers in teaching and learning from student perception consists of 21 items. The collected data were analyzed using frequency, percentage, Spearman Rho test, Mann Whitney U test, and Kruskal Wallis test. The findings of this study showed that students' mental health level and the level of mental health elements implementation by teachers in teaching and learning were at the moderate level. The findings also found that there was a significant relationship between each element of mental health with students' academic achievement level, as well as the level of mental health elements implementation by teachers in teaching and learning. In addition, the results also shows that there were no significant difference in the mental health level among the students from the aspects of gender, hometown, and years of study. In short, an intervention program needs to be implemented to overwhelm students' mental health problems, because prevention was better than cure.*

Introduction

Many studies have reported that there is a strong relationship between mental health problems and students' academic achievement in schools, colleges and universities. The common mental health problems encountered by vocational colleges' students are the transition from primary school towards the anxiety on tests, failure in completing academic work, academic achievements, family and financial commitments. Studies also shown that students will



experience emotional disorders and high stress level throughout their studies at vocational colleges. The high stress level will affect a student's health problem and his academic achievement [1]. However, many of them do not realize that stress can also lead to a positive direction. Stress under well manage can induce individuals to test their potential and reach their performance at maximum levels. Stress can be a positive aspect of learning if the student is able to take the stress as a challenge to expose their capability in learning [2]. Most of the problems faced by stressed students are they do not know how to effectively control the stress. It is important to know the physical and emotional limit of student who is under stress. In order to overcome the negative aspect of stress in a student's life, he needs to know what is the factors lead him to stress because psychological adjustment can help in improving the effect of stress [3]. The negative effects of stress is inhibit the targeted achievement of student. Slow bloomer in academic is easy to experience stress. If stress is not addressed, this student may choose the wrong step and high tendency to fail more often than other students. Furthermore, [4] states that electrical engineering courses students are much more depressed than other courses.

Therefore, this study was conducted at Vocational Colleges (VC) and focused on electrical engineering course students because electrical engineering is a challenging and difficult discipline. Electrical Engineering's concept and theories are totally abstract, however, it has good prospects compared to the other courses at VC [5]. In order to improve the quality of education among the students, the level of awareness of mental health needs to be applied so that the country will not be burdened with the generation that suffering from mental health problems. Furthermore, mental health studies for vocational colleges are limited. Vocational college students take responsibility for mastering technical skills either through practical skills provided through an institutional curriculum or having self-initiative to follow any courses offering additional skills, as noted in the Malaysia Education Development Plan (Higher Education) that increase the number and quality of the program offered by HEIs and vocational colleges is one of the spikes in improving the quality of education in the country.

In short, this study aims to:

- a) Identify mental health level among electrical course students at vocational colleges.
- b) Determine the level of mental health elements implementation of the teacher in teaching and learning from the students' perspective.
- c) Investigate the relationship between mental health level and the academic achievement of electrical coursework students.
- d) Analyze the differences in students' mental health problem based on their demographics (gender, hometown, year of study).

Methodology

This study was conducted by employing the survey method as research design in order to determine the mental health profiles among the Electrical Engineering students in vocational colleges. Survey was selected as research design because the data could be collected directly from respondents in a short time and the results could also be generalized to the population accurately and effectively [6]. A total number of 132 Electrical Engineering Course students from three vocational colleges in southern zone Malaysia were selected as respondents in this study. They were selected by using strata random sampling technique and the sample size was determine by referring to [7].

The instrument used in this study were DASS-21 inventory in Malay version to measure students' mental health problem and a set of self-developed questionnaire to measure the implementation level of mental health elements of teachers in teaching & learning. DASS-21

inventory consists of 21 items that determine three elements of mental health level, namely Depression, Anxiety and Stress. Each item was rating by using the following scale [8]:

- 0 = did not apply to me at all
- 1 = applied to me to some degree, or some of the time
- 2 = applied to me to a considerable degree or a good part of time
- 3 = applied to me very much or most of the time

The total score will classification into five categories, namely Normal> Mild> Moderate> Severe> Extremely Severe. Those who have Normal to Moderate level only need a general intervention program but those who tend to have severe and extremely severe level may need clinical help to manage and conquer their mental health problem. As the scale of this inventory is tend to have high internal consistency, also being widely used among the researchers and clinicians [8], therefore, the reliability analyses can be excluded. Meanwhile, for the self-developed questionnaire, it is consists of 21 items and being developed by adapting to DASS-21 inventory in order to measure how well does a teacher implement the mental health elements during their teaching and learning session. Alpha Cronbach was used to test the reliability of this set of instrument. The results show that $\alpha = 0.72$, this means the instrument can be used to collect the needed data [6]. The collected data were analyzed using frequency, percentage, Spearman Rho test, Mann Whitney U test, and Kruskal Wallis test.

Results

Mental Health Level among the Electrical Engineering Students in Vocational Colleges

Table 1 shows the mental health level among the Electrical Engineering Students in Vocational Colleges. For the depression, most of the students tend to have moderate level, about 46 from 130 respondents (34.8%). Surprisingly, about 53 of them (40.1%) tend to have severe and extremely severe level in depression. The depression score level in descending order is moderate>severe>mild>extremely severe. For the anxiety element, most of the students, about 60 (45.5%) tend to have extremely severe level. The anxiety score level of the students in descending order is extremely sever>moderate>severe>mild. For the stress element, majority of them tend to have moderate level too, about 55 (41.7%) of them score at this level. The stress score level in descending order is moderate>mild>sever>extremely severe>normal.

Table 1. Students' Mental Health Level.

Level	Elements of Mental Health					
	Depression		Anxiety		Stress	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Normal	0	0	0	0	11	8.3
Mild	31	23.5	10	7.6	28	21.2
Moderate	46	34.8	35	26.5	55	41.7
Severe	40	30.3	27	20.5	26	19.7
Extremely Severe	13	9.8	60	45.5	12	9.1
Total	130*	98.8	132	100	132	100

*2 missing value.

Level of Mental Health Elements Implementation of the Teacher in Teaching and Learning



Table 2 illustrates the mental health elements implementation in teaching & learning from the students' perspective. Findings show that students perceive teachers only implement and emphasize mental health problem at medium level. The mental health problem being highlighted by teachers during the teaching & learning session in descending order is depression (89.4%) >anxiety (84.1%) >stress (77.3%). Luckily, about three to five percent of the teachers concern about students mental health issues.

Table 2. Level of Mental Health Elements Implementation of the Teacher in Teaching and Learning.

Level	Elements of Mental Health					
	Depression		Anxiety		Stress	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Low	7	5.3	14	10.6	25	18.9
Medium	118	89.4	111	84.1	102	77.3
High	7	5.3	6	4.5	4	3.0
Total	132	98.8	131*	99.2	131*	99.2

*1 missing value.

Relationship between Mental Health Level and Academic Achievement

Table 3 shows the correlation analyses between mental health score and students' CGPA using Spearman Rho. The findings showed that the mental health scores for all three elements have a significant correlation with students' academic performance measure in CGPA. For depression, $r = -.398, p < .0001$; anxiety $r = -.465, p < .0001$; stress $r = -.295, p < .0001$.

Table 3. Correlation between Mental Health Score & Students' CGPA.

Spearman Rho	Elements of Mental Health		
	Depressio n	Anxiety	Stress
Correlation coefficient	-.398	-.465	-.295
Sig (2-tailed)	.000	.000	.000

Correlation is significant at the 0.01 level (2-tailed).

Differences in Students' Mental Health Problem based on Their Demographics

Table 4 and Table 5 show the comparison of mental health score from the aspect of gender (male and female) and hometown (urban and rural) using Mann Whitney U test. The findings show that there are no significant difference in mental health score between male and female students, as well as urban and rural students. On the other hand, Table 6 show the comparison of mental health score among the year one, year two and year three students by using Kruskal Wallis Test. Findings indicate that there is no significant in mental health score among the year one, year two and year three students.

Table 4. Comparison Mental Health Score between Male & Female

Mann Whitney U	Elements of Mental Health		
	Depressio n	Anxiety	Stress
	1687.00	1889.50	1846.50
Asymp. Sig. (2 tailed)	.162	.678	.533

a. Grouping variable : Gender

Table 5. Comparison Mental Health Score between Urban & Rural

	Elements of Mental Health		
	Depressio n	Anxiety	Stress
Mann Whitney U	1153.00	1158.00	1055.00
Asymp. Sig. (2 tailed)	.938	.963	.490

a. Grouping variable : Home stay (Urban & Rural)

Table 6. Comparison Mental Health Score among Years of Study

	Elements of Mental Health		
	Depression	Anxiety	Stress
Chi Square	1.870	.876	1.193
df	2	2	2
Asymp. Sig.	.393	.645	.551

a. Kruskal Wallis Test

b. Grouping variable : Years of Study

Discussion

Findings show that majority of the electrical engineering course students in vocational colleges tend to have moderate level in depression and anxiety, however, they scored extremely severe level in stress. This finding is in line with the study of [9] which stated that the factor of academic performance expectation, career and social relations affecting the level of anxiety. This situation cannot be taken lightly because it will affected students' performance and achievement directly. High expectation in academic performance may lead to the negative impact on the students, and this is in line with [10] findings. In addition, according to [10] anxiety among students are caused by physical and health disorders, financial problems, family problems, educational problems, relationship problems with teachers and peers. Surprisingly, many students experiencing stress issue are at extremely severe level. This may due to the students themselves are unable to manage stress especially during the due date to submit assignment or test.

The findings also found that there is a moderate level of teachers' implementation in mental health elements during teaching & learning. However, the stress level of the students is at the extremely severe level compared to the elements of anxiety and depression. The problem of stress of students should be given full attention compare to another two mental health elements. This situation happen may due to some students perceive that teachers do not play an important role in addressing mental health problems but it is the responsibility of counselling teacher. Additionally, teachers may be less aware of mental health problems than students' academic achievement. Furthermore, teachers always send students with mental health problems to counselling teacher. Therefore, teachers should need to take action and circumstance into consideration if they really concern students' achievement regardless cognitive, psychomotor and affective.

Moreover, this study found that there is a significant relationship between the mental health level and the level of academic achievement based on Average Grade Cumulative Value



(CGPA). According to [11], stress or anxiety will affect academic achievement, emotional, physical health and the idea of suicide. Additionally, extreme academic burdens can increase stress among students as they are urged to achieve academic excellence to enable them to gain status in the community. In addition, to get good results, students compete with each other in exams, tests or assignments. Therefore, such competition must be implemented in a healthy manner so that the students do not fall in the level of depression, anxiety or stress.

Furthermore, no significant difference was found in mental health problem among the students with difference years of study. However, mean score of year one students is higher than year two and year three. Year one students tend to have high level in mental health, especially stress compare to year two and year three. This is likely because first-year students are new students entering in vocational colleges with different learning environment compare to secondary school. At the beginning of the semester of study in vocational colleges, the first year students have been given theoretically challenging assignments and at the same time, they need to complete and competence in practical practice such as electrical wiring training, motor control training, electric machine training and so on. This can cause students who enrol in electrical engineering discipline feel stressed and anxieties compare to their previous school life.

In spite of this, this study reports that there is no significant difference in mental health problem from the aspect of gender and urban/rural students. However, analysis shows that male mental health score is higher than that of female students. This statement is contrary to the findings of [12], saying that male students lack in mental health problems as males are more likely to seek mental health service than females. Furthermore, many students from engineering courses are usually monopolized by male because the nature of this field is challenging, tough to learn and the various pressures that must be faced [13]. Findings of [14] revealed that there were no stress differences between male and female students as stress affects academic achievement, disappointment, physical health and suicidal ideas. Often, mental health problems among rural respondents may be due to factors such as financial factors, factors of life events and lack of knowledge about awareness of mental health problems. Nevertheless, these factors are not only happened in rural areas but people in urban areas are also experiencing similar problems. The Health Ministry study in 2015 shows that about 300,000 out of 1.2 million rural and urban residents in Kelantan state have mental health problems due to various stresses. [15] stated that most of the problem or causes of stress including drug symptoms, depression, family problems and rising cost of living that burdening the people.

Conclusion

In summary, the level of mental health among electrical engineering students in three vocational colleges is at moderate level. However there are also some students who suffer from mental health problems at severe and severe levels. Most of the first-year students are more likely to have depression, anxiety and stress problems than the second and third year. This findings show that the mental health level of the student should be addressed seriously so that the students are able to deal with their mental health problem. All parties like Ministry of Education, Ministry of Health, Vocational Colleges Principals, teachers even the community and parents should work together to prevent students from suffering mental health in order to produce competitive human capital, excel in personal and academic achievement as well as holistic in terms of physical, emotional, spiritual, intellectual, and social. On the other hand, students need to identify their mental health level and apply the appropriate methods to address mental health problems through proper channels. Further studies should be conducted by



evaluating the most effective intervention programs in preventing students' mental health problems. For example, using apps or "Hello, are you OK" campaign and so on.

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Acknowledgments

The authors wish to thank the Ministry of Education Malaysia (MOE) and the Research and Management Centre (RMC) of Universiti Tun Hussein Onn Malaysia for the FRGS grant (Vote No.: 1472) awarded to conduct this study. The publication of this work was supported by the PPG grant (Vote No.: V024) awarded by MOE. The authors would also like to thank to those who graciously gave their time to participate in this study.

ALUMINIUM AS ELECTRICITY CONDUCTIVITY

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Abstract. *Electricity is one of the important sources of energy for daily use, specifically for residential and industrial areas. Electric sources now day generated by coal, hydro, wind, petroleum, sun, etc. The objectives of this research are to produce electricity from various aluminum resources and to examine the effect of various waste cans in the production of sources of electricity. Aluminum waste can have recorded as the largest source of aluminum in the waste stream. Therefore, aluminum waste was chosen as the research material divided into two samples, waste food can and waste beverage can. Application of alkaline electrolysis, aluminum-based electrodes and porous electrodes along with zero gap cell is carried out using ionic liquid electrolyte made from vacuum dries NaCl, NaOH, and seawater. The NaOH reaction with various aluminum has recorded as the best solution of all. Comparison with the different types of aluminum resources shows NaOH solution produced the highest electric reacts for pure aluminum with 34.1% and 35% for aluminum foil respectively. Meanwhile, aluminum waste food can, 24.3% and waste beverage can, 6.6%. Pure aluminum with NaOH solution shows highly readable compared to aluminum recycling reactions. T-test result obtained show the mean of two data in favor majorly have data reading differences except for the mean for foil vs. plate data which is 0.2 (more than 0.05). Electricity testing on various types of aluminum proved that aluminum waste can as an electric resistivity using a different solution in electrolysis.*

Introduction

Malaysia is known as one of the developing countries in the world. Electric power industry in Malaysia has played an important role in the dramatic economic development. In Malaysia, electricity generation is mostly fossil-based, in particular natural gas and oil. Malaysia have been majored in main resources which are gas, coal, oil, hydro and renewable energy. In 2000, Malaysia began to recognize the potential of biomass, biogas and other renewable energy resources in the Fifth Fuel Policy (1). The wide use of crude oil and fossil fuels in general has

also given rise bad issues regards on human's health and environment conditions. Besides, the improvement in living standards and the advancement of technology is growing rapidly, resulting in increased request for energy use continuous and at the same time cost is getting higher too (15). If we too depend towards the non-renewable resources it will over if we do not find the new alternative way to replace it. Even though this resources that mentioned before give us ease in life but it brings harm to nature without us being aware. For example, logging for dam construction can cause habitats in the forest to be threatened (2).

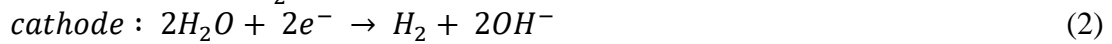
The objectives of this research are to produce electric energy from different aluminum resources and to study the effect of different wasted cans in producing electricity sources. Then, to measure the pH value from different electrolyte solution. Lastly, to determine the optimum condition of this study results. The study focuses on full-scale of aluminum product fully besides also uses other chemical substances such as activated carbon, seawater and other electrical tools. Moreover, this purpose studies focusing on the uses of electrochemical experiment. This energy production is able to make the electric energy and can decrease environment pollution. This workability of aluminum can provide a positive change in our country. This suitability of this material can contribute to innovation in preserving natural resources.

Electrolysis

Electrolysis of water assumes an essential job in the generation of hydrogen dependent on power from sustainable power sources. Hydrogen got from electrolysis is portrayed by high immaculateness (99.9%, paying little mind to the kind of electrolyzer), while the electrolysis procedure itself is anything but difficult to utilize and does not require a long start-up time. (3). Hydrogen (H_2) is a basic atom in this response and has drawn much consideration throughout the decades. H_2 creates multiple times bigger response vitality than hydrocarbon powers when it responds with air. Moreover, the burning of H_2 produces zero carbon outflow and is likely made through water electrolysis. In any case, the creation cost is dependably the issue because of the traditional strategy to deliver H_2 (essentially water electrolysis) is neither affordable nor practical. Next, capacity and transport of H_2 present security concern and has dependably been a test. Along these lines, an increasingly basic, cheap and safe technique to produce H_2 is liked. As aluminum metal is abundant in Earth's crust and the reaction by-product can be recycled, aluminum-water reaction is considered as an alternative method of producing H_2 . A full reaction with water under ambient conditions, 1 g of aluminum can generate 1360mL of H_2 gas. However, the protective alumina layer's restrictive properties lower the reaction rate and the output of H_2 production. Therefore, in order to increase the yield of H_2 gas production, aqueous alkaline solution is applied to remove the passive aluminum layer. As reported by Huang et al., the H_2 production rate has been improved by NaOH and KOH. Thus, a cheaper source of H_2 gas is tested for electrolysis process through aluminum-water reaction in this study. (4)

Alkaline electrolyzer

This is the most widely recognized innovation utilized in water electrolysis. The effectiveness of electrolysis in such gadgets can achieve 82%. Alkaline electrolyzers are describe by high proficiency and moderate cost. The purity of hydrogen acquired by electrolysis utilizing this sort of equipment is extremely high, running from 99.7% to 99.9%. In this procedure, water ought to be furnished with a conductivity of under $5 \mu\text{S}/\text{cm}$. The response happening at the cathode (HER—Hydrogen Advancement Response) and anode (OER—Oxygen Development Response) are appeared by equations (1) and (2) while the general response is appeared in equation (3).



This electrolyzer typical consists of two electrodes that are immersed in the electrolyte and separated by a membrane. Maximizing ionic conductivity is the solution's role. OH⁻ ions penetrate this membrane, resulting from the cathode reaction. Hydrogen from the cathode is obtained and water from the anode is obtained with a small amount of oxygen. It is most likely that alkaline solutions like sodium hydroxide (NaOH), potassium hydroxide (KOH), and calcium hydroxide (Ca(OH)₂) will be used. (10)

PEM water electrolysis

Proton exchange membrane (PEM) electrolyzers produce very high purity hydrogen and require very pure water of approximately 1 μS / cm low conductivity. Figure 1 shows a PEM water electrolyzer schematic diagram. Only on the anode side, where it is divided into hydrogen and oxygen ions, is water supplied. The membrane only allows hydrogen ions, which at the cathode are then reduced. Oxygen with moisture is obtained from the anode, while hydrogen is obtained from the cathode with a small amount of moisture which may penetrate the membrane rate. There is a very thin polymer membrane separating the cathode and anode in this type of electrolyzer. The anode oxidation process produces free ions of hydrogen and oxygen, while hydrogen ions are reduced in the cathode. (3)

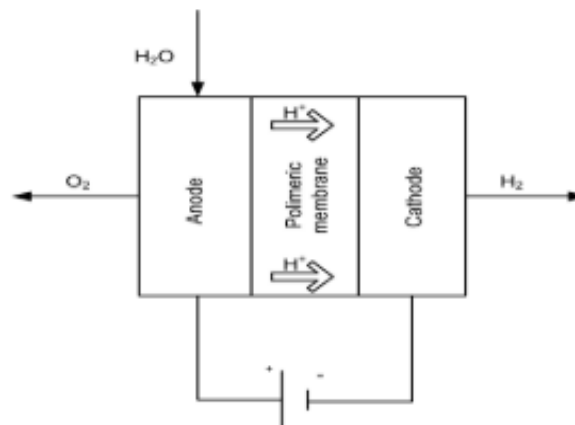


Figure 1. Schematic of PEM water electrolyzer.

Alkaline electrolyzers are similar to PEM electrolyzers, but use the electrolyte instead as an alkaline solution. Polymer electrolyte water electrolysis (PEM) has more advantages than alkaline water electrolysis, advantages are ecological cleanliness, small size and mass, high hydrogen gas purity, low gas crossover, low power consumption, high electrical conductivity control, high pressure operation, high safety level, easy handling and maintenance (5).

Zero gap

The use of a cell design based on the zero-gap concept is an important step towards these 'Advanced Alkaline Electrolysers.' The zero-gap cell design works in alkaline electrolysis by compressing two porous electrodes on either side of a membrane or gas separator conductive hydroxide ion. This results in a gap for the traditional setup between the two electrodes equal

to the thickness of the membrane (< 0.5 mm) rather than (> 2 mm), thus significantly reducing the contribution of ohmic resistance from the electrolyte between the two electrodes. A gas diffusion layer provides an electrical connection from the porous electrode to the bipolar plate while allowing electrolytic solution feed and the removal of gas products simultaneously. Figure 2 shows that the main difference between traditional configuration and zero-gap design is the use of porous electrodes rather than solid metal sheets. This enables very small inter-electrode gap cells with compact design and high efficiency. It forces gas bubbles to be released from the electrodes' backside, reducing their cell voltage contribution. Figure 2(a) Standard setup, (b) zero gap setup—showing the main design differences, the porous electrodes are pressed on either side of the gas separator to reduce the inter-electrode gap, and the conducting gas diffusion layer provides an electrical connection between the electrodes and the bipolar current collector. (6,11)

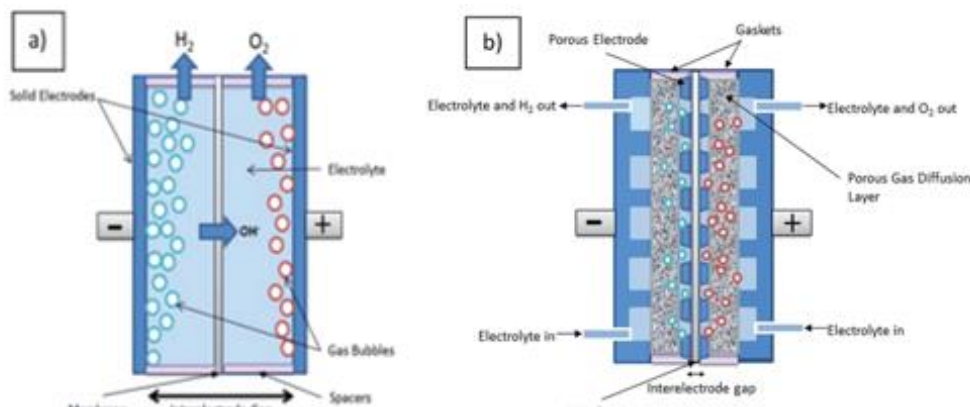


Figure 2. (a) Standard setup, (b) zero gap setup (6).

Material and method

To prepare 500ml of 1molar solution of Sodium Chloride, NaCl which is combine by 14.61g of NaCl powder and distilled water. To prepare 500ml Sodium Hydroxide, NaOH solution is same method with NaCl solution but use different mass which is 10g for 1molar (Figure 3). The methodology employed in this chapter is we constructed Al-Graphite cells in simple cells, using an aluminum foil or sheet and recycled cans as anode, a graphitic cathode, and an ionic liquid electrolyte made from vacuum dried NaCl and NaOH and another solution is seawater. See Methods the cathode was made from either pyrolytic graphite or a three-dimensional graphitic foam. We used activated carbon as cathode (6,8). This is show in Figure 4 below. pH value of all solution measured by using pH meter (Figure 5). Voltage of sample is measured by using multimeter which is electrical instrument to measure different electrical quantities such as voltage, current and resistance (Figure 6).



Figure 3. Preparation of solution.



Figure 4. Measure pH of solution.



Figure 5. Al-Graphite cells in simple cells.



Figure 6. Voltage of sample is measured.

Results and discussions

Effect of alkalinity on aluminiums

The pH scale of acidic is less than 7 averages, for neutral is 7 and alkaline pH is more than 7. In Figure 7, the parameters of pH results for NaOH and NaCl solution at alkaline range. Meanwhile, for seawater show at acid range.

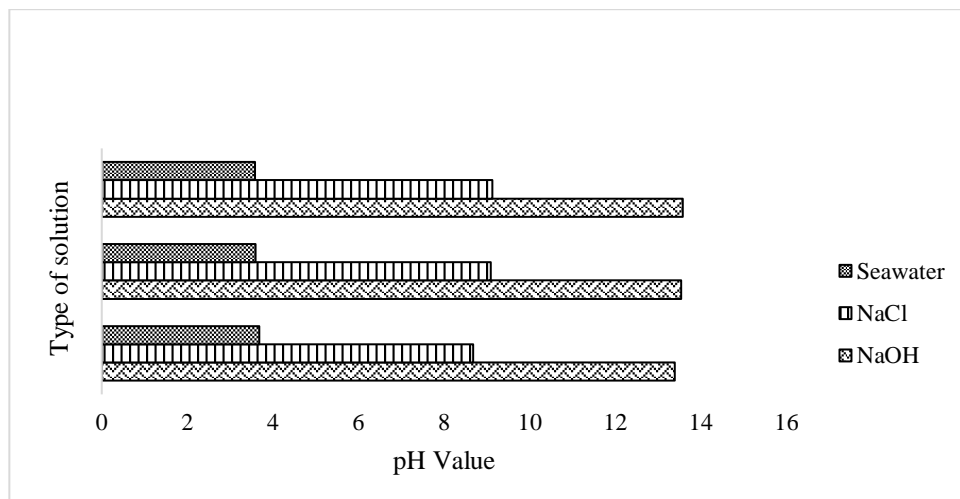


Figure 7. Graph of PH reading of solution.

Based on the Figure 8, NaOH solution on pure aluminum can make the electric presence of aluminum with a relatively high reading but not in aluminum recycle. NaOH solution only produces high readings on food cans only. Similarly, with NaCl solution, pure aluminum has

the highest majority reading as a whole. In addition, seawater is only capable of generating a relatively satisfactory voltage readings for all types of aluminum used.

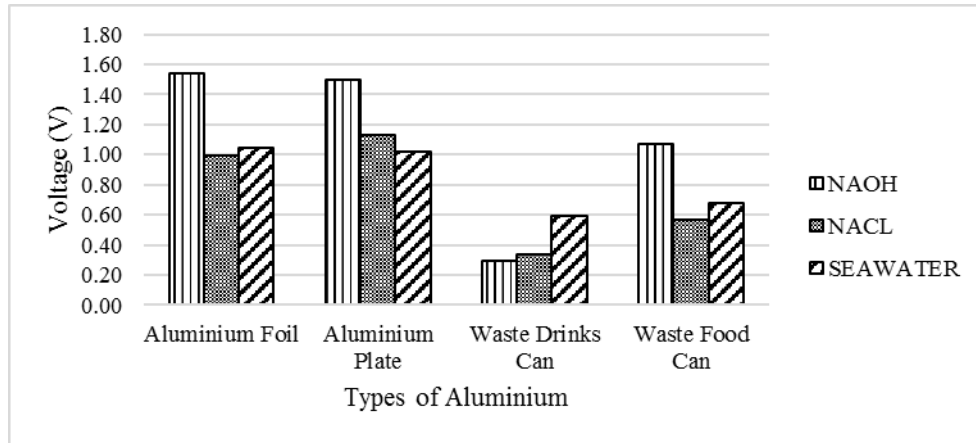


Figure 8. Average voltage of various aluminum resources.

Based on the Figure 9, the voltage readings for the waste aluminum on food cans are higher than the beverage cans with the difference of 57 %. Whereas for pure aluminum, aluminum foil has higher voltage readings than aluminum plate with difference 1.3%. However, all voltage readings for all four samples show the presence of voltage by using NaOH solution.

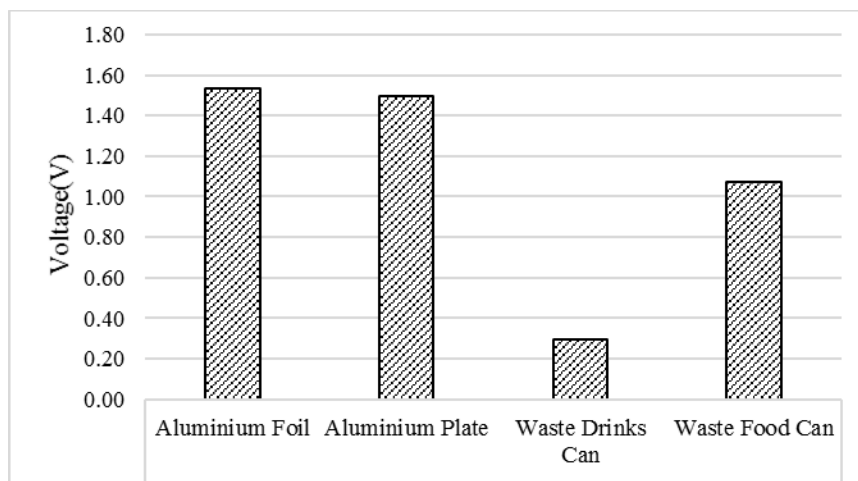


Figure 9. Average voltage by using sodium hydroxide, NaOH.

By using the same method, the sample is carried out using the NaCl solution. Based on the Figure 10, the voltage readings for the waste aluminum on food cans are higher than the beverage cans with the difference of 25%. Meanwhile for pure aluminum, aluminum plate has a higher voltage reading than aluminum foil with a difference of 6.1 %. All values of voltage readings for all four samples show the presence of voltage by using 1 mol of NaCl solution.

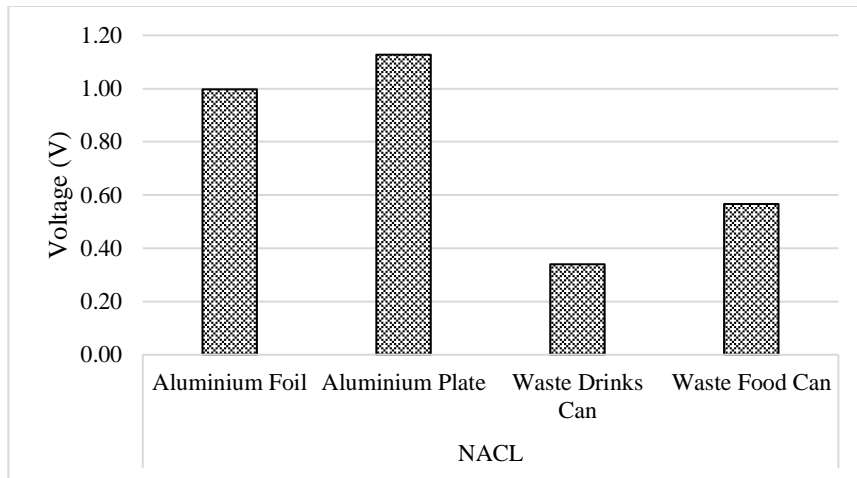


Figure 10. Average voltage by using sodium chloride, NaCl.

Based on the Figure 11, the voltage readings for the waste aluminum on food cans are higher than the beverage cans with the difference of 6.6%. Whereas for pure aluminum, aluminum foil has higher voltage readings than aluminum plate with different 5.1%.

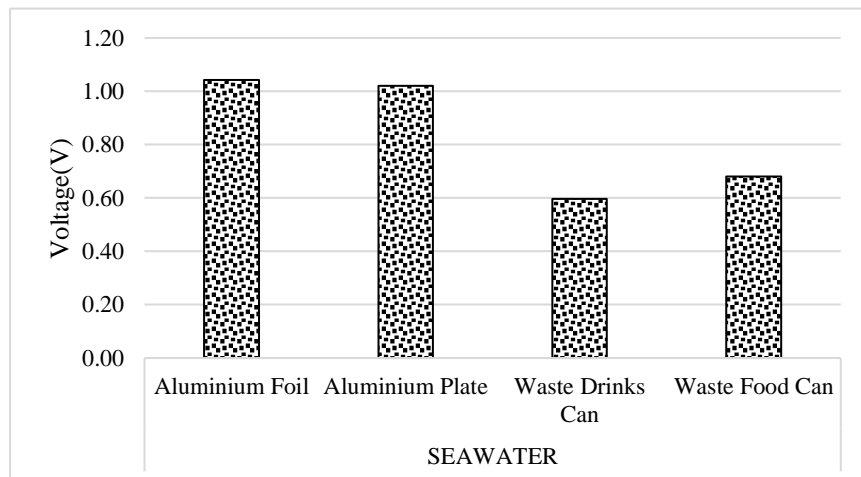


Figure 11. Average voltage by using seawater.

Based on overall result, NaOH is the best solution to be used as an electrolyte in electrolysis among the all solution. Between all the resources aluminum, aluminum plate is the best choice to produce the higher voltage than other it is proved based on the data that we got in Figure 8. T-test analysis is used to determine if there is a significant difference between the means of two groups, which may be related in certain features. Based on the data obtained in table 1, it can be concluded that there are differences between two data sets. In conclusion, data that obtained the value of 0 at p value proved that there was a difference in reading between two data with data reading less than 0.05 while the data obtained more than 0.05 indicates that there was no reading difference between the two data as found on the foil versus plate in Table 1.

Table 1. T-test data values

Data of t-test	P value	P value
Aluminum Foil vs Aluminum plate	0.177	0.2
Aluminum Foil vs Drink can	1.60667E-06	0
Aluminum Foil vs Food can	8.83434E-05	0
Aluminum Plate vs Food can	1.17114E-05	0
Aluminum Plate vs Food can	0.00060958	0
Drink can vs Food can	1.15123E-05	0

Resistance during reaction

Some response resistances in the electrolyte were also identified through this experiment. At high current densities, the obvious resistance is the Ohmic loss in the electrolyte, which includes bubble resistance, diaphragm and ion transmission, and corrosion of aluminum.

Resistances due to Bubbles

Additional resistance to ion transfer and electrochemical responses is caused by the existence of bubbles in the electrolyte and electrode surface. Hydrogen and oxygen-gas bubbles occur on cathode and anode surfaces during electrolysis and are separated only when large enough from the surface.

The coverage of bubbles decreases the contact between the electrolyte and the electrode, blocking electron transmission and improving the overall system's Ohmic loss.

Energy losses are always comparatively low in the power circuit, but at greater current densities those caused by ionic transfer become more important. The development of gas bubbles on the surface of the electrode makes a significant contribution to complete energy loss.

A greater reaction rate therefore produces greater quantities of gas bubbles, which can prevent the electrode from entering into contact with the electrolyte. In short, the bubble impact is a issue which must be solved by changing the electrode surface, decreasing the surface tension of the electrolyte or using mechanical flow to force the gas bubbles to leave the cell. (9)

Resistances due to corrosive

The use of an aqueous NaOH solution creates aluminum corrosion due to aluminum and water reactions (Al-H₂O reaction). The most easy and efficient strategy to promote the Al-H₂O response is to add hydroxides, mainly sodium hydroxide (NaOH). Aluminum, however, suffers from a severe restriction issue, which arises when a consistent and adhering oxide layer is formed on the aluminum surface. (12)

The dissolution of the surface oxide layer to aluminum due to a chemical attack on the hydroxide ions OH⁻ also depends on other variables, such as OH⁻ concentration, and aluminate ions Al(OH)₄⁻ at the layer or resolution interface. The transport of OH⁻ and Al(OH)₄⁻ ions to and away from the metal or solution interface through the solution is, therefore, anticipated to affect anodic aluminum dissolution process. (13)

In the presence of the oxide layer, the anodic dissolution response of aluminum ions can be categorized by the motion of the aluminums through the layers and an indirect metal dissolution response by the subsequent creation and dissolution of the oxide layer. (14)

Conclusion

In conclusion, after the completion of the study, the objective of the study was well implemented. Testing the presence of electricity on various types of aluminum has been carried out well and the results obtained can be used as reference for future research. Various types of aluminum have proven to be able to flow electrical current thereby reducing the amount of environmental pollution caused by many aluminum discharges. Through the results of this study, food cans can produce high voltage readings compared to drinks in the aluminum recycle category with NaOH solution. This solution is selected because it produces high voltage readings in bulk for the four aluminum. The highest reading for food cans for a sample is 1.11V. If 208 samples are connected in parallel it will produce 230V which is suitable for residential area in Malaysia.

Acknowledgments

This research has funded by Centre for Diploma Studies, University Tun Hussein Onn Malaysia. Authors are also grateful to technicians in Environmental Laboratory, Pagoh Campus, Universiti Tun Hussein Onn Malaysia (UTHM) for their help in completing this project research.

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TEACHING AND LEARNING BASED ON IR 4.0: READINESS OF ATTITUDE AMONG POLYTECHNICS LECTURERS

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Abstract. *The Industrial Revolution 4.0 (IR 4.0) not only changed the landscape of the industry sector, but also brought significant changes to the education sector, especially for higher education. These changes include changes in pedagogy, skills, and technology related to education. However, the question arises whether the lecturers at Higher Education Institutions, such as polytechnics, are ready to apply IR 4.0 elements in their teaching process. Therefore, this study was conducted to examine the level of readiness of polytechnic lecturers towards teaching and learning process based on IR 4.0 from attitudes aspects and to study the gender differences in the measured aspect. Survey technique was used as the research design in which 222 lecturers from three polytechnics in the State of Johor were chosen as respondents for the study. A set of questionnaire was used to obtain survey data from respondents. The gathered data were analyzed by using descriptive and inferential statistics. The findings show that the readiness of lecturers in the aspect of attitudes is at a moderate level. In addition, the findings also reveal that there is a significant difference in attitude readiness between male lecturers and female lecturers. In conclusion, the responsible party should take appropriate action to improve the attitude of polytechnic lecturers so that they are better prepared to apply the IR 4.0 elements in the teaching process and subsequently produce quality graduates and meet the needs of the industry.*

Introduction

Education plays a major role in the development of human capital in order to achieve Vision 2020. The advancement of cyber technology and easier access to the internet have brought about reformation and development in education. The Ministry of Education Malaysia (MOE) is committed to place Malaysia's education system as one of the best system in the world by improving the quality from the aspects of infrastructure, academic manpower, students' ability as well as pedagogy and andragogy. Education transformation in terms of pedagogical aspects is needed to produce graduates who are equipped with various skills and capable of facing challenges of the 21st century and Industrial Revolution 4.0 (IR 4.0). It is imperative to reform and refine the education aligned with the needs of industrial sectors within the sphere of IR 4.0 and 21st century.

In order to realize these aspirations, lecturers, especially those in higher learning institutions, play an important role in training and producing high quality graduates and enhance graduates' employability by improving the teaching and learning. There are many aspects influencing the quality of teaching and learning. For instance, teaching and learning cannot be efficiently conducted without appropriate teaching facilities, such as conducive classroom and projector. These basic facilities are needed to allow lecturer and students to engage in learning activities during the teaching process. Apart from facilities, lecturers should also possess adequate content knowledge and pedagogical skills because effectiveness of learning depends largely on how lecturer delivers the learning contents [1].

Pedagogy or the teaching method is always changing due to the change of learning environment and technology. A few decades ago when computer and internet technology is not broadly accessible, teaching and learning process is done through face-to-face activities using concrete learning materials [2]. The advent of internet has changed the landscape of teaching and learning in which teaching can be facilitated through the use of online learning materials. In addition, face-to-face interaction between teacher and learner is no more required to make learning occurs as it can happen in a virtual platform [3]. In the context of IR 4.0, the pedagogy is once again in need of change because learning institutions have to produce workers who can work with technology related to IR 4.0.

Ideally, the teaching and learning process should integrate the elements of IR 4.0 such as Internet of Thing (IoT), Cloud Technology, big data and Augmented Reality [4]. However, the integration of the elements IR 4.0 into teaching and learning is dependent on the knowledge, skill and attitude of lecturer towards IR 4.0. According to Mohd Sani [5], the lecturer's understanding on the IR 4.0 context still remain unclear. In addition, lecturers are also lacking confidence in applying the concept of IR 4.0 in their teaching and learning process and face difficulties in adapting to new education reforms. The fundamental problem is that most of the lecturers do not understand the rationale behind the changes and what role they need to play to implement the teaching and learning based on IR 4.0 [6]. This was agreed upon by Syarifuddin and Halim [7] where he said that educators are not aware of the latest changes and do not feel the need to make changes in their teaching tasks. Therefore, any changes in the curriculum and education system need to be disseminated and given a clear explanation to educators.

Although the concept of IR 4.0 has been publicly introduced in 2011 in Germany [8], this concept is still new to Malaysia industry and education sector. Therefore, it is not sure whether or not the lecturers are ready to implement the teaching and learning based on IR 4.0. Some researchers (e.g. Ornstein and Hunkins [9]) argue that when educators are satisfied with the existing working condition, they tend to avoid changes or to move out of the comfort zone. Worse still, when lecturers do not have a profound and clear understanding regarding the idea behind IR 4.0, they are most probably to refuse to apply the idea in their work. This kind of attitude might influence the readiness of lecturers towards implementation of teaching and learning based on IR 4.0.

In alignment with this argument, this study was conducted to find out readiness level from the aspect of attitude among Polytechnics lecturers to implement teaching and learning based on IR 4.0. In addition, this study also aimed to see if there is any difference between male and female lecturers in the readiness because we believe that male and female lecturers differ in several characteristics such as behavior and personality.

Polytechnic lecturers were the focus of this study mainly because there is a big number of Polytechnics in Malaysia and Malaysia Polytechnics play a significant role in producing skilled workforce to various industrial sectors in Malaysia.



Research Methodology

Sample

In this study, a total of 222 lecturers from three Malaysia Polytechnics were randomly selected to be the research respondents. Out of the total, 138 lecturers are male (62.2%) and 84 lecturers are female (37.8%). In addition, 166 Lecturers have more than 10 years of teaching experience, and the rest (56 lecturers) have less than 10 years of teaching experience.

Instrument

The attitude of respondents was measured with 10 items in a set of questionnaire. The five-point scale was used, ranging from 1 (very disagree), 2 (disagree), 3 (slightly disagree), 4 (agree) and 5 (very agree). The items were checked by three experts and the items were refined according to experts' comments and suggestions. The questionnaire yielded sufficient level of reliability, $\alpha = 0.86$.

Data analysis

Descriptive statistics (mean and standard deviation) was used to analysis the data in order to find out the readiness level of polytechnic lecturers in terms of attitudes toward teaching and learning based on IR 4.0.

The readiness was divided into three level, namely low, moderate, and high according to the mean score. Table 1 shows the interpretation of mean score.

Table 1. Interpretation of mean score

Mean score	level
1.00 – 2.39	Low
2.40 – 3.79	Moderate
3.80 – 5.00	High

Apart from that, Shapiro-Wilk test was conducted to check the normality of the dataset. Shipro-Wilk test was used because the sample size was smaller than 2000 [19]. The test result revealed that the data was not normally distributed, $W=0.94$, $p<0.001$. For this reason, the assumption of normal distribution in dataset was violated. The violation of this assumption indicates that non-parametric analysis method, specifically Mann-Whitney test, has to be used to analyse the gender difference in attitude of lecturers based on teaching and learning in IR 4.0.

Findings

In this study, the attitude of polytechnic lecturers is very important to determine their acceptance of the concept of IR 4.0 in teaching and learning. Data were analysed using descriptive statistics to find out the readiness level of polytechnic lecturers in terms of attitudes toward teaching and learning based on IR 4.0. Table 2 illustrates the mean, standard deviation and interpretation for the readiness level.

Table 2. Mean, standard deviation and interpretation for the readiness level of polytechnic lecturers in terms of attitudes toward teaching and learning based on IR 4.0

No. Item s	Items	Mean (M)	Standard Deviation (SD)	Level
1	I feel comfortable in teaching the subject by integrating IR 4.0 elements.	2.71	0.77	Moderate
2	I feel that the use of IR 4.0 concepts will benefit my students.	3.08	0.90	Moderate
3	I feel the use of teaching aids based on IR 4.0 will be more effective in teaching process	3.20	0.84	Moderate
4	I am interested in conducting an assessment for students based on IR 4.0	3.24	0.76	Moderate
5	I am interested in using IR 4.0 technology in my teaching and learning	3.32	0.78	Moderate
6	I am interested in enhancing my knowledge in IR 4.0	3.39	0.75	Moderate
7	I am ready to take an IR 4.0-based learning course to improve my skills	3.08	0.84	Moderate
8	I am interested in applying IR 4.0 elements in my teaching process	3.46	0.83	Moderate
9	I feel the implementation of IR 4.0-based teaching and learning does not burden lecturers	3.09	0.93	Moderate
10	I am interested in participating in activities (such as workshops, seminars, conferences) related to IR 4.0	4.02	0.90	High
Total Mean		3.26	0.83	Moderate

Based on the outcome shown in Table 2, the readiness in terms of attitude among the participating polytechnic lecturers is at a moderate level ($M = 3.26$, $SD = 0.83$). The results of the analysis show that the highest mean value is the 10th item ($M = 4.02$, $SD = 0.90$) which measured whether the lecturers are interested in participating in activities (such as workshops, seminars, conferences) related to IR 4.0 based on learning and this item shows the value of mean interpretation high compared to other items. On the contrary, the 1st item (*I feel comfortable teaching the subject related to using the IR 4.0 based learning method*) obtained the lowest score ($M = 2.71$, $SD = 0.77$). In short, the lecturers have moderate level of readiness towards all items, except Item 10. The mean values of all items are located between 2.71 and 4.02.

Apart from determining the readiness level, this study also aimed to find out if there is any difference in attitudes towards teaching and learning based on IR 4.0 between male and female lecturers. Mann-Whitney test was used and the results are shown in Table 3.

Table 3. Analysis of Mann-Whitney test for aspect of attitude

Aspect	Gender	Mean (M)	Standard Deviation (SD)	U	df	Sig. (2- tailed)
Attitude	Male	2.99	0.45	1176	222	.000
	Female	3.71	0.41			

Based on the results shown in Table 3, the mean value for female lecturers ($M= 3.71$, $SD = 0.41$) is larger than male lecturers ($M=2.99$, $SD=0.45$). Although male lecturers and female lecturers have the same level of readiness (moderate level), the mean value for male lecturers is actually at the lower end, whereas the mean value for female lecturers is at the upper end. The Mann-Whitney test result indicated that there was a significant difference between male and female lecturers in terms of attitudes, $U = 1176$, $p < 0.05$. It means that the readiness level in attitude among female lecturers is significantly higher than male lecturers.

Discussion

Lecturer's role becomes more significant in the era IR 4.0. In order to realize the goal education in alignment with IR 4.0, lecturers need to play an important role by demonstrating a positive attitude towards implementing IR 4.0 elements in their teaching and learning in order to produce workforce that can meet the industry's needs.

Overall, the findings showed that the level of readiness of polytechnic lecturers in terms of attitudes toward the application of IR 4.0 elements in teaching and learning was at a moderate level which can be regarded as satisfactory. However, there are rooms for improvement. The findings showed that attitudes of lecturers was not fully ready to embed IR 4.0 elements into teaching and learning. This findings is within our expectation because whenever a new technological products and new educational concept are created, it will take some times for academicians to adopt those new things due to lack of understanding and skill in the initial phase. For example, when School Based Assessment (SBA) was first introduced to the school teachers, majority of them did not show positive attitude to the SBA implementation and their readiness level to implement SBA was not very encouraging also [10].

The present findings indicated that many lecturers are interested in participating seminars, workshops and discussion related to IR 4.0. This findings reflects the fact that those lecturers have sufficient motivation to embrace IR 4.0 in their teaching. This might help to produce high quality graduate and thereby enhancing employability because industry needs graduates who can work with technology related to IR 4.0 [11]. As a polytechnic lecturer, he/she needs exposure through courses, seminars, workshops or knowledge sharing sessions to improve his/her knowledge and skills related to IR 4.0 and then apply those knowledge and skill in the teaching process. This will benefit the students and also enhance the quality of education. As what has been mentioned by Hassan [12], an instructor can perform their duties in a focused and continuous manner to enhance their understanding and skills when they have positive attitudes towards their profession.

Apart from that, the findings also showed that lecturers were not fully comfortable with the subjects taught, the teaching techniques and the use of teaching aids based on the IR 4.0. This findings mean that those lecturers are not yet affectionately ready to integrate IR 4.0 elements into taught courses, teaching methods, and teaching aids. This result might be due to the lack of knowledge and skill related to IR 4.0 and therefore hindering them to apply IR 4.0 elements in teaching process [13]. In addition, negative or ineffective experience while trying



to use the latest technologies in their teaching and learning process might discourages lecturers to use the technology innovation.

Lecturers find it difficult to try something new in their teaching and learning process. This is likely due to their low curiosity [14]. Implementation of IR 4.0 in teaching and learning requires lecturers to equip themselves with a variety of technological skills so they can carry out more professional and effective teaching. As a academician, he/she needs to be responsible, dedicated and productive. But the lack of self-confidence among lecturers might cause them not to accept reforms in the education system [15].

To a certain extent, polytechnic lecturers presume that the implementation of IR 4.0 based teaching might have an impact on their workload. In fact, the burden of lecturers' assignments is already quite high. Apart from teaching task, the lecturers are involved in co-curriculum, research, publication, and administration work. Integrating IR 4.0 elements into teaching will be adding more load to their existing tasks. This is because, in the implementation of IR 4.0, lecturers need to attend courses, providing teaching materials in line with IR 4.0, providing evaluation materials and strategies in line with IR 4.0 and so on. Such works are very burdensome for lecturers due to administrative duties [16]. Disrespectful or negative attitudes will develop if one considers the implementation of an activity is burdensome and non-fun activities [10].

In addition, lecturers are less interested in using technology in their teaching and learning. The findings show that the level of lecturer's interest is still at a moderate level in the use of technology in teaching and learning, where lecturers are still not yet ready to accept IR 4.0 challenges in their teaching. This may be due to the lack of technological facility and technical support which cause the lecturers to assume that the use of technology in learning is ineffective [17] and hence it causes lecturers not to be positive about the implementation of teaching and learning based on the IR 4.0 concept.

This study also aimed to find out the gender difference in terms of readiness in attitude. The findings show that there is a significant difference between male and female lecturers in terms of attitudes toward teaching and learning based on IR 4.0. Female lecturers are more ready to embed IR 4.0 into their teaching as compared to male lecturers. The possible explanation for this outcome might be that the male lecturers prefer to apply the teaching method that they used to practice in their teaching and tend to avoid multitasking job as compared to female lecturers who are more obedient and tend to follow the curriculum changes [18].

Conclusion

This study was conducted to obtain information on the attitude of polytechnic lecturers on the implementation of teaching and learning based on IR 4.0. The participating lecturers' readiness in attitude is at a moderate level, indicating that there are still some rooms to improve lecturers' attitude towards the implementation of teaching and learning based on IR 4.0. It means that more works need to be done and more efforts has to be invested in order to make lecturers ready to implement teaching and learning based on IR 4.0.

The present findings also discovered that female lecturers are more ready to integrate the elements of IR 4.0 into teaching and learning compared to male lecturers in terms of attitude. This findings seem to suggest that female lecturers are more aware of the importance of current technological development in teaching and learning in comparison with their male counterparts.

Lecturer's attitude toward the use of IR 4.0 elements in teaching their learning is important to determine the success or failure of a new system in education. The effectiveness of reforming a system or the implementation of a program in education depends greatly on the

attitudes of academicians. The attitude of polytechnic lecturers should be enhanced so that the implementation of teaching and learning based on the concept of IR 4.0 is effective and useful for students.

Acknowledgement

This study was financially supported by the Universiti Tun Hussein Onn Malaysia (UTHM) contract grant with vot nr: H279.

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EFFECT OF ETCHING TIME ON CHARACTERIZATIONS OF POROUS SILICON PASSIVATED BY A NANO-SILVER LAYER

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Abstract. Porous silicon (PS) is a candidate for silicon-based optoelectronic applications. This paper presents the effect of etching time on the properties of PS deposited by a nano-thin film of a silver layer (10 nm Ag/PS) using radio frequency (RF)-sputtering technique at room temperature (RT). The PS was prepared by electrochemical etching (ECE) method for n-type (111) Si in an electrolyte solution containing hydrofluoric acid (HF) and ethanol (C₂H₆O) at a volume ratio of 1:4 with a direct current of 10 mA for different etching duration (30, 45, and 60 min). Structural, surface, and optical characterizations of the samples were carried out by using field emission scanning electron microscopy (FESEM), energy dispersive X-rays (EDX), X-ray diffraction (XRD), UV-Vis spectrophotometer, and photoluminescence (PL) spectroscopy. The results show that the sample prepared for 30 min demonstrated enhancement in the PL and reflectivity spectra compared to other samples which indicate a higher etching rate and a thinner wall between the pores on the surface over a larger exposed area was obtained.

Introduction

Nanostructured porous silicon is one of the well-known nanostructured materials. The PS is a good candidate due to the ease of fabrication, large surface area, manageable surface modification, and various pore sizes and morphologies [1]. The fraction of pores volume over total volume is called the porosity. The PS has been applied in a wide range of applications such as light-emitting devices, solar cells, and sensing devices [2, 3]. The formation process of PS has intricate dependence on many factors such as HF concentration, properties of Si wafer, current density, illumination intensity, and etching time [1, 4]. The etching time is mainly affecting the depth and diameter of the pores [5]. To date, it has been shown that metalized PS demonstrates promising features for effective surface-enhanced Raman scattering (SERS) that resulted from the excitation of surface plasmon resonance (SPR) effect [6]. The visible luminescence from PS can be explained in terms of a band gap increase compared with bulk Si [7]. Rigorous studies [8-14] have been performed to enhance the luminescence intensity and stability of PS, thereby improving the performance of optoelectronic devices developed by PS

[10]. One of the approaches to augment the luminescence intensity of PS is passivating its surface via metals such as copper, silver, and aluminium using various techniques that include sputtering, chemical vapor deposition, electrochemical etching, electrodeposition, and immersion plating [9, 10, 15, 16]. In this study, the structural and optical characteristics of the PS prepared by electrochemical etching for different etching time (30, 45, and 60 min) and passivated with 10 nm Ag thin film are presented. The characterizations were carried out by using the FESEM, EDX, XRD, reflectivity using UV–Vis spectrophotometer, and PL measurements.

Experimental Procedure

The initial material was n-type c-Si (111) wafer with resistivity ranging from 1-10 Ω . cm, thickness of 256-306 μm and a diameter of 50.87 ± 0.5 mm. The PS was fabricated using the ECE technique and the etching cell includes two electrodes: platinum (Pt) as a cathode and silicon (Si) surface acts as an anode. A direct current of 10 mA was applied using a DC power supply and the basic electrolyte includes a 10:40 ml mixed solution of 49 wt% HF acid and 99.7 wt% $\text{C}_2\text{H}_6\text{O}$ in a Teflon container. The samples were prepared at room temperature and illuminated with a 150-W xenon (Xe) lamp placed over the Teflon cell during the experiment. Three samples were prepared for three etching time which was 30, 45, and 60 min. The Ag layer of 10 nm thickness was deposited on the prepared PS samples via the RF-sputtering technique at RT. The Ag was chosen due to its high electrical conductivity (63.01×10^6 S/m) and carrier concentration ($1.070 \pm 0.001 \times 10^{28} \text{ m}^{-3}$) that can help to increase the PL intensity of the PS surface. The operating parameters used for the deposition process comprise RF power, chamber pressure, and Ar gas flow rate were 120 W, 1.55×10^{-2} mbar, and 20 sccm, respectively. The Ag-passivated PS samples were subsequently annealed at 700 $^\circ\text{C}$ for one hour in a vacuum annealing furnace with a base vacuum pressure of 4.5×10^{-5} mbar.

Results and Discussion

The surface morphology of the samples was studied using a high-resolution FESEM (FESEM: JSM-6460LV system). The FESEM images of the samples are shown in Fig. 1. The pits reveal the initiation of the etching treatment on the surface of Si wafer. Apparently, there is a continuous distribution of pore sizes on the sample in Fig. 1(c) compared to others and the pore size increases as the etching time increases. In addition, the diameter and depth of pores augmented as etching time increases which indicating a progressive dissolution of the Si walls at the surface. This result is consistent with the outcomes reported in [4, 17, 18]. Furthermore, it is obvious that the Ag layer is mostly covered the surface of sample in Fig. 1(a). To explore the variations in the surface structure of PS, analysis of samples was accomplished using EDX which is often attached to FESEM system. The EDX spectra of samples with element composition of Ag film are shown in Fig. 2. As can be seen, the surface composition of PS is altered due to the presence of Ag over its surface. There is insignificant variation in Si and Ag composition of the samples prepared for 30 and 45 min. However, the Ag percentage is slightly decreased that is followed by an increase in Si percentage for the sample prepared for 60 min.

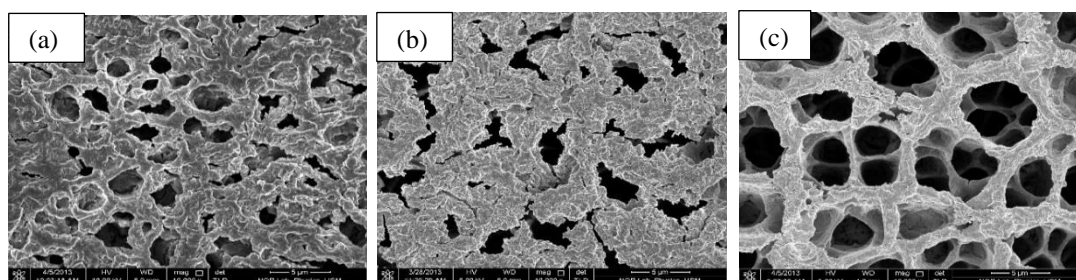


Figure 4. FESEM images of Ag/PS fabricated for: (a) 30 min, (b) 45 min and (c) 60 min.

Figure 3 shows the XRD patterns of the samples. It is obvious that the Ag atoms are coordinate on the PS surface for all samples. The Ag diffraction peaks are at Bragg angle (2θ) of 38.09° , 44.20° , 64.55° , and 77.35° , respectively. The presence of these peaks in the spectra specifies the crystallinity of the material after passivation. Besides, with increasing the etching time, an increase in the intensity peaks of Ag and lower intensity for Si peak can be observed, which indicates the improved crystalline features of the deposited Ag on the PS surface [19].

Figure 4 shows the reflectance spectra of the PS samples in the wavelength range of 200-1000 nm. As can be seen, the Ag/PS prepared for 30 min has higher reflectivity value compared to the other samples. The reduction of the reflectivity is due to the enhanced scattering and light absorption in the porous and bulk interfaces [20, 21] which is an important parameter to enhance the photoconversion process for some devices. Moreover, due to the different pore sizes (Fig. 1), some silver particles penetrate the pores (Fig. 1(c)) and others decorate the PS surface (Fig. 1(a) and (b)). The increase in the

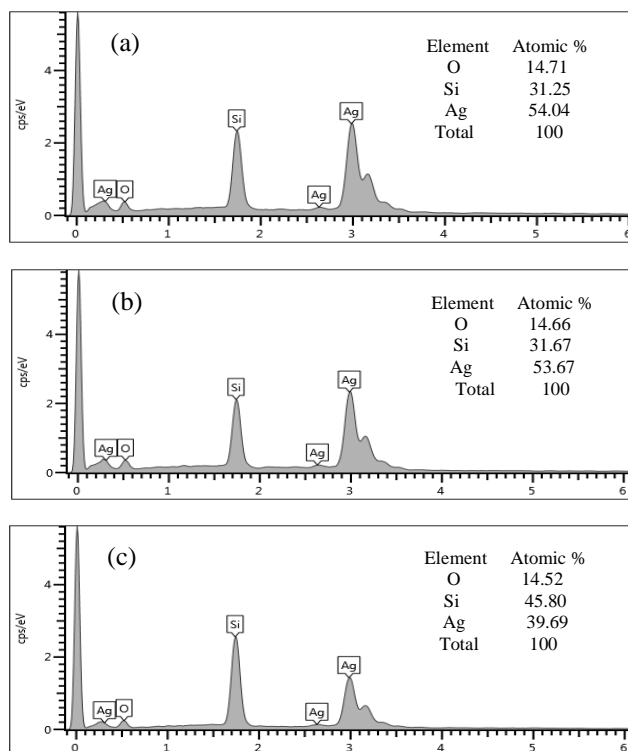


Figure 5. EDX spectra of Ag/PS fabricated for: (a) 30 min, (b) 45 min and (c) 60 min.

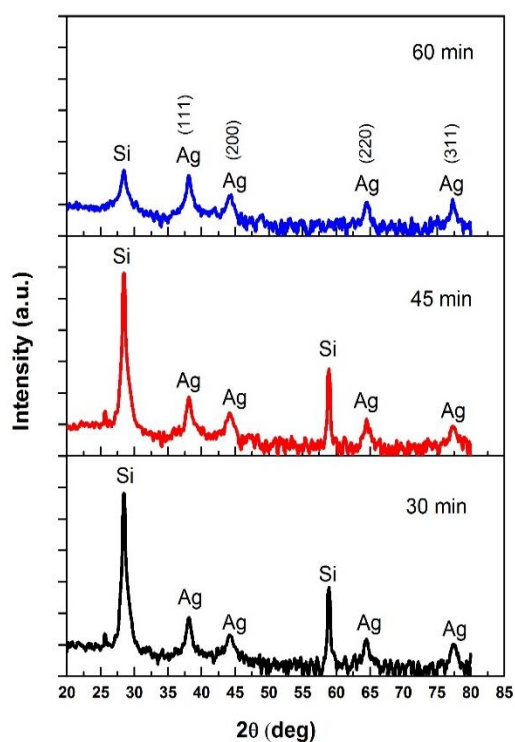


Figure 6. XRD spectra of Ag/PS prepared for different etching time.

reflectivity at higher wavelengths is probably due to the random distribution of the pores and increasing the roughness. It is obvious that with increasing the etching time, the pores density increases and hence the reflectivity reduces. Moreover, the bands of spectra are corresponding to plasmon resonances related to the absorption/scattering process of the coated Ag. Obviously, the SPR band for the samples mostly located at 353 nm and the intensity of the SPR band of Ag/PS prepared for 30 min is higher than that of other samples. This appoints that a greater SERS activity of the corresponding sample jumping together with the conclusion made after the structural study of the samples. The observed behaviour of the SPR bands can be explained

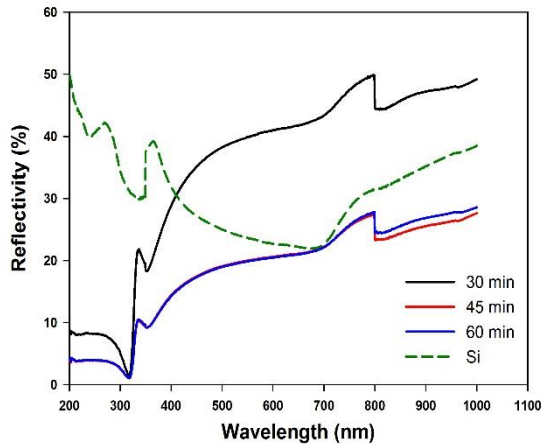


Figure 7. Reflectivity spectra of Ag/PS samples treated for different etching time.

by the gradual increase of the Ag nanoparticles dimensions during their growth and the effect of the interparticle plasmonic coupling [6].

An excitation source of xenon (Xe) light with wavelength of 450 nm was used to measure the PL spectra of the samples at RT as plotted in Fig. 5. The treated samples display a significant improvement of PL intensity centred at 605.5 ± 0.5 nm with $E_g \sim 2.04$ eV ($E_g = 1.17$ eV for bulk Si). It is clear that the PL intensity declined with increasing the etching time and the main

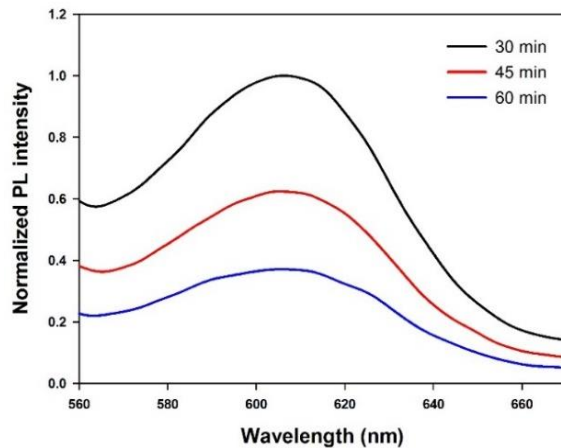


Figure 8. PL spectra of Ag/PS samples treated for different etching time.

peak of PL in Ag/PS structures remains at the same position (605.5 ± 0.5 nm). The PL intensity is proportional to the number of photons emitted by the surface of PS. The increase in PL intensity can be explained by the change in the structure from Si-H bonds to Si-O-Ag and Si-Ag which saturate dangling bonds that could increase the PL intensity. The highest intensity of the sample treated for 30 min could be due to the Ag particles passivated a majority of dangling bonds located on the surface. The reduction in the PL intensity for other samples may be attributed to the increase in the pore sizes which causes the penetration of Ag particles into micropores of silicon more than deposition on the surface. This behaviour can be explained in terms of the increase of layer macroporosity, which strongly reduces the amount of the light emitting nanocrystallites [22]. Fig. 1(c) validates this explanation as it shows a higher macroporosity of the sample and bigger macropore diameter. Table 1 summarizes that the peak of PL intensity is relatively higher for sample prepared for 30 min compared to other samples. It can also be deduced from Table 1 that the PL intensity of Ag/PS samples increases, which is attributed to the enhancement of SPR effect of Ag nanolayer that leads to an improvement on both PL and reflectivity [23-25].

Table 2. Maximum intensity of PL and reflectivity with peak wavelength of the samples.

Etching time (min)	Max PL intensity (a.u.)	Reflectivity at max PL (R%)	Peak wavelength (nm)
30	193.11	41.05	606
45	120.44	20.64	605
60	71.62	20.51	605.5

Conclusion

This study aimed to describe the characterizations of porous silicon layer developed by using the electrochemical etching method for different etching time and passivated by ultra-thin silver film (10 nm) using the RF-sputtering technique. The structural and optical characteristics of the samples were investigated. The analysis of FESEM, EDX and XRD measurements showed that the structural properties of Ag/PS samples were enhanced, as confirmed by the presence and coordination of Ag on the PS surface. In addition, the optical properties of Ag/PS prepared for 30 min were improved as indicated by the augmentation of reflectivity and photoluminescence of this sample. The highest PL intensity of the sample treated for 30 min could be attributable to the Ag particles passivated a majority of dangling bonds that located on the surface and reduction of the macroporosity layer. The modification and enhancement on the structural and optical properties of the Ag/PS is a result of Ag high electrical conductivity and the presence of surface plasmons resonance. The improvement on the PL intensity of Ag/PS will enhance the performance of optoelectronic devices developed by porous silicon.

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Acknowledgments

The authors would like to thank School of Physics, Universiti Sains Malaysia (USM) for supporting this research and they are grateful to the RCMO USM with grant (304.PFIZIK.6316276).



DESIGN AND IMPLEMENTATION OF WASHING-FILLING-CAPPING MACHINE FOR SMALL-SCALE REVERSE OSMOSIS WATER INDUSTRY

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Abstract. *This paper discusses the design and development of a semi-automated washing, filling and capping machine for 5-gallon bottle used by local reverse osmosis water (RO) refilling supplier. The problem facing by the local supplier is low production capability of RO water as the washing to capping processes were done manually, which were time and energy consuming. This manual procedure also caused back pain and fatigue to the staff. The objective is to design and develop a semi-automated machine (3-in-1 machine) which involves a washing-rinsing module to clean the external and internal of three 5-gallon-bottles simultaneously, a RO water filling module and a bottle capping module. The effluent of filtered RO water is collected and used as the source water for bottle washing-rinsing process. This helps to optimize the water usage. The results show that the productivity of supply has improved. The production per hour has increased by 52.3%. The production cost per unit of bottle has reduced by 28%. The new machine has successfully operated, improving the productivity and ergonomically designed to minimize physical discomfort to the staffs.*

Introduction

In reverse osmosis (RO) water refilling and packaging industry, various types of machines are used to carry out the step by step process from cleaning to transporting the RO water bottled process. However, some variation in terms of machine is possible depending upon the type of container and operation mechanism used in the industry. Mainly, three parts of machines are used to complete the whole processes of refilling RO water in a bottle: washing machine, filling machine and capping machine. The bottle washer machine is a prominent module out of the



bottle filling and packaging line, and it is used in the beginning of the processes. The bottle washer machine's functionality will differ depending on the type of container used [1].

Firs Tech Enterprise is one of the fast-growing companies in Terengganu, Malaysia that has been supplying bottled reverse osmosis (RO) water under their own brand; 'Neutragize'. With fifteen years of experience, their core business has been focusing on providing reversed osmosis (RO) water to local customers such as Tenaga Nasional Berhad (TNB), Kerteh Terminal Sdn Bhd (KTSB), Universiti Malaysia Pahang (UMP) and residential areas near Dungun, Paka, Kemaman and Kuala Terengganu. The bottled water is packaged using a cylindrical-shaped five-gallon polycarbonate transparent container. In current practice, empty bottles are collected and replaced with filled bottles, which will go back and forth between the company's refilling station and their customers.

In Firs Tech Enterprise, the existing washing process is 100% being done manually by an operator in an area of 3.0 m². However, before the washing process is executed, the collected bottles are required to undergo a screening or sorting process to segregate which bottle could be reused and which could be terminated due to excessive dirt or stain stick on the surface of the bottle. Sometimes, if the bottle no longer represents its original shape or look, i.e. an obvious dent or scratch on any part of the bottle including the cap, it can also be discarded in order to meet the customer's satisfaction. Figure 1 shows the flowchart of current practice of washing-filling-capping process.

During the washing process, the bottle is washed inside and out to prevent any contamination that can affect the quality of RO water. Currently, the process is manually performed whereby the operator must hold the bottle with one hand while the other hand is used to wash and rinse inside and out of the bottle. The clean-up process is done whereby the operator scrubbed the outer wall of the bottle using heavy duty sponge and liquid detergent to remove dirt, sand, grease or soil that stick on it. On the other hand, no liquid detergent is used while washing the inner bottle. An amount of running water is used to rinse the bottle inside out. Water is sprayed inside the bottle, and the bottle is shaken vigorously to let any slime detached from the inner part of the bottle. The residue is removed by positioning the bottle mouth in downwards position. The cleaned bottle is now ready to be refilled with RO water.

Currently, the refilling process is carried out using a handheld hose to convey the RO water from a RO water tank to the bottle. This practice is manually done in which the operator needs to open and close the hand valve to refill the RO water in the bottle which being placed on the floor. The bottle is then manually capped using a conventional capping tool and lifted by the operator to the stock area.

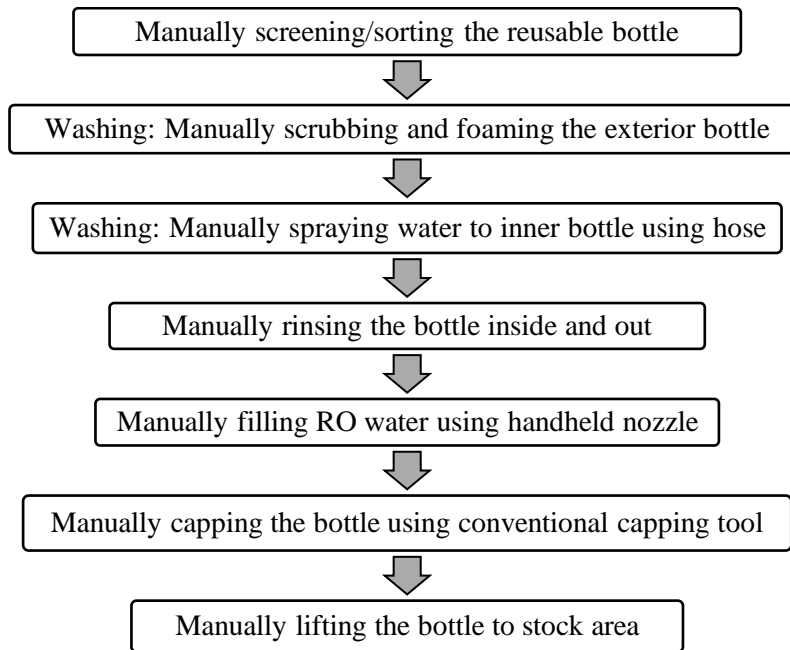


Figure 1. Flowchart of current practice of washing-filling-capping process

Based on the existing practices, the operators have suffered very much from lower back pain as they must complete the whole processes for approximately one hundred bottles daily using their limited energy. It is no doubt that the pain experienced has caused the employee discomfort. It has caused exhaustion among the operators thus reduced the company's efficiency.

To date, there is no standard bottle cleaning procedure existed in Malaysia. Each vendor practices his own cleaning method or process that they themselves considered as effective and easy to execute. However, it was learned that there are several industrial-scale bottle washer machines commercially available in the market. For instance, Norland International's BWF60 and Triton 450 machines are capable of cleaning three to five containers simultaneously and can also tolerate bottles or containers of distinct sizes [2]. In addition, the standard bottle washer machines used in the beverage industry on a big scale are much more complex in mechanical and control elements and expensive for the beverage industry on a small scale. The large-scale bottle washer machine has a capacity of 10,000 to 150,000 bottles per hour [3]. However, such machines are only suitable for large enterprise, space consuming and not suitable for small scale RO water enterprise.

Nonetheless, there were a few studies that have been conducted to design and develop innovated bottle washer machines for either big or small-scale drinking water industries which purposely custom-made for a specific producer. Fakriza et al. [4] has designed an improvised automated gallon washing machine to minimize musculoskeletal disorder (MSDs) in CV Barokah Abadi using ergonomic function deployment (EFD) approach. Patel et al. [5] has put an added value to a bottle washer machine by developing PLC based process loop control for the machine. In addition, Gajjar et al. [1] has successfully designed and developed a bottle washer machine for Returnable Glass Bottle (RGBs) using Creo Software, embedding it with PLC controller and programmed it with ladder diagram in the SIMATIC Manager. All innovated machines listed have resulted in significant improvements to their client's factory productivity. Thus, this project aims to design and develop a modular, five-gallon cleaning

machine that can be used in much smaller space aligned with Firstech Enterprise’s expectation which is to increase their productivity and serve ergonomically designed machine.

Research Methodology

The semi-automated machine comprises of three parts which are process part, electrical part and mechanical part. The design and improvising process are described in the next section. Further design is performed by adding ergonomic elements to the concept of design by considering the worker's comfort, security and health. In applying ergonomics elements to the original idea of the entire method, existing working circumstances are also assessed as a reference [3]. In the hope of reducing the risk of back pain in employees, the addition of ergonomics elements is performed.

Process flow chart

Figure 2 shows an improvised flowchart of washing-filling-capping process that has been designed and implemented in Firstech Enterprise. Semi-automated washing machine has been developed to replace the previous manual washing process. The developed machine kept the bottle to rotate with the bottle mouth in a downward position during the cleaning process. It cleaned three empty bottles simultaneously whereby the exterior part of the bottles are scrubbed by heavy duty brush and foamed with liquid detergent. While for interior part, water is sprayed all over the inner wall by using the sprinkler nozzle. The rinsing process took place at the same time. The other processes; filling and capping were still being done manually but a few necessary instruments have been invented to ease these processes.

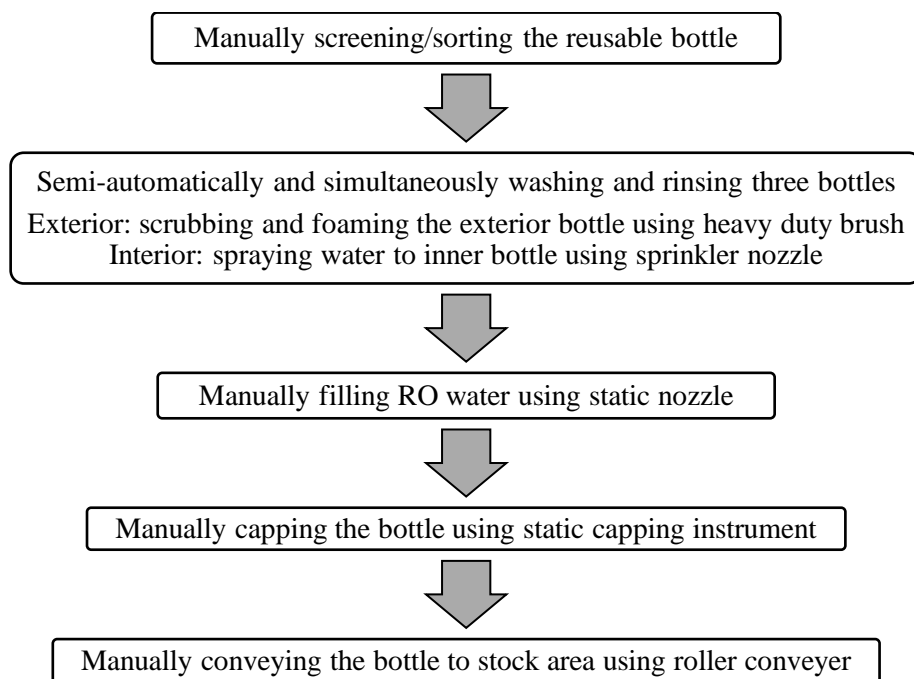


Figure 2. Improvised flowchart of washing-filling-capping process

Electrical parts

The project uses four-single phase AC motor. Two of the motors were used to generate pressurized water up to 10 MPa to clean the inner surface of the bottle through a customized spray nozzle designed to remove stains and dirt. Another pressure washer is employed in a

detergent injection mechanism to enhance the cleaning action for the outer surface of the bottle which usually tarnished with oil, sand and dirt. In order to optimize the cleaning action, the rotating mechanism is designed so that the bottle will rotate during the process. This is accomplished by placing another AC motor with gear mechanism to hold the bottle and rotate them simultaneously. The summary of the electrical parts used in the project is tabulated in **Table 1**.

Table 1. Electrical Components Used in The Proposed Machine

No	Item	Quantity	Specification
1	AC Motor	1	Bottle rotating mechanism
2	Centrifugal Pump	1	Outer surface cleaning
3	Pressure washer	1	Inner surface cleaning
4	Pressure washer	1	Detergent injection mechanism

Figure 3 illustrates an electromechanical relay logic diagram designed for the project. It consists of a master switch (Enable), to enable the whole system, a start push button (Start PB), a stop push button (Stop PB), a control relay (C1), a timer (TD1) and four motors (M1-M4). The machine can only be activated if the enable switch is in active position. When the start button (Start PB) is pressed, control relay coil, C1 will be energized and will activate all C1 contacts. As a result, TD1, M1, M2, M3 will be activated. When the desired operation time is achieved, TD1 contact will break the active connection to M1, M2 and M3 and will stop the washing operation. If the operator wishes to use detergent to enhance the cleaning process, a detergent switch is also provided and can be triggered at any moment during the operation. Besides, Stop PB can also be used if the operator wishes to stop all operations even though the desired cleaning time has yet to be achieved. It will also serve as the emergency stop button shall any undesired event occurred during the operation.

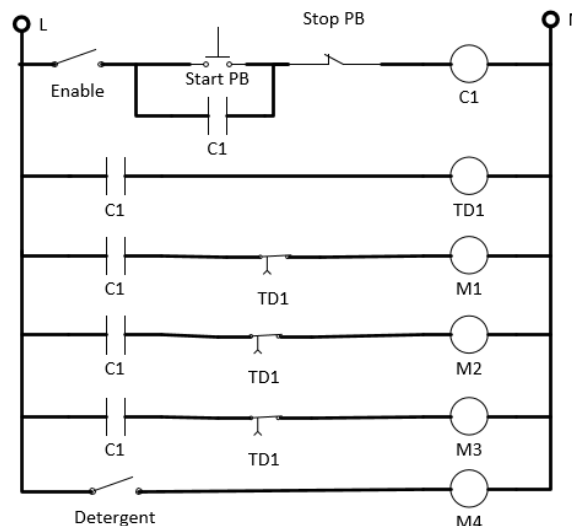


Figure 3. An Electromechanical Relay Logic Diagram

Mechanical Parts

Figure 4 illustrates the mechanical design of semi-automated washing machine. The module consists of three compartments to wash and rinse three bottles simultaneously. Every compartment uses the same washing and rinsing method. The bottle is placed in downward position and the moving holder that grips the bottle mouth will keep the bottles to rotate continuously when the cleaning process takes place. The static heavy-duty brushes used to

scrub the bottles are placed in three positions; attached to the lid which used to wash the bottom part of the bottle, at the middle of the washer which used to scrub the middle part of each bottle, while the other one is located at the neck of the bottle. There is a sprinkler nozzle at every compartment that functions to spray inside of each bottle while it is rotating.

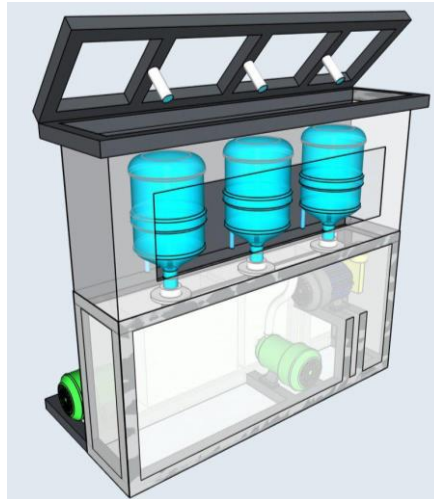


Figure 4. Semi-automatic Washing Machine

Figure 5 illustrates the design of filling module in which the hand valves are opened and closed manually. Previously, the process is conducted handheld while the bottles are placed on the floor. Now, it is ergonomically performed on a bench to avoid uncomfortable posture hence any discomfort on the body of operators such that back pain.

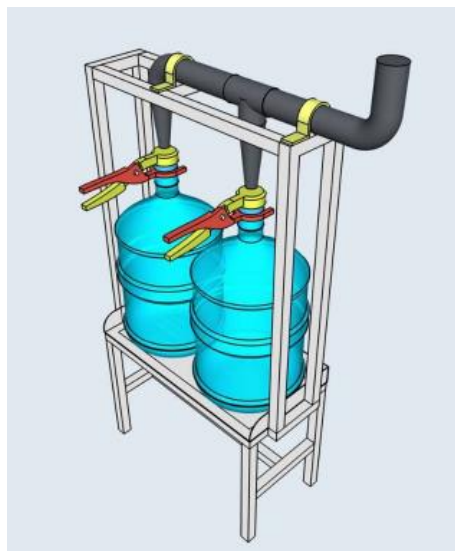
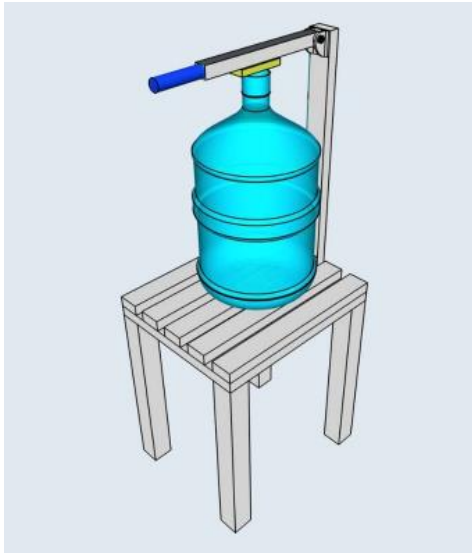
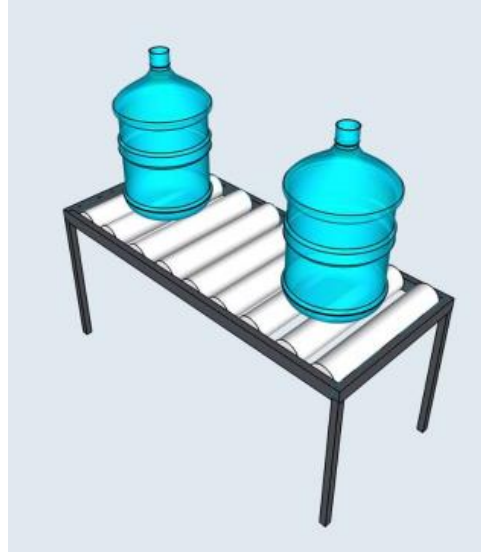


Figure 5. Filling Module

Figure 6a shows the capping module which is handled manually using a fulcrum capper. The bottle is capped on a bench after being delivered by the rolling conveyor from filling module. Previously, the process is conducted on the floor whereby the operators manually pounded the cap onto the lid of the bottle using capping hammer. **Figure 6b** illustrates the design of a roller conveyor to convey filled bottles from filling module to capping module and stock area in sequence.



(a)



(b)

Figure 6. (a) Capping Module (b) Roller conveyer

Result and Discussion

This chapter will discuss and analyse the results obtained from the project done in the previous chapter. The analysis of data is important to evaluate the success of the project. **Table 2** shows several tests that have been conducted to evaluate the functionality of the washing machine parts. Most of the features on the machine demonstrated an operative function thus remarked as “Fully functional”. On the other hand, a few features which have shown unsatisfactory functions were further repaired to improve the operation.

Table 2. Functional Test on Washing Machine

No.	Features	Description	Remarks
1.	Start and Stop button	Machine starts to operate when start button is pressed and maintained on operating condition until stop button is pressed	Fully functional
2.	Wash timer	Timer can be set within 1-30 minutes and will deactivate all operation when desired time is achieved	Fully functional. The time must be set depending on the level of dirtiness of the bottle
3.	Pressure washer	Pressurized water is injected to clean the inner surface of the bottle	The water pressure was unsatisfactory
4.	Bottle rotation	The bottles will rotate during the cleaning process	Some bottle fails to rotate during test due to uneven size of the bottle
5.	Detergent injector	When the detergent switch is activated, detergent will be injected to the bottle	Fully functional
6.	Exterior sprayer	Water will be sprayed to the outer surface of the bottle	Fully functional
7.	Lid safety switch	If the machine lid is open, the machine will not operate	Fully functional

Table 3 shows an estimated process cycle time took for to complete washing-filling-capping processes. The effluent of filtered RO water is initially collected and used as the source water for bottle washing-rinsing process. Three empty bottles have been washed and rinsed simultaneously in the washing machine which the set timer was 30 seconds. After the washing-rinsing process, the bottles were filled with RO water and being capped using capping instrument. Two filling nozzles and one capping instrument were located side by side in the process line. The capping instrument is connected to a long roller conveyer which used to transfer the refilled RO water to stock area. The estimated total cycle time to complete the whole processes is about 140 seconds.

Table 4 shows a summarization of productivity gain measurement before and after the project is executed. Based on the table, it shows that the production cost per bottle has decreased by 28.0% from RM0.25 per bottle to RM0.18 per bottle. The production per hour has increased

by 52.3% from 19 bottles to 29 bottles. Regarding the customer's satisfaction, the delivery accuracy has increased by 25% from 80% to 100%. Overall, the project has demonstrated improvement to the company's productivity.

Table 3. Estimated Process Cycle Time

No.	Sub-process	Process cycle time (s)
Cleaning	1 Open machine lid	3
	2 Fix the first bottle	5
	3 Fix the second bottle	5
	4 Fix the third bottle	5
	5 Close and lock machine lid	2
	6 Switch on enable button	1
	7 Press start button	1
	8 Cleaning process	
	a. Rinsing	
	b. Detergent	30
	c. Brushing and rotating	
	9 Open machine lid	3
10 Unload first bottle	2	
11 Unload second bottle	2	
12 Unload third bottle	2	
<i>Estimated total cycle time for cleaning process for three bottles</i>		61
Filling	13 Fix the first bottle at the filling station	3
	14 Fix the second bottle at the filling station	3
	15 Press the fill start button	1
	16 Filling process	60
	17 Press the fill stop button	1
<i>Estimated total cycle time for filling process for two bottles</i>		68
Capping	18 Bottle transfer to capping station	4
	19 Capping	2
	20 Bottle transfer to pallet – stock area	5
<i>Estimated total cycle time capping process for a bottle</i>		11
<i>Estimated total cycle time to complete whole processes (seconds)</i>		140 seconds

Table 4. Productivity Gain Measurement

Metric	Before Project	After Project	Improvement %
a. Revenue improvement			
Total Sales (RM)	6,309	9,800	+ 35.6%
Number of staff (pax)	2	2	-
Production cost per bottle (RM)	0.25/bottle	0.18/bottle	+ 28.0%
b. Production/process cycle-time improvement			
Process Simplification (No. of process)	3	3	-
Reject Rate (%)	20%	10%	+50.0%

Average time to complete process (seconds/bottle)	183 seconds/bottle	123 seconds/bottle	+32.8%
Production per hour (bottle)	19 bottles/hour	29 bottles/hour	+52.3%
c. Customer satisfaction			
Number of complaints received within the measurement period	0	0	-
Accurate Delivery (%)	80%	100%	+25.0%

Conclusion

The main points concluded from this research work can be summarized as follows:

1. The semi-automated of washing-filling-capping machine for Firstech Enterprise has successfully designed and implemented.
2. The total sales of Firstech has increased as much as 35.6% after the implementation of the new machines in the refilling station.
3. The production cost per bottle has decreased by 28.0% which from RM0.25 per bottle to RM0.18 per bottle.
4. This existing of new washing-filling-capping module in Firstech Enterprise has increased the productivity of RO water bottle by 52.3% which from 19 bottles per hour to 29 bottles per hour.
5. The new machine has been designed ergonomically for operator's comfort and safety.

Acknowledgments

The researchers are grateful to Kementerian Pendidikan Tinggi Malaysia for providing the Grant of Private-Public Research Network (2018-2019). Great thanks are extended to Firstech Enterprise for the great collaboration and commitment throughout this project.

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IOT-ENABLED ELECTRIC SOCKET TEST BED UTILIZING IFTTT AND NODE-RED

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Abstract: *Electrical socket outlet can sometimes be difficult to reach especially for people with limited ability or elderly if the location is under the table, behind the furniture or anywhere that requires physical movement. Other than that, most users have the tendency to forget to switch off the power outlet that can cause overcharging, overuse of electricity and can also lead to destructive burning. This project focused on the development of an IoT-enabled electric socket test bed utilizing recent IFTTT modules and node-red flows so that multiple digital services such as voice detection component of Amazon Alexa, Google Assistant, telegram notification and many more can be embedded and tested. The system architecture comprised of a nodeMCU microcontroller embedded with ESP8266 wireless module, Amazon Eco intelligent speaker, a power supply, several socket outlets, graphical interface and middleware based on Blynk, IFTTT and node-red. User interaction with the system can be established through both mobile apps and voice command recognition so that they can easily control common household appliances such as turning it on or off with minimal exertion. Even though the project are still at its early stage of development, test results indicated that the proposed system can be operated with full functionality and there is much room for improvement especially on the voice activation and security asp*

Keywords: *Intelligent system, Blynk, cloud based, nodeMCU, Arduino*

Introduction

The development of smart devices has seen a tremendous rise in recent years. The advancement of Internet of Things (IoT) technology enables interconnection between human and almost every digital devices around us. Future homes are expected to be equipped with IoT-enabled devices in which can be monitored and controlled via wireless communication over the internet. Being able to use smart technology will certainly help to enhance the quality of living for every citizen especially those with physical disabilities and seniors. For example, previous work by [1] aimed to provide a smart home system for elderlies and disabled that integrate Kinect module for gesture detection to control electrical appliances. Usability study indicated that the system managed to help the volunteers but was limited to a specific Kinect detection and

coverage area. Besides, any effort to increase the coverage area and to exchange conventional appliances with a smarter device can be costly.

Alternatively, smart socket has been receiving much attention by many researcher as it can be used to intelligently control ordinary equipment without any expensive modification. Previous work contributed by [2] and [3] presented the development of smart plug solution based on Bluetooth Low Energy (BLE) with User Interface (UI) provided for smartphone user. The plug will establish direct Bluetooth link to the user's smartphone to control the proposed socket from a distance without any additional gateway or internet connection required. Authors in [4] and [5] attempted to design a smart plug that can be controlled via phone from any location by employing cloud service in addition to existing Wi-Fi link. However, it can only support a single load which might cause inconvenient if multiple electric equipment is concerned. Nguyen et al. [6] and Al-Hassan et al. [7] proposed to integrate multiple socket outlets interconnected within the same wireless network with the capability to recognize the type of electrical appliances being plugged in. Aiming for a better energy management features, voltage and current measurement was also embedded. However, the proposed product was relatively bulky due to various sensor inclusion and lacking in the aspect of prompt notification via phone or email. Meanwhile, Lin et al. [8] proposed MorSocket to control more than one socket outlet as opposed to single-socket control that are commercially available and capable to automatically alter the socket output based on its embedded sensor data. In addition, cheaper alternative solution has also been identified and reported [9][10]. Galioto et al. [10] raised up some concern about energy balancing between production and demand in which energy demand tend to be more variable and less controllable. Thus the implementation of smart, interconnected plug will enable real-time data measurement from domestic houses that will help to produce better domestic load control mechanism. Other than that, intelligent smart plug with shared knowledge capabilities has also been presented in [11]. The plug was set to learn user behavior using Neural Network so that it can create electrical usage forecasting for better energy management.

In this paper, a smart plug with multiple activation and monitoring strategy is proposed and presented. It involves the incorporation of voice command which was also reported in [12][13], text command via telegram, android or iOS application and also web interface for electrical usage monitoring.

Methodology

System block diagram

Figure 1 represents the block diagram of the proposed system. The project utilized NodeMCU as its core processor. Voice command will be captured and interpreted via intelligent speaker system known as Amazon Eco that employs digital assistant named ALEXA with the capability of understanding simple human conversation. Each voice command or instruction given will be evaluated and compared with the conditional instructions set through "If This than That" (IFTTT) module, a free web-based service that has the capacity to provide chains of simple conditional statements to trigger specific events such as sending notification through email, telegram, alarm system and so on. Once triggered, it will update the control signal through Blynk server which will be responsible to establish communication between smartphone apps and connected hardware. Socket activation can also be done through telegram and Blynk apps. Node-red was employed to listen to virtual port within the Blynk server and log the socket activation activity for further analysis and monitoring purpose.

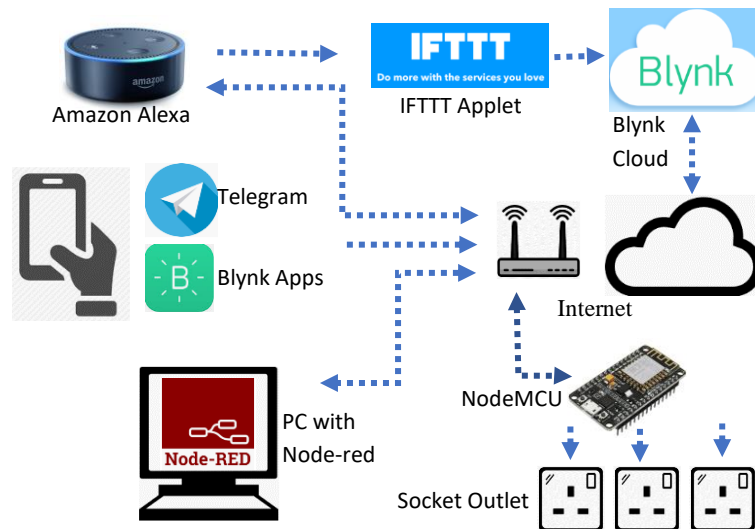


Figure 1. Block diagram of the proposed system

NodeMCU

NodeMCU is a microcontroller specifically designed for IoT application and has been widely used by many[14][15]. It is embedded with ESP8266 WiFi module, GPIOs, PWM, I2C and ADC all in a single board. In this project, two GPIOs were used and were connected to two electrical relays. ESP8266 can be connected to WiFi module which credentials such as SSID and password needed to be set within the program code prior to the deployment. In line-of-sight (LOS) condition, nodeMCU can be deployed within 300m radius from the WiFi assess point. Meanwhile, in indoor situation, its effective range will depends on the type of walls or building materials at the location that might cause difficulty for the radio signal to pass through. Like many other microcontroller, NodeMCU requires 5VDC supply as its main power source. Thus, an AC to DC converter was also used to convert the 240VAC source to a 5 VDC to power up the NodeMCU in this project.

Blynk

Blynk platform plays an important role for the proposed project. It was designed specifically for IoT application and can be used to control and read input and output modules remotely[16]. Blynk consist of three main components including the Blynk App, Blynk Server and Blynk Library. Using the Blynk App, a unique identifier or auth token was created for the project which can be used to link all the hardware connection at the nodeMCU board to the smartphone. Once linked, it can control any I/O pin on the nodeMCU hardware directly and any data from the microcontroller can also be sent to the apps. Meanwhile, any changes on the project I/O data was also being stored and synced at Blynk server that can be retrieved if the internet connection was interrupted or reset. Besides, Blynk platform also comes with a comprehensive libraries to support most of the popular embedded hardware such as Arduino, NodeMCU, and Raspberry Pi, to enable communication with the server and process all incoming and out coming commands.

If This, Than That (IFTTT)

IFTTT (If This, Than That) is an online platform that enable interconnection between various digital services available across the internet such as Google, e-mail, Amazon, smart phones, smart devices online shopping apps, credit cards and much more [17]. This platform was used

for this project as it allows the adoption of voice recognition services provided through Amazon Alexa application. To set up the IFTTT service, user need to specify the ‘condition’, which represented by the term ‘IF’ and the ‘consequence’, which represented by the term “than that”. For example, if the condition is set to detect someone saying “hey Alexa, find my phone”, than, a triggering action can be set such as ringing the phone out loud or obtaining the GPS location of the phone. In this paper, an applet was developed to activate each relay and another applet was constructed to deactivate them. Figure 2 shows the IFTTT applet developed for this project.

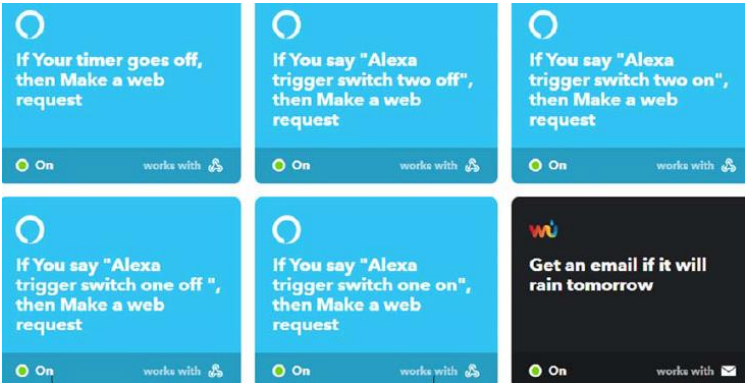


Figure 2. Some of IFTTT applet developed for the project

Node-red

Node-red is a visual programming tools design by IBM to help IoT developers to ease the implementation of complex tasks such as HTTP request, sending notification through email, SMS or telegram, storing and also loading data [18]. With Node-red, one can easily upgrade the features of the project without any hardware or code modification. In this project, Node-red was deployed to listen to events from Blynk server linked to this project so that additional data logging can be made. By doing so, it is possible for user to keep track their daily household load activities for certain period of time. Figure 3 depicts a sample of node-red flow used to monitor the status of the socket. Based on the flow, if the socket is activated, it the user interface shown in figure 4 will be updated.

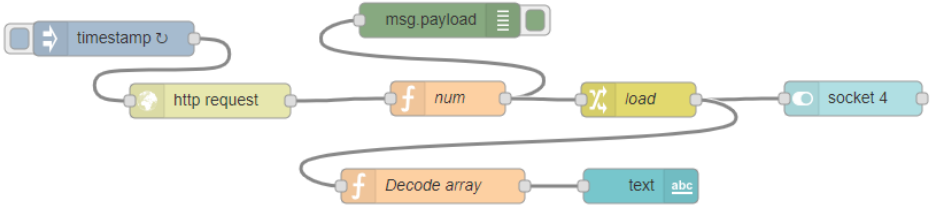


Figure 3. Node-red flow used to update socket status via web interface

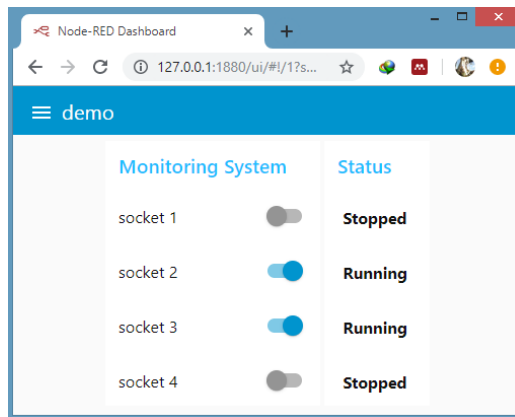


Figure 4. Dashboard served as user interface for the project

Relay module

Relay module was used in this project as a switch that will open or close the connection of the live wire at the socket outlet. It consist of a coil that can be energized using 5VDC supply, a normally open (NO) contact, and a normally close (NC) contact. Upon receiving input signal from nodeMCU, the relay coil will be energized and the contact will switch position from NO position to NC position and vice versa as the result of electromagnetic force generated around the coil. In order to hold the contact position, the coil need to be energized continuously and if the power is cut, the contact will automatically return to its initial position. In this project, each contact used for the socket outlet can sustain up to 10Amps of AC current rated at 240VAC. Consequently, each socket outlet developed in this project will be able to support electrical loads that are rated below 2000watt of power. Among them are smart TV, computer, table fan, phone charger, small rice cooker, radio and much more.

Functionality test

Figure 5 illustrates the experiment setup to test the functionality of the proposed smart socket. The test consist of three experiments as described in the following section.



Figure 5. Experimental setup

Experiment 1: Voice activation

During this test, a specific voice command set for the project was used. For example, use can say “Alexa, trigger switch 1” in order to activate the load connected to the first socket. Three different users were also selected to give the voice command in order to test Alexa’s capability to cope with different English accent. For security reason, Alexa can also be set to respond to voice command from certain user only.

Experiment 2: Activation using Blynk Apps

The second test utilized the Blynk application installed on an iOS device to activate the load attached to the second socket outlet. A table fan was used as a load during this test. A customized button widget representing the socket's activation switch was pressed by the user to activate the table fan as shown in figure 6.

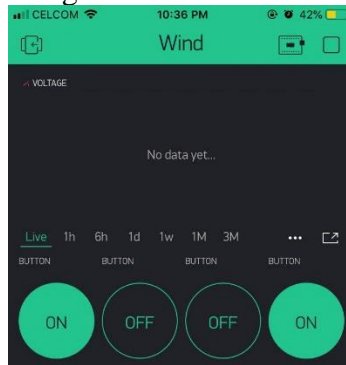


Figure 6. Blynk Apps with custom switch widget for socket activation

Experiment 3: Activation via Telegram apps

During this procedure, a text such as '/status' was sent using telegram apps and the system responded by providing the information of all the available socket outlet. If given text was '/switch1ON', then the system will respond by enabling socket outlet number 1. Figure 7 depicts the use of Telegram Apps to check the activation status of the connected socket outlet.



Figure 7. Socket outlet status monitoring via Telegram apps

Results

Functionality test

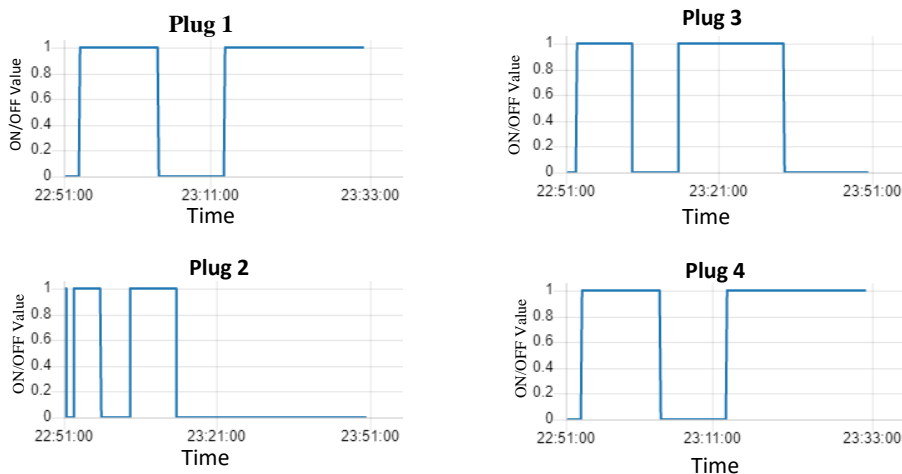
Table 1 presents the results of the functionality tests described in the previous section. It is clear that the proposed socket is ready to be used with full functionality. Alexa managed to interpret voice command given from user and update Blynk virtual port through the IFTTT service. However the effectiveness of the voice detection might vary depending on the user's distance from the smart speaker. Still, the proposed smart socket manage to offer several alternative such as using Telegram text or smart phone application in order to control the attached electrical appliances.

Table 1 Functionality test

No	Functions	Result
1.	Voice command detection	PASS
2.	Socket activation via voice command	PASS
3.	Socket activation via Blynk Apps	PASS
4.	Socket activation via Telegram Apps	PASS
5	Web interface	Operational

Plug usage monitoring system

In addition to web-based socket activation status display, user can also keep track of their socket activity so that they were more aware of their electrical usage. Figure 8 illustrates the sample of real-time data for the socket activity within one hour. Based on the graph, value ‘0’ indicated that the plug was OFF while value ‘1’ indicated that it was turned ON.

**Figure 8.** Socket outlet activity log via web interface

Conclusions

In this paper, a smart socket with multiple activation method was presented and discussed. Results indicated that it can be operated with full functionality and ready to be used. Future research might integrate the existing setup with the ability to provide real time electricity bill estimation as presented in [19] and utilize machine learning method for better energy management and utilization.

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VISUAL SLOPE INSPECTION USING UNMANNED AERIAL VEHICLE (UAV)

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Abstract. Nowadays the natural slope cuts for the purpose of the construction of public transport is ubiquitous in Malaysia. These cuts cause the changes of the natural slope structure thus make the slope structure become unstable and causes to rubble. In order to avoid the slope's failure, the monitoring work on slope should be carried out by the responsible party to ensure that the slopes are in good condition and the advance warning can be issued before the occurrence of the rubble. Conventional method of slope monitoring is extremely high risk. Usually, maintenance personnel will climb up to the top of the slope to take pictures for the purpose of monitoring reports [1]. Slope monitoring activities are also limited as climbing steep slope structures require a lot of energy and takes quite a while. Therefore, this research aims to explore the ability of the micro UAV aircraft usage in order to monitor the slope condition. The aim of study is to monitor the high risk slope using UAV. To achieve the aim, the following objectives are formulated by produce orthomosaic image, Digital Terrain Model (DTM) and Digital Surface Model (DSM) using pix4d mapper software, analysis the image of drainage system taken by UAV and developed contour of the slopes and analyse watershed of the slope using global mapper software. In this paper, the drainage on the slope becomes the focus since its plays an important role as it reduces the existence of groundwater and to transport the rainwater pours on slope surface. The study was conducted at two places where first at Kuala Pilah Federal Route 361 and second at Jalan Bangi Selangor State Route B17. The processes involved were planning and preparation before flight, data retrieval using UAV aircraft, image processing using Pix4dmapper software and assessment of the slope using Global Mapper software. Subsequently, the slope condition can be determine based on the monitoring of the slope drainage. Through this study, the condition of slope surface can be seen by images taken from UAV such as cracking on slope structure and excessive vegetation growth in slope drainage. Besides that, the slope inclination, height and water flows on surface can be known. Therefore, the usage of UAV aircraft for slope monitoring and inspection was successfully and the aims of this paper was achieved since the device shows a very good tendency and the ability to monitor the slope condition.

Introduction

In Malaysia, there are many man-made slopes where the slope is cut for the construction of infrastructure and the construction of man-made slopes if not carefully monitored will result in landslide occurred. Slope failure typically exists when there is heavy rain where it will decrease soil shear strength as well as increase the stress in the ground as the result of its water conditions in the soil [2]. This issue can have a great impact on the surrounding such as safety of life and property and public morals issues.

In this study, the slope drainage will be focus. Slope drainage is important in maintaining slope stability. The present of groundwater in slopes is never good as it destabilizes the slope by adding weight, destroying cohesion between grains, and reducing friction. When water takes the place of air between the grains of soil, it will most likely increase the probability of downslope mass movement and lead to slope failures as the earth in slopes become a lot heavier [3].

In conventional monitoring method, a professional surveyors is require to conduct the survey in the study area and it is not practical for large areas because it would involve a lot of labor, a huge cost and time to complete the investigation work [4]. This study will carried out to facilitate the work of examination slope surface structure by using a micro UAV technology. This method is an alternative for acquiring the image and video quality for the inspection and monitoring of the slope. It also can reduce the risk of slope safety inspectors to conduct inspections in addition to saving energy and working time.

2. Literature review

Unmanned Aerial Vehicle (UAV) is a small, unmanned aircraft programmed for more dynamic flights. In Malaysia, the use of the UAV over the last two decades is aimed at national defence, mapping, monitoring coastal areas and air traffic and remote sensing [5]. The UAV also comes with a camera that offers the possibility to map areas faster and more flexibility than classic aerial photos [6]. Now the use of UAV has been further developed in the field of civil engineering. The UAV became popular for large scale use in low budget mapping [7]. In conclusion, this UAV is a small plane with high resolution cameras combined with a very light platform as one of the data acquisition systems to capture digital images from the air [8].

In this study, the UAV micro aircraft used is DJI Phantom 3 Advance. The UAV is used to retrieve information and slope data visually. The UAV is powered by Sony's 1 / 2.3-inch camera sensor, with a 12-megapixel image resolution allowing for clearer shooting. The aircraft is taken with a failsafe system where the aircraft will return to its original position by itself and immediately land before it runs out of power. It is controlled by a remote-connected remote controller on the plane using Wi-Fi connected to the smartphone that has been installed DJI Phantom 3 Advance software.

In obtaining the data, Pix4Dcapture is an application that turns consumer drone into a professional drone mapping tool. A free companion to Pix4D photogrammetry software, Pix4Dcapture is the perfect tool to automatically capture image data for optimal 3D models and maps. After that, all the data will be processed by using Pix4Dmapper and Global Mapper. Pix4Dmapper is the software that naturally forms the pictures that were taken from the air using Unmanned Aerial Vehicle (UAV) micro aircraft or by using digital camera from the ground. It utilizes technology that takes a shot at the guideline of perceiving the picture content (pixels) so as to make a total 3D model of the subject [9]

Global Mapper is a viewer capable of displaying the Geographic Information System (GIS) raster, elevation, and vector datasets, allowing users to easily view, edit and export their data in multiple formats. The all-in-one GIS application that friendly use. This remarkable

software combines a powerful array of spatial data processing tools with an unmatched list of compatible file formats resulting in a program that no GIS professional or map [10].

Methodology

The methodology study explains how objective is achieved and the scope of the study that has been described based on the methods used throughout the study. Methodology also helps research find out more clearly what is needed and what needs to be done in order to make sure that a survey is conducted through the selection of a particular method. The methodology includes four fundamental stages including flight arranging, UAV preparation, and data collection.

Flight planning

In the planning stage of the flight, the planning must be done first before aviation activities take place. This is to facilitate data retrieval work and to ensure that research works well as well as obtaining accurate information. Some parameters need to be explained during the flight planning stage.

The flight planning be done by determine the pattern of the fly. In this study, grid mission is used as a pattern to capture the image for both slopes. The mission is run by using Pix4Dcapture that have to be install in smartphone. This application will help the flights are run smoothly. The figure 1 show the same pattern of flight which is grid for both slopes at different places. The height of flight need to be set before start the flight mission. The UAV flown from height of 60 metre for slope at Jalan Kuala Pilah and 50 metre for slope at Jalan Bangi. The height is different because of the height of slopes are different.

The grid size is set for slope at Jalan Kuala Pilah is 4000cmx3000cm and 5472cmx3648cm for slope at Jalan Bangi. By using this application, the UAV will flies with consistent speed that is 4m/s for both mission. As a whole, the UAV controlled automatically by Pix4dcapture application. The most important during flight mission is ensure that the Global Positioning System (GPS) of UAV are connected with the smartphone through Pix4dcapture application.



Figure 1. Images of slope with grid mission flight using Pix4Dcapture at location (a) Jalan Kuala Pilah and (b) Jalan Bangi

UAV Preparation

A few things should be checked before flight mission, for example, usefulness of self-sufficient chipset, radio modem, camera mount to hold computerized camera, intensity of battery, electronic speed controller and global situating system. At that point, the operator needs to check the movement sensor of the UAV, for example, lift, rudder and throttle before propelling

it. The equipment used is a set of DJI Phantom 3 Advance model aircraft equipped with a smartphone with a built-in application of this special UAV aircraft.

Data Collection

To obtain the data, only one person can operate the remote control UAV's. The UAV will be flown around the slopes to be used as a study site. When UAV flights are carried out, the altitude of the UAV distance from the slope surface and its speed should be maintained so that the picture can be taken clearly and have greater quality. The image will automatically take by using Pix4dcapture application that installed in smartphone. The height of drone flight will be set in this application. Figure 2 show the image of slope via UAV at slope in Jalan Kuala Pilah at height 60 metre where in Jalan Bangi, UAV flies with height 50 metre.

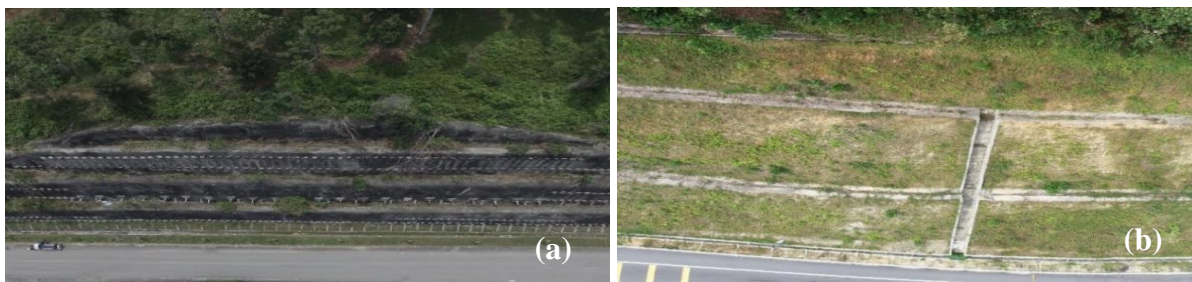


Figure 2. The slope at (a) Jalan Kuala Pilah at a height of 60 metre and (b) is slope at Jalan Bangi at a height of 50 metre

Image Processing by Pix4Dmapper

Visual analysis of slopes is done with processing of image by using Pix4Dmapper. Pix4Dmapper will produce orthomosaic photo, Digital Terrain model and Digital Surface model. All these are used to generate contour and watershed analysis. This software is based on automatically finding thousands of common points between images. Each characteristic point found in an image is called a key point. When 2 key points on 2 different images are found to be the same, they are matched key points. Each group of correctly matched key points will generate one 3D point.

Result and Discussions

The Image of both slope processed using the Pix4Dmapper software to produce Orthomosaic Photo, Digital Terrain Model (DTM) and Digital Surface Model (DSM). Once image processing is completed, files will be exported to Global Mapper Software for analysis. By using this software, it allows the user to perform a watershed analysis on loaded terrain data to find stream paths as well as delineate the watershed areas that drain into a given stream section. Additionally, the contour can also be identified through this software.

Image Processing using Pix4Dmapper

Image of both slopes taken via UAV by using the Pix4Dcapture application installed in the smartphone will be processed using the Pix4Dmapper software to produce Orthomosaic Photo, Digital Terrain Model (DTM) and Digital Surface Model (DSM). Pix4Dmapper will combine all the photo taken by UAV for both slopes. There are 40 images of slope at Jalan Kuala Pilah and 73 images of slope at Jalan Bangi. This can be seen in figure 3.

An orthomosaic photo is an aerial photograph geometrically where the scale is uniform and the photo has the same lack of distortion as a map. Unlike an uncorrected aerial photograph, an orthomosaic photo can be used to measure true distances, because it is an accurate

representation of the Earth’s surface, having been adjusted for topographic relief, lens distortion, and camera tilt [11].

Prior to generating the orthomosaic Pix4D generates a 3D point cloud. The point cloud generated by the 40 images for slope at Jalan Kuala Pilah and 73 images for slope at Jalan Bangi. The point cloud can be edited to remove any spurious points. The point cloud looks quite pixelated, so there is an option in Pix4D to view a 3D mesh instead. The 3D mesh is a 3D model where all the dots of the point cloud are connected in order to create a surface.

A digital terrain model (DTM) can be described as a three – dimensional representation of a terrain surface consisting of X, Y, Z coordinates stored in digital form. It includes not only heights and elevations but other geographical elements and natural features such as rivers, ridge lines, etc. [12]. This process is done by using Pix4Dmapper show in figure 4.

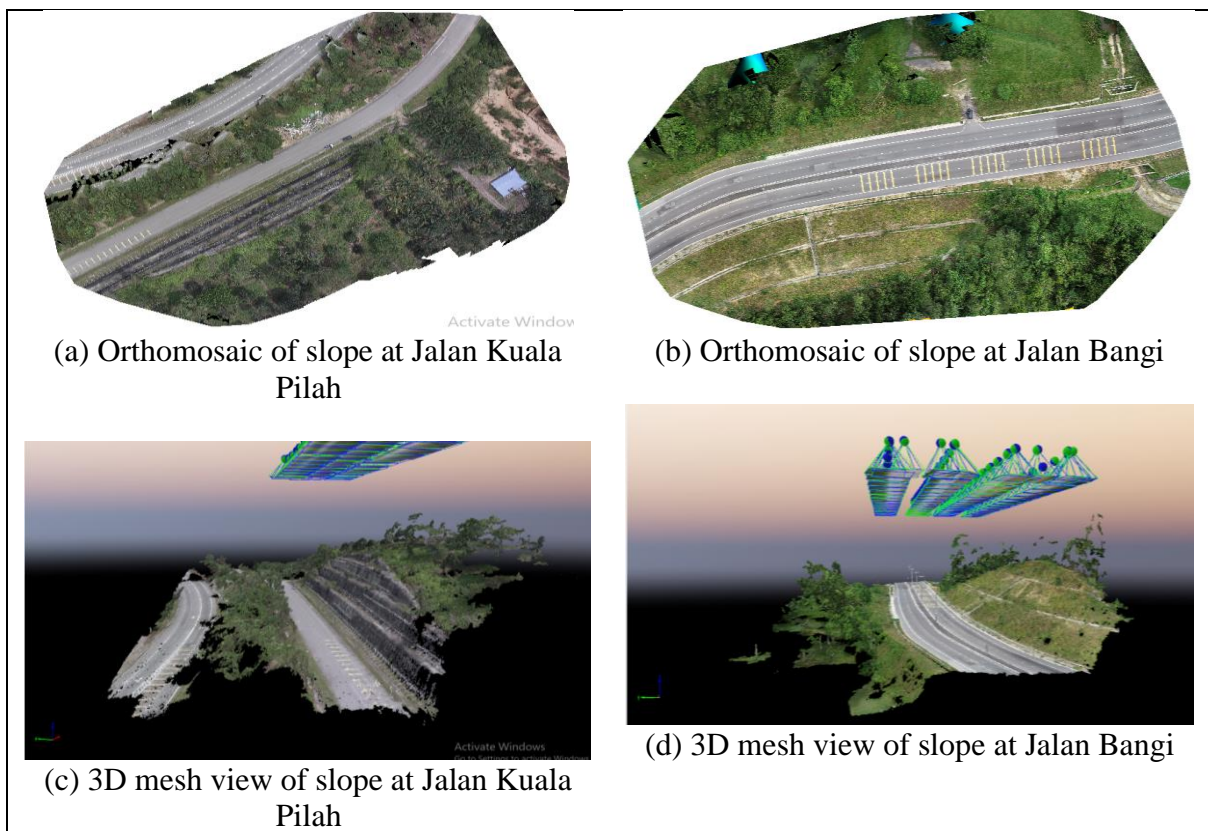


Figure 3. The orthomosaic and point cloud with 3D mesh view photo processed by Pix4Dmapper for both slope

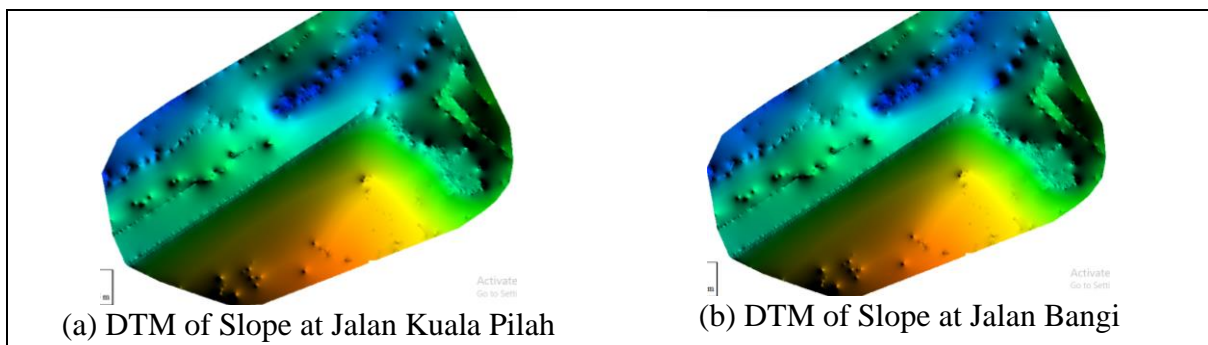


Figure 4. The digital terrain model for both slope generated using Pix4Dmapper

The final process in Pix4Dmapper is digital surface model (DSM). DSM generated using the 40 overlapping overhead images for slope at Jalan Kuala Pilah and 73 overlapping overhead images for slope at Jalan Bangi. The colours represent the different heights. The slope and the flat surface of the ground can be easily identified. Different from DTM, DSM show all the vegetation, road and other surface. Figure 5 shows that the blue colour represent the lowest height and almost red-orange colour represent the highest height.

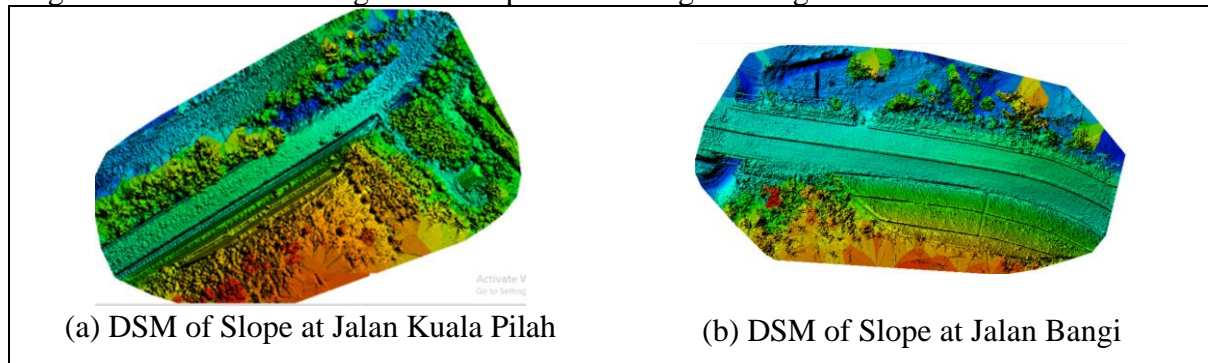


Figure 5. Digital Surface Model of slopes

Slope Analysis Using Global Mapper Software

In this study, perform a watershed analysis on loaded terrain data to find stream paths as well as delineate the watershed areas that drain into a given stream section and to check the conditions of the drainage system of the slopes whether the drainage can drain the water into the mainstream. Figure 6 shows the result of watershed analysis for both slopes. It can clearly see the stream network as well as the drainage areas for each stream segment.

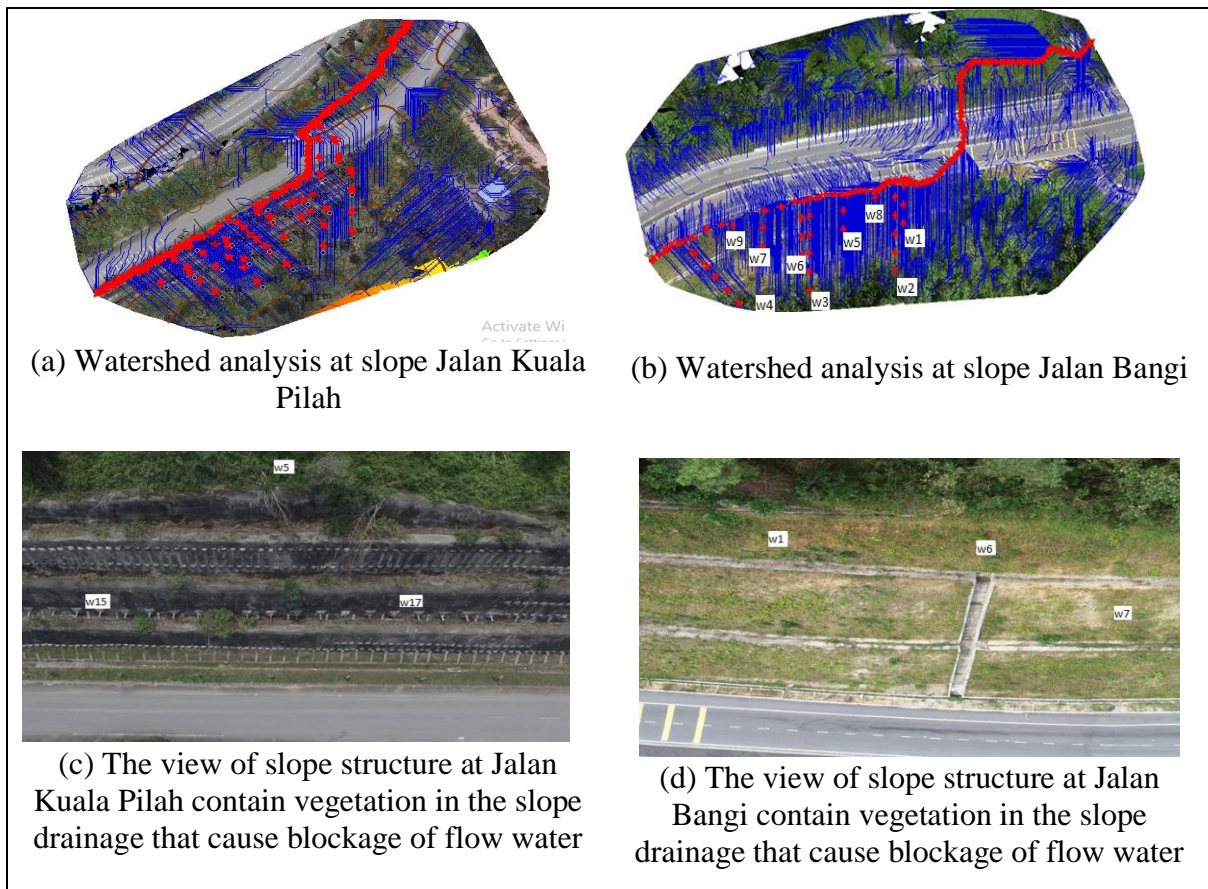
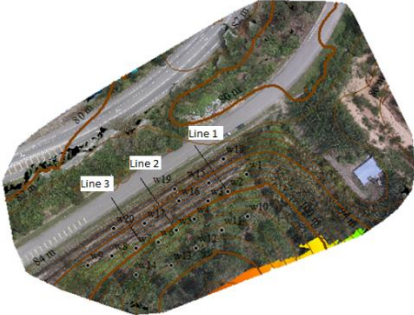
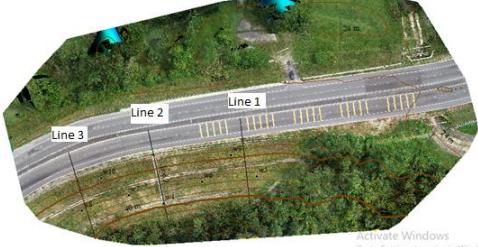
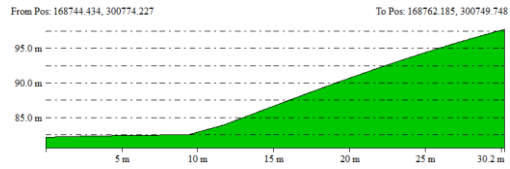
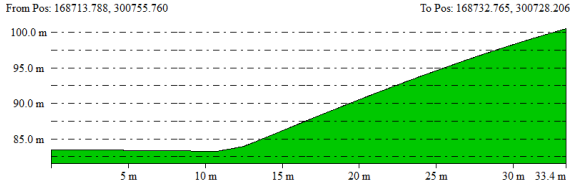
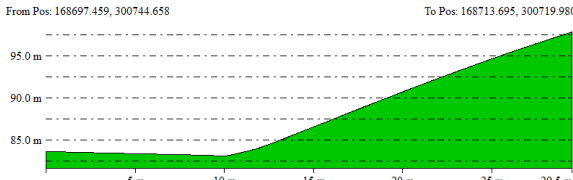
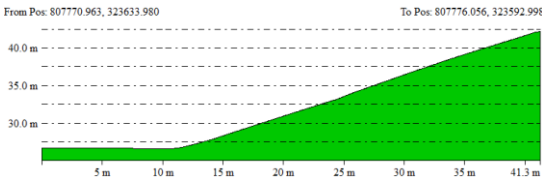
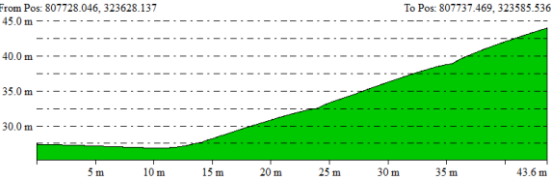
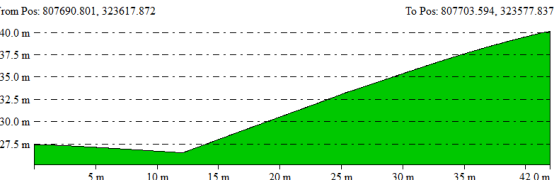


Figure 6. The watershed analysis for both slope and actual view of slope that causes blockage in slope drainage

The most common method of representing the topography of a particular area is to use contour lines. A contour is an imaginary line that connects points of equal elevation. Global Mapper can easily obtain geographic information from different sources, in a simple way. To create contour lines anywhere in the world, it must first review the metadata. In this study, data DTM generated from Pix4Dmapper is used. Contour interval is the vertical distance between contour lines. In this study, both slope is generated contour with interval of 2 metre. The contour generated by Global Mapper software can determine the height of the monitored slope. Additionally, contraceptives can determine the highest area in the area studied. Based on the resulting contours, the height of the slope at Jalan Kuala Pilah is 16 metre and Jalan Bangi is 17 metre. Table 1 shows the contour line and cross section that generated from Global Mapper Software whereby the calculation as shown in figure 7.

Table 1. The contour and the cross section for both slope

<p>(b) Contour generated at slope Jalan Bangi</p> 	<p>(b) Contour generated at slope Jalan Bangi</p> 
<p>(b) Cross section of slope Jalan Kuala Pilah</p>  <p>Line 1: The height of slope obtain from cross section line 1 is 15m and slope distance is 21.2m.</p>  <p>Line 2: The height of slope obtains from cross section line 2 is 16.25m and slope distance is 23.4m.</p>  <p>Line 3: The height of slope obtains from cross section line 3 is 14.5m and slope distance is 19.5m.</p>	<p>(b) Cross section of slope Jalan Bangi</p>  <p>Line 1: The height of slope obtain from cross section line 1 is 16m and the slope distance is 28.8m</p>  <p>Line 2: The height of slope obtain from cross section line 2 is 18m and the slope distance is 31.1m.</p>  <p>Line 3: The height of slope obtain from cross section line 3 is 14m and slope distance is 29.5m.</p>

Calculation of Determine Percentage Different height between Contour Map and Cross Section

i. Slope at Jalan Kuala Pilah

Height of slope from contour = 16 metre

Highest height of slope from cross section = 16.25 metre

$$\text{Different height (\%)} = \frac{(16.25-16)}{(16.25+16)/2} \times 100 = 0.39\%$$

ii. Slope at Jalan Bangi

Height of slope from contour = 17 metre

Highest height of slope from cross section = 18 metre

$$\text{Different height (\%)} = \frac{(18-17)}{(18+17)/2} \times 100 = 1.43\%$$

Calculation of Determine Slope Gradient

i. Slope Gradient at Jalan Kuala Pilah

Average height from cross section = $15+16.25+14.5 = 15.25$ metre

Average distance from cross section = $21.2+23.4+19.5 = 21.37$ metre

Slope Gradient, $\theta = \tan^{-1}(15.25/21.27) = 35.64^\circ$

ii. Slope Gradient at Jalan Bangi

Average height from cross section = $16+18+16 = 16$ metre

Average distance from cross section = $28.8+31.1+29.5 = 29.8$ metre

Slope Gradient, $\theta = \tan^{-1}(16/29.8) = 28.23^\circ$

Figure 7. The simple calculation in obtain percentage different height and slope gradient

The three cross sections produced from 3 different places. Line 1, 2 and 3 indicate where the cross section is done. From the height obtained from cross section, the top height of slope at Jalan Kuala Pilah is 16.25 metre. Therefore, the altitude difference of the slope produced through the contouring and cross section of the slope at Jalan Kuala Pilah is 0.39%. The gradient is also obtained by the presence of this cross section. The gradient of the slope in Jalan Kuala Pilah was 35.57 degree. For the slope at Jalan Bangi, the top height of slope is 18 metre. Thus, the difference height difference of the slope produced through the contouring and cross section of the slope is 1.43%. Just as the slope in Jalan Kuala Pilah, Jalan Bangi slope gradient can also be obtained. The slope gradient at Jalan Bangi is 28.23 degree.

Figuring the Damage of Slope Drainage Structure

The monitoring and evaluation of the slope drainage conditions is made through the images taken from the UAV. This monitoring is aimed at achieving the objectives of the study. Surface drains will be seen if there is any blockage occurs from excessive vegetation growing in drainage channels. The slope at Jalan Kuala Pilah is a slope constructed from concrete. This means that this slope has the highest potential of cracking than the slope of Jalan Bangi where the slope of Jalan Bangi is composed soil. However, this study only monitors the drainage system of slopes.

The growth of vegetation on the slope drainage structure is one of the problems with the slope drainage structure. Vegetation that grow in the slope of the slope can cause waterways to be stuck and may also result in overflowing of water. It can be identified through the taking of

UAVs on both slopes that are monitored. Figure 8 shows the vegetation found in the monitored slope.



Figure 8. The excessive growth of vegetation in slope drainage at Jalan Kuala Pilah

Slope drainage at Jalan Bangi also found plant growth on the surface of the drain. This can be seen on images taken from UAV. The slope at Jalan Bangi is a soil slope, therefore the drain is filled with silt and fine particle from soil. This is because sand and fine particles are carried by rainwater. Water is a fluid that flows and is capable of bringing this fine particle into the drain. This can cause clogged drainage and the surface of the drainage will be covered. When the drainage surface is filled with sand, it will block the flow of water in the drain and cause water to flow out of the drain as depicted in figure 8 and 9.



Figure 9. The vegetation growth on slope and the silt in drainage at Jalan Bangi

Based on the captured picture, almost the entire both surface slope drainage is filled with plants. This can be stated that these slopes are not maintained or monitored by the responsible party. Figure 10 show that almost the surface of slope drainage at Jalan Kuala Pilah and Jalan Bangi were covered by vegetation. By using Global Mapper software, the length of highlighted slope drainage can be determining. By using the length of the drain, it can facilitate the maintenance work of the slope drainage.

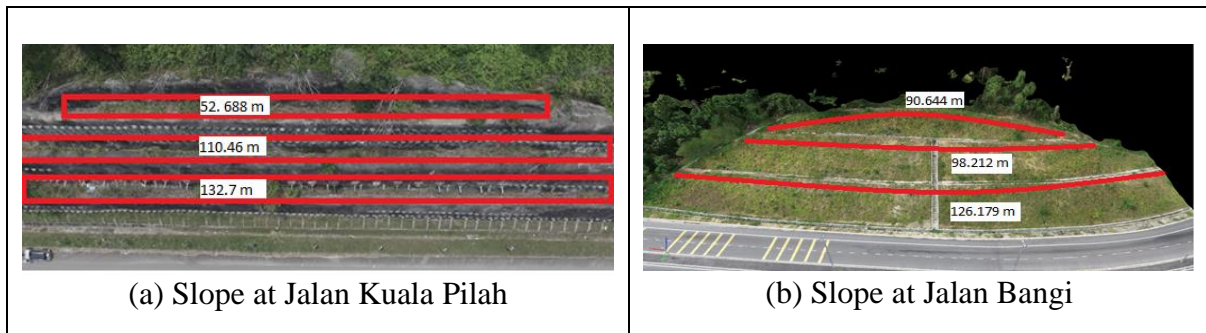


Figure 10. The overall view of slope drainage covered by vegetation, sand and silt at (a) Jalan Kuala Pilah and (b) Jalan Bangi

The cracking on the drainage structure is also one of the common problems in the slope structure. In this study, cracks will be check on slope surface and drainage. Cracks that work on the surface of slope or drainage can cause the failure of the slope to occur where the water enters the crack cavity will then become a pressure within the slope structure. Cracking on drainage surface are not found because the drainage surface is covered by vegetation. Figure 11 show the crack happened on slope surface.

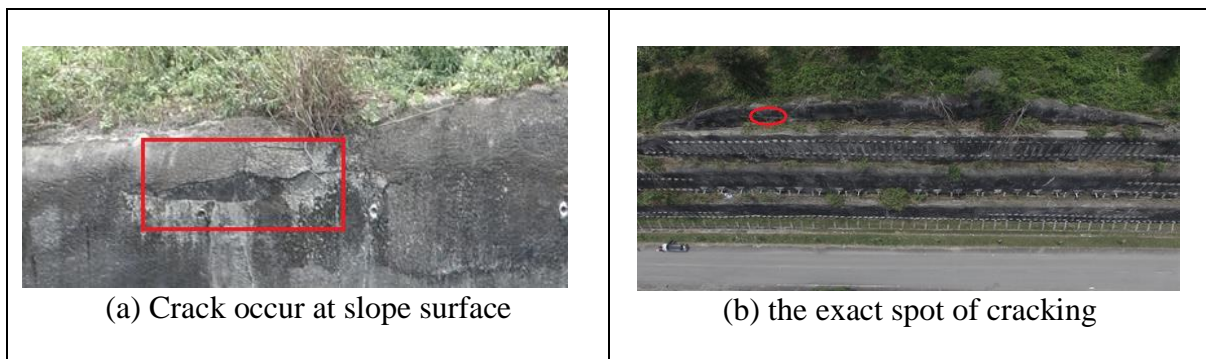


Figure 11. The crack occur and exact spot of cracking occur at slope Jalan Bangi.

5. Conclusions

As a conclusion, this study has been conducted as a monitoring method on the surface of the slope using Unmanned Aerial Vehicle (UAV). The use of UAV is aimed at helping maintenance work be carried out easily without having to climb at each level of the slope. The study was conducted at two locations, the slope in Jalan Kuala Pilah Federal Route number 361 and the slope in Jalan Bangi Selangor State Road number B17. For the elevation of the flight, the slope image at Jalan Kuala Pilah was taken at 60 meters high while the slope of Jalan Bangi was at 50 meters high. The height difference is due to different height slope altitude. This study introduces the use of UAVs could be used as an alternative in acquiring information and identify the damage occurring on the surface of the slope. In addition, the combined information obtained from UAV with software such as Pix4Dmapper and Global Mapper can help to analyse the slope in obtaining contours and the flow of water that occurs on the slope. Therefore, this method can facilitate monitoring work and some analysis of the slopes while saving time and energy. Conventional methods such as climbing slope slopes are still in use where this method can invite various hazard risks such as dropping falls or getting poisonous from animal attacks. Consequently, the use of UAV micro aircraft in slope monitoring work should be used as a

major alternative especially on high and steep slopes. In addition, the frequency of slope monitoring should also be done so that the slope structure condition is always safe. This can prevent the collapse of the slope occurs and the safety of road users are not endangered.

6. Acknowledgments

This study was sponsored by the Ministry of Education Malaysia through FRGS grant (Vot No.:1620). The author would like to thank to Reseach Management Centre (RMC), UTHM, Johor.

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ATTITUDES OF PUBLIC UNIVERSITIES' STUDENTS IN MALAYSIA TOWARDS ENTREPRENEURSHIP

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ABSTRACT: *Unemployment among young people is one of the argumentative political issues as well as a burden for people living through it. It will cause a severe repercussion to the new generation and our nation, if we do not address the problem diligently. Main reason is the slower hiring compared to the number of job seekers. The slower pace of hiring is due to cautious business sentiments and a moderate economic performance that restrains businesses from expanding their workforce. Nevertheless, entrepreneurship is another aspect that needs to be fostered among youths, and frameworks designed to help them build their entrepreneurial thinking and career options. Therefore, the issues above lead the main objective of the paper where it focused on the factors that affect attitude towards entrepreneurship among public universities' final year students in Malaysia. Normality, exploratory factor analysis (EFA), reliability, Pearson correlation, T-test, analysis of variance (ANOVA) and a multiple regression analysis were used to assess the attitude and identify its influencing factors. Respondents of the study are 381 final year students from 21 public universities in Malaysia. The results indicated that three out of four hypotheses for the relationship between independent variables and dependent variable showed significant relationships. The relationship between enterprise knowledge, entrepreneurship education and understanding business risk on attitude towards entrepreneurship were found significant. However, the findings revealed that gender aspect was found not significant on Malaysia public universities final year students' attitude towards entrepreneurship. The government, higher education institutions and business incubators have an important role to play in changing the attitude towards entrepreneurship among students, and setting effective entrepreneurship strategies.*

INTRODUCTION

With the expanding pace of globalization and constrained jobs of governments in employment creation becoming worst day by day, advancing business has turned out to be one of the arrangement choices for countries to support development and make more employments in the economy (Ibrahim et al., 2017). Global unemployment in 2018 is projected around 5.5%, slightly better than 2017's reading of 5.6% on the back of a better global GDP outlook, with an expected growth of around 3.6% in 2018 from 3.3% in 2017. In fact, global youth

unemployment is higher than global unemployment. It is around 13.2% in 2017 and is estimated to stay around the same level in 2018. In Malaysia context, although headline unemployment is around 3.4% in 2017, the youth unemployment rate is over three times higher at around 10.8% in 2017 (Dass, 2018).

Youth unemployment, which includes unemployed individuals aged 15 to 24, a typical age range that covers those who have just finished high school or graduated from colleges and looking for jobs, remains stubbornly high. This age is normally age that not serious about doing work that why employer afraid to hired them. Statistic from the among human resource manager say that most of the fresh graduate are demanding high salary but don't any experience regarding the job that they want.

Pioneering goals among the public universities understudy in Malaysia in view of the high rate of joblessness. The reason for the present examination is to address this issue by exploring innovative aim among public universities understudy in Malaysia. This exploration could give helpful bits of knowledge in regards to enterprising expectations for approach creators and organizers in colleges just as in government with respect to youthful grown-ups, especially in tending to the issue of joblessness among school graduates. Ibrahim et al., (2017) claim that government facing trouble in making job creation due to advancement in globalization. This career choice is seen as a choice that could improve the economy performance, particularly to the labour market because the entrepreneurship activity is able to create more jobs and prosperous (Mohamad et al., 2014).

Business is an alternative way to support developments and create more jobs in a country. Youth entrepreneurship is gaining popularity and now plays an integral role in ensuring sustainable economic growth as it has the potential to fuel innovation, create jobs, increase productivity and competitiveness, as well as achieve societal goals. Entrepreneurship is an important ingredient in modern global economic development (Shah & Soomro, 2017) because of its role in creation of new businesses and jobs, bringing about stronger competition, and even increasing productivity through technological changes (Johansen et al., 2012). To create a strong nation extraordinary elements must be insert to build up youth to perform pioneering exercises. People's expectations are vital to build up business visionaries for each general public. By exploring innovative aim among public universities understudy in Malaysia. This could give some input of knowledge related to enterprising expectations for approach creators and organizers in colleges.

LITERATURE REVIEW AND HYPOTHESES

Attitude Towards Entrepreneurship

Based on factor influencing student's attitude towards entrepreneurship, many students lack of enterprise knowledge on how to start a business and they worried about the failure, revealed by Belwal et al. (2015). There are positive attitudes of students towards the entrepreneurship and promoting the enterprise knowledge in the areas of enterprise could be achieved through internship events (Ibrahim et al., 2017). The organization has also created the program to assist the start-up companies with a complete support package (Al Mubarak 2008).

H1: There is a significant relationship between enterprise knowledge on attitude towards entrepreneurship

Entrepreneurship Education and Attitude Towards Entrepreneurship

Studies from (Farashah 2013; Kuehn 2008, Lanero et al. 2011) show that entrepreneurship education and intention individual to starts a business. Entrepreneurship education is very important to equip the university students the entrepreneurial competencies

(Ferreira et al. 2012). Kolvereid and Moen (1997) and Lee et al. (2005) has found a studies that show students who took business course has a higher attitude to start up a business, has more knowledge about the entrepreneur and a new venture creation.

H2: There is a significant relationship between entrepreneurship education on attitude towards entrepreneurship

Understanding Business Risk and Attitude Towards Entrepreneurship

Understanding business risks is strong factor that support attitude towards entrepreneurship and this studies has been support by Antonites and Wordsworth (2009) say that risk taking in entrepreneur has a strong relationship with the success of entrepreneurs in establishing new ventures. Unwillingness to take risk and fear of failure were the major problem of university students to start their own business (Ibrahim et al, 2017) . The study also found that understanding of risk is correlated with attitude towards entrepreneurship. This result is consistent with studies by Antonites and Wordsworth 2009, Kor et al. (2007), Belwal et al. (2015).

H3: There is a significant relationship between understanding business risk on attitude towards entrepreneurship.

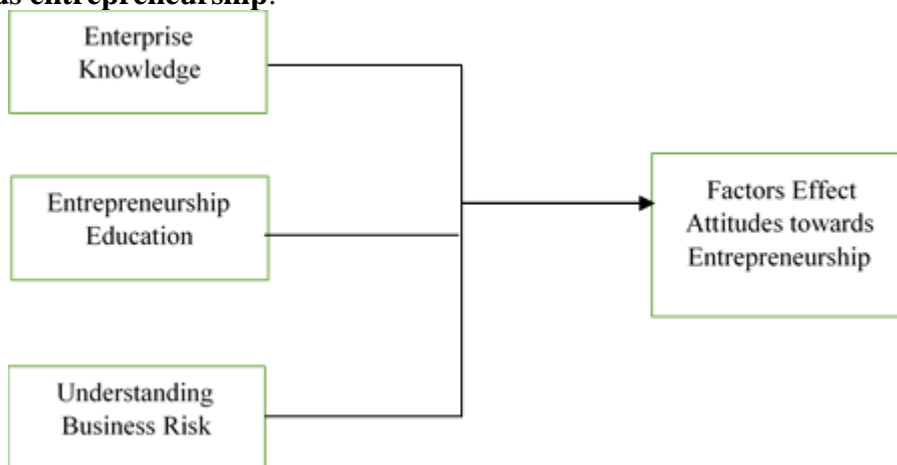


Figure 1: Conceptual Framework

Figure 1 illustrated the conceptual framework of the present study. It is hoped that the current study will strengthen the existing theory and provide a greater understanding of the relationship between the tested variables. The model indicates that enterprise knowledge, entrepreneurship education and understanding business risk are posited to influence the attitudes towards entrepreneurship among public universities final year students’ in Malaysia.

METHODOLOGY

A probability sampling, specifically, simple random sampling was employed in this present study. The self-administered questionnaire was chosen as the data collection technique. This self-administered method using online questionnaires via google form is more efficient for the researcher due to time and cost constraints. The questionnaire contained an introductory statement presenting the topic of the survey and stating that the answers would be treated in the strictest confidentiality. All the constructs in this study were measured using a seven point Likert scale, (1) “Strongly Disagree”, (2) “Disagree”, (3) “Slightly Disagree”, (4) “Neutral”, (5) “Slightly Agree”, (6) “Agree”, and (7) “Strongly Agree”. All items generated for all scales in this study were reviewed by an expert in English and Malay language from a local university to ensure their accuracy.

PARTICIPANTS

Respondents are chosen randomly from all Malaysia public universities. Table 1 shows that out of 381 respondents, 60.6% respondents were female and 39.4% were male. The highest of the respondent aged is between 19 - 21 years (70%), the second is aged between 22-23 years (22.6%). For the race of respondents, found that Malay were 81.9% followed by Chinese 10.5%, followed by Indian 6% and followed by others races 1.6%. The religion, the highest is Islam respondent 85.3% meanwhile Buddhism were 6.9%, followed by Hinduism 6%, Christianity is 1.6% and followed by others religion were 0.2%. Lastly, all main courses such as business administration, accounting, science and technology, engineering and others were equally distributed in the study.

Table 1: Respondent Total Profile (N=381)

Respondent's Demographic	Categories	Frequency	Percentage
Gender	Female	231	60.6
	Male	150	39.4
Ages	19 – 21	267	70
	22 – 23	86	22.6
	24 – 26	24	6.3
	27 – 29	3	0.8
	30 and above	1	0.3
Race	Malay	312	81.9
	Chinese	40	10.5
	Indian	23	6
	Others	6	1.6
Religion	Islam	325	85.3
	Buddhism	26	6.9
	Hinduism	23	6
	Christianity	6	1.6
	Others	1	0.2
Education course	Business administration	76	20.0
	Accounting	76	20.0
	Science and Technology	76	20.0
	Engineering	76	20.0
	Others	77	20.0

DATA ANALYSIS

The Statistical Package of Social Sciences (SPSS) version 23.0 is using to analyse the data obtained from the questionnaire. SPSS is using to assistance in descriptive statistics where it involves data analysis by using standard deviation and mean value. Correlation matrix table which contained of mean, correlations and standard deviation between the same and different variables was industrialized by using descriptive statistics and Pearson product moment. This section about the results of data analysis which is factor analysis, Pearson correlation, t-test, ANOVA, multiple regression analysis, normality and reliability. The values for each variable were determined by the sum of the scores given by the participants, on a five-point Likert scale.

RESULTS AND DISCUSSION

Exploratory Factor Analysis

The results of factor loading and dimension using by exploratory factor analysis were shown in the Table 4 -7 below. The Kaiser-Mayer-Olkin measure of sampling (KMO) is used. The taken item of factor is >0.4 of the factor loading. The results of the exploratory factor analysis showed that the Kaiser-Meyer-Olkin measure of sampling adequacy was 0.886, which is acceptable. The Bartlett's test of sphericity was significant (Approx. $\chi^2 = 4732.177$, $df. = 528$, $p = 0.00$) and conformed to the multivariate normality of the data.

Table 4: Factor Loading Attitude Towards Entrepreneurship

Factor	Items of Factor	Factor Loading
Factor 1	B2 : Among various choices, I would rather be an entrepreneur.	-0.776
	B1: If I have the chance and resources, I would like to start a business.	-0.741
	B7: I think if I decide to begin a spin-off business then it would succeed.	-0.648
	B6 : Being an entrepreneur would bring a good satisfactions for me.	-0.634
	B5: A profession as an entrepreneur is attractive.	-0.625
	B4: Being an entrepreneur indicate more advantages than disadvantages.	-0.586
	B3: Being an entrepreneur would lead to impressive satisfaction	-0.570
	Eigenvalue	8.894
	Percent Total Variance	26.95%

Table 5: Factor Loading Enterprise Knowledge

Factor	Items of Factor	Factor Loading
Factor 2	C7: Enterprise financial affairs.	0.779
	C6: Business icon of an enterprise.	0.697
	C5: Duties of entrepreneur	0.656
	C9: Insurance and law payments of an enterprise.	0.654
	C3: Problem acknowledgement & solution of enterprises	0.632
	C2: Basis of starting up an enterprise.	0.599
	C8: Control feasibility studies	0.551
	C1: Enterprise create ideas	0.516
	C4: Business drafting of an enterprise.	0.509
Eigenvalue		2.564
Percent Total Variance		7.77%

Table 6: Factor Loading Entrepreneur Education

Factor	Items of Factor	Factor Loading
Factor 3	D9: I was able to build entrepreneurial knowledge, skills and competencies through the entrepreneurship subjects that I attended.	-0.670
	D1: I have taken entrepreneurship course at college.	-0.574
	D8: Through entrepreneurship lectures, I now understand the significance of entrepreneurship.	-0.416
	D10: As a result of taking subjects on entrepreneurship, I have better knowledge about business.	-0.618
	D2: I consider entrepreneurship as a beneficial career choice	-0.586
	D6: My lecturers encourage interest in entrepreneurship through the subjects on	-0.580

	entrepreneurship and small business management.	
	Eigenvalue	2.052
	Percent Total Variance	6.21%

Table 7: Factor Loading Understanding Business Risk

Factor	Items of Factor	Factor Loading
Factor 4	E10: The necessary practical detail to start a business is in my hand.	0.704
	E9: Networking and making professional contacts are on my satisfactory levels.	0.698
	E7: I can smoothly conduct the process of producing a new business.	0.658
	E11 : I can start a compete business.	0.599
	E5: Developing new products and services are on my satisfactory levels.	0.593
	E6: In recognition as an entrepreneur are on my satisfactory levels.	0.587
	E8: My levels of problem solving is on satisfactory.	0.585
	E1: My implementing ideas are reasonable.	0.584
	E12: The basics of starting a business and keeping it running smoothly have I master it.	0.497
	E4: Leadership and communication skills are on my satisfactory levels.	0.477
	Eigenvalue	1.754
	Percent Total Variance	5.31%

The principal components analysis extracted four factors having eigenvalues greater than 1.0. Factor 1 (Attitude Towards Entrepreneurship) was loaded with seven items, explaining 26.95 percent of the variance. Factor 2 (Enterprise Knowledge) comprised nine loaded items, explaining 7.77 percent of the variance. Factor 3 (Entrepreneur Education) comprised six loaded items, explaining 6.21 percent of the variance. Factors 4 (Understanding Business Risk) loaded with ten items, explaining 5.31 percent of the variance. For further analysis, only four factors were used based on the reliability score and the number of items loaded.

6.2 Reliability

Table 8 shows the value of the Cronbach Alpha for each of the variables under study. Cronbach 's alpha value for Factor 1 (affect attitudes towards entrepreneurship) was 0.848. While Cronbach's alpha value for Factor 2 (enterprise knowledge) was 0.818, Factor 3 (entrepreneurship education) was 0.795 and Factor 4 (understanding business risk) was 0.834. These showed that all variables exceed the acceptable standard of reliability analysis of 0.6. From the analysis, measurement scales are confirmed met the acceptable standard of reliability analysis.

Table 8: Internal Consistency Reliability Coefficient

Items	Number of Item	Cronbach's Alpha
Factor 1 Attitudes Towards Entrepreneurship	7	0.848
Factor 2 Enterprise Knowledge	9	0.818
Factor 3 Entrepreneurship Education	6	0.795
Factor 4 Understanding Business Risk	10	0.834

Pearson Correlation

1) Relationship of enterprise knowledge (x1), entrepreneurship education (x2), understanding business risk (x3) and attitude towards entrepreneurship (Y).

Table 9 illustrated the relationship between enterprise knowledge, entrepreneurship education, understanding business risk and attitude towards entrepreneurship was analyzed using the Pearson moment product correlation (r). This analysis has been used to derive the results from the study of both objectives that will determine the relationship between enterprise knowledge, entrepreneurship education, understanding business risk and attitude towards entrepreneurship. To ensure that there are no normal and normal violations, initial analysis is done. Because there are three (3) bivariate pairs, alpha Bonferroni adjusted ($\alpha_{adjusted}$) than 0.0167 (0.05 / 3) has been used. It has been used to test all bivariate correlation hypotheses (X1 & Y, X2 & Y and X3 & Y).

In addition, this analysis has been demonstrated by the following hypotheses to achieve significant relationships between enterprise knowledge, entrepreneurship education, understanding business risk and attitude towards entrepreneurship. The research hypothesis is:
H1: There are relationship between enterprise knowledge (X1) and attitude towards entrepreneurship (Y).

H2: There are relationship between entrepreneurship education (X2) and attitude towards entrepreneurship (Y).

H3: There are relationship between understanding business risk (X3) and attitude towards entrepreneurship (Y).

Table 9: Relationship of Enterprise Knowledge (X1), Entrepreneurship Education (X2), Understanding Business Risk (X3) and Attitude Towards Entrepreneurship (Y)

Variables	Mean	SD	Y	X1	X2	X3
(Y) Attitude Towards entrepreneurship	3.7649	0.60782	1	0.000	0.000	0.000
(X1)	3.7579	0.51702	0.469	1		

Enterprise Knowledge (X1)						
Entrepreneurship Education (X2)	3.7305	0.60902	0.494	0.422	1	
Understanding business risk (X3)	3.6911	0.51250	0.457	0.372	0.532	1

** Correlation is significant at the 0.01 level; Bonferroni adjusted alpha (α adjusted)

= 0.167 (0.05/3)

1) Relationship between enterprise knowledge (X1) and attitude towards entrepreneurship (Y).

As shown in the Table 9, the most powerful linear relationship is found between enterprise knowledge (X1) and attitude towards entrepreneurship (Y) ($r = 0.469$, $p = 0.00$, $\alpha_{\text{adjusted}} = 0.0167$). The positive correlation coefficient of 0.469 shows as the score of enterprise knowledge increases as soon as the rating of the attitude towards entrepreneurship. The result shows that there is a significant relationship between enterprise knowledge (X1) and attitude towards entrepreneurship (Y).

2) Relationship between entrepreneurship education (X2) and attitude towards entrepreneurship (Y).

The second linear relationship is found entrepreneurship education (X2) and attitude towards entrepreneurship (Y) ($r = 0.494$, $p = 0.000$, $\alpha_{\text{adjusted}} = 0.0167$). Positive correlation coefficient 0.494 indicates a score for increased entrepreneurship education and attitude towards entrepreneurship. The result shows that there is a significant relationship between entrepreneurship education (X2) and attitude towards entrepreneurship (Y).

3) Relationship between understanding business risk (X3) and attitude towards entrepreneurship (Y)

Finally, focus on understanding business risk shows a moderate positive linear correlation to attitude towards entrepreneurship ($r = 0.457$, $p = 0.000$, $\alpha_{\text{adjusted}} = 0.0167$). The result shows that there is a significant relationship between understanding business risk (X3) and attitude towards entrepreneurship (Y). This finding clearly supports the study hypothesis that there is a moderate positive linear relationship between understanding business risk (X3) and attitude towards entrepreneurship (Y).

6.4 T – Test

The objective of the study was to compare the difference in the mean score of attitude towards entrepreneurship (Y) to gender differences. Table 10 shows that no significant difference between gender ($F = 3.834$, $p = 0.051$) and attitude towards entrepreneurship.

Table 10: Describes Attitude Towards Entrepreneurship and Gender Based On Mean Score

Variables	Gender (mean)		f	Sig.
	Male	Female		
<i>Attitudes towards entrepreneurship</i>	3.7619	3.7695	3.834	0.051

Analysis of Variable (ANOVA)

The objective of the study was to compare the difference if there are more than two groups in the mean score of attitude towards entrepreneurship (Y). The results in Table 11 show significant difference between race ($F = 3.978$, $P = 0.004$), and education course ($F = 7.007$, $p = 0.000$). However, there are no significant difference between age ($F = 1.694$, $p = 0.151$) and religion ($F = 2.498$, $p = 0.21$).

Table 11: Results of One-Way ANOVA Test between Selected Demographics Variables and Attitude towards Entrepreneurship

Variables	Mean	f	Sig.
AGES			
19 – 21	3.7202	1.694	0.151
22 – 23	3.8870		
24 – 26	3.7917		
27 – 29	3.7619		
30 and above	4.5714		
RACE			
Malay	3.7321	3.978	0.004**
Chinese	4.0643		
Indian	3.5901		
Others	4.0571		
RELIGION			
Islam	3.7468	2.498	0.211
Buddhism	4.0110		
Hinduism	3.5901		
Christianity	4.4143		
Others	4.5714		
EDUCATION COURSE			
Business	3.8211	7.007	0.000**
Accounting	3.9151		
Science and Technology	3.8175		
Engineering	3.7712		
Others	3.7649		

Note: 1) *. The mean difference is significant at $p \leq 0.05$ level

Multiple Regression Analysis

This indicates that the slope of the estimated linear regression model line is not equal to zero confirming that the proposed two predictors multiple linear regression model of the study is highly significant. The largest beta coefficient obtained was 0.279 for enterprise knowledge. This means that this variable makes the strongest unique contribution in explaining the dependent variable, when the variance explained by all other predictor variables in the model

was controlled for. The Beta value for entrepreneur education was the second highest (0.262). Table 12 exhibits the summary results of the Multiple Regression analysis for the present study. All the results have been discussed in detail in the sub sections. All relationships were found to be significant relationship ($p < 0.05$) and were in the direction of the postulated hypotheses.

To test the relationship between Enterprise Knowledge and Attitudes towards Entrepreneurship, multiple regression was utilized. The result is shown in Table 12, the standardised coefficient is 0.269, with a t value of 6.015 and adjusted R Square of 0.236. The significant level of 0.000 was found for this hypothesized main effect at a highly significant level of 0.01. This means that Hypothesis 1 was accepted. The results strongly indicated that the higher the Enterprise Knowledge among public universities' final year students in Malaysia, the more likely it would lead to positive attitude towards entrepreneurship. The present research findings are consistent with Ibrahim et al. (2017). They found that there are positive attitudes of students towards the entrepreneurship and promoting the enterprise knowledge in the areas of enterprise could be achieved through internship events (Ibrahim et al., 2017).

Secondly, in order to test the relationship between Entrepreneurship Education and Attitudes towards Entrepreneurship, multiple regression was also utilized. The result is shown in Table 12, the standardised coefficient is 0.262, with a t value of 5.161 and adjusted R Square of 0.353. The significant level of 0.000 was found for this hypothesized main effect at a highly significant level of 0.01. This means that Hypothesis 2 was accepted. The results strongly indicated that the higher the Entrepreneurship Education among public universities' final year students in Malaysia, the more likely it would lead to positive attitude towards entrepreneurship. In the past study's findings done by Farashah (2013) are consistent with the present study as they found that entrepreneurship education will leads to positive attitudes towards entrepreneurship.

Table 12: Results of Multiple Regressions

Variables	R ²	Δ R ²	Beta	t	Sig.
Enterprise knowledge	0.238	0.236	0.279	6.015	0.000
Entrepreneur education	0.364	0.363	0.262	5.161	0.000
Understanding business risk	0.248	0.246	0.214	4.301	0.000

*Significant at $p \leq 0.05$

Lastly, the relationship between Understanding Business Risk and Attitudes towards Entrepreneurship was tested. The result is shown in Table 12, the standardised coefficient is 0.214, with a t value of 4.301 and adjusted R Square of 0.246. The significant level of 0.000 was found for this hypothesized main effect at a highly significant level of 0.00. This means that Hypothesis 3 was accepted. The results strongly indicated that the higher the Understanding Business Risk among public universities' final year students in Malaysia, the more likely it would lead to positive attitude towards entrepreneurship. In the past studies' findings done by Ibrahim et al. (2017) are consistent with the present study as they found that the higher understanding business risk will leads to positive attitudes towards entrepreneurship.

CONCLUSION AND RECOMMENDATION

The most crucial part of this paper is the findings where it revealed that enterprise knowledge, entrepreneurship education, understanding business risk have a huge impact to the attitudes

towards entrepreneurship among public universities' final students in Malaysia. This result is consistent with the previous studies (Mohamad et al., 2014; Henderson and Robertson, 2000) and its implication is indeed, entrepreneurship can be cultivated through education. Thus, this paper support the policy of the Ministry of Higher Education on cultivating educated entrepreneur, as stated in its Malaysia Education Blueprint 2015-2025. For instance, the Entrepreneurship Development Institutions of Higher Education, a policy aims to promote the education and development entrepreneurship among institutions of higher learning (Malaysia Education Blueprint 2015-2025). The core subject of Basic Entrepreneurship syllabus offered to undergraduate students covers limited areas. Therefore, students who interested in this particular field need to explore more specific entrepreneurship programs in Entrepreneurship Centre in their universities as well as other government agencies such as Tekun Nasional, Teraju, Majlis Amanah Rakyat and others. Moreover, it is hoped that every Malaysian graduate will have the relevant disciplinary knowledge and skills (ilmu), ethics and morality (akhlak), as well as the appropriate behaviours, mindsets, cultural, and civilisational literacy (beradab) to advance them to a high level of personal well-being. They will be global citizens with a strong Malaysian identity, ready and willing to contribute to the harmony and betterment of the family, society, nation, and global community. Such holistic, entrepreneurial, and balanced graduates are a natural extension of the goal of the Malaysian basic education system to develop values-driven Malaysians. It is important to move from a world of job seekers to job creators.

ACKNOWLEDGEMENT

We would like to acknowledge the Faculty of Defence Studies Management, National Defence University of Malaysia for academic supports.

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FINISHING LINE EVALUATION OF BRACKET PRODUCT FWD RR SPRING BT 1702 BY APPLYING 8 STEPS 7 TOOLS METHOD TOYOTA PRODUCTION (CASE STUDY: PT BA)

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Abstract. *PT Bakrie Autoparts is a company which runs in foundry and mainly produces cast iron such as wheel hub, brake drum, disc rotor and flywheel. The major problem encountered by this plant is the slow delivery to consumers because the finishing process takes too long time along with the increasing demand while there is no significant improvement. This research focuses on the mapping of the hindrances and problems in the finishing line of Bracket FWD RR Spring BT 1702, how much the actual output is, what causes the problem, and what improvement can be done to remove or reduce the hindrances. The method used is 8 Step 7 Tools Toyota Production System. Time measurement result and Output Standardd calculation is based on finishing line cycle time 142 seconds per pcs and output Standardd 25 pcs per hour. After applying the method of 8 Step 7 Tools Toyota Production System, cycle time line finishing can be reduced to 66 seconds and the output Standardd to 53 pcs per hour. The output line finishing improvement reaches 112% faster than the previous one. Besides that, the improvement makes a better performance Standardd in the finishing process of Bracket FWD RR Spring BT 1702 so the product is in better quality and it ensures the operators's work safety.*

Keywords: *Lateness, Hindrances, finishing Line, 8 Steps 7 Tools TPS*

Introduction

The tight industry competition nowadays is measured by not only the ability to produce highly qualified products and competitive selling price but also the on-time product delivery to customers. PT. Bakrie Autoparts is one of the foundry companies producing automotive items with cast iron as the main material and its produces brackets, brake drums, disc rotors, wheel hubs and flywheels. Casting process can be briefly described as a series of continuous steps in making metal casting starting from the casting design to the finishing process. The casting design is the first stage of the casting process. The design is then converted into a pattern and core box as the reference to make the mold and core mold. The next process is melting the metal all at once or sequentially. The metal liquid is then poured into the mold. The metal liquid in the mold will cool down in a period of time. The next process is removing it from the mold and cleaning the casting (finishing).

The main problem that the plant encounters is that the products are not delivered on time to the customers as there are hindrances and waste during the finishing process- *finishing line* - caused by the increasing demand while there is no significant improvement.

The finishing process of Bracket FWD RR Spring BT 1702 consists of several steps, some of them are processes using a machine grinder, a manual grinder, the final inspection on the end product and the last process is arranging the casting from the roller to the pallet (keeper). The finishing line system works in parallel and continuous way in the production as the company has set the hourly output needs to be fulfilled in its production.

The writers think that the output done in in the finishing line is not optimal yet as the high or low output in a continuous production line is highly affected by the bottleneck and the time balance between one process with another in the line. Bottleneck is a condition where an operation or a facility limits or hinders output in one sequence in a production line, Gaspersz, 2005). Bottleneck can also be described as a work station which has the highest service time compared to other service stations in the production line, (Groover, 2001).

Based on the observation done earlier, the factors causing the hindrance in the finishing line when producing *Bracket RR Spring* BT 1702 lie in the process of product handling. Unnecessary work and ineffective method used in working also contribute to the problem.

The hindrances and problems are evaluated and verified in this research. The method used is *8 Step dan 7 Tools Toyota Production System*. The result of this research is to improve the method used in working so it will become effective and efficient in order to give the expected production output and at the same time prioritize work safety and product quality.

Literature Review

The advanced step (fettling) on the casting covers all steps from cooling down the metal in the mold ends (casting cooling) up to its arrangement to be delivered. The processes comprise cooling down, removing the casting from the mold, cleaning the casting from runner, gates and risers, first inspection, parting lines, grinding, improving, last inspection, packaging, and shipment.

TPS (*Toyota Production System*) puts its all effort to completely eliminate waste, avoid overburden and uneven work in all sectors to enable its members to work effectively and efficiently. TPS, having high Standardd, ensures the method used is safe and the approach is consistent to get the best quality. Toyota Members always keep improving their Standardd and procedures to get the best result, increase efficiency, and eradicate wastefulness.

In ATQC system, the 8 steps are used to solve problems or make improvement. The basic principle of the 8 steps are PDCA (Plan, Check, Do, Action) and later on it will be called 8 steps PDCA. Problem solving and improvement cannot be applied only once, instead it is a continuous process. Therefore, the 8 steps PDCA should be applied with the purpose of continuously improving (kaizen) something.

The 8 steps of improvement start from determining the theme, analyzing the present condition, setting the target, analyzing the cause and effect, planning action, applying the action plan, evaluating the result, Standarddizing and creating follow up actions. Seven tool management is a check sheet, stratification, graph and control map, pareto diagram, cause and effect diagram, scatter diagram, histogram.

Stop watch time study was first introduced by Frederick W. Taylor in the 19th century. The method is best applied in short-term and repetitive work. The result can show the fixed time needed to finish a work cycle.

Methodology

In the research methodology are described as the stages of problem solving, the 4 steps known as PDCA (Plan, Do, Check and Action). Plan consists of selecting the theme or title of a problem, Do refers to how to solve the problem. Check is the result of the problem solving. Action is Standardizing and making follow up action regarding the next problem to solve. The flow diagram of problem solving can be seen in Figure 1.

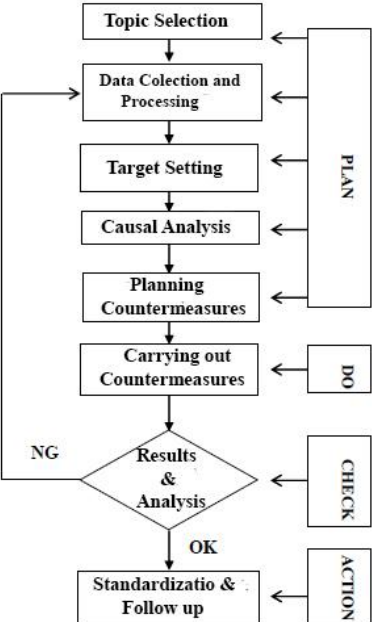


Figure 1. Problem-solving flow diagram

During the data collection stage, stopwatch time study is used to find out the Standard output in the finishing process of *Bracket FWD RR Spring BT 1702*. The steps to apply the measurement can be seen in Figure 2.

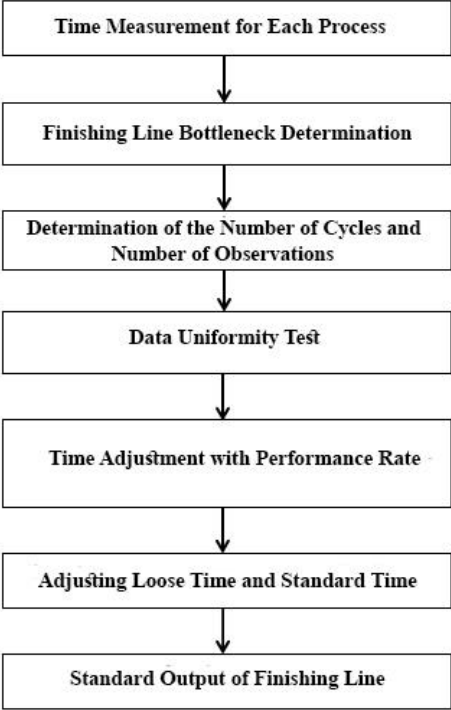


Figure 2. Stopwatch time study steps

Results and Discussions

This stage describes the result of analysis based on the *8 steps 7 tools Toyota Production System* method and the result after improvement is implemented based on the existing problem. Moreover, the calculation of the finishing line output and result analysis uses *QCDSMPE (Quality, Cost, Delivery, Safety, Morale, Productivity, Environment)* method after improvement becomes a significant point according to the target reached.

4.1 Analysis using 4M1E method

Analysis result using 4M1E (*man, material, metode, machine, environment*) method can be seen in Table 1-5.

Table 1. Man Factor Analysis

No.	Analyzed Points	Standard	Actual	Assessment
1	Number of operators needed	5 People	5 People	OK
2	Average age	<ul style="list-style-type: none"> ▪ GM: 22-35 Years ▪ GT1: 22-35 Years ▪ GT2: 22-35 Years ▪ FI: 22-35 Years ▪ KP: 22-35 Years 	<ul style="list-style-type: none"> ▪ GM: 25 Years ▪ GT1: 28 Years ▪ GT2: 29 Years ▪ FI: 30 Years ▪ KP: 23 Years 	OK
3	Mental attitude, character, work ethic	Diligent, Hard Worker, and Tenacious	Diligent, Hard Worker, and Tenacious	OK
4	Skill or ability to work	Able to grind properly and correctly, inspection in accordance with the Standard	Able to grind properly and correctly, inspection in accordance with the Standard	OK

Table 2. Machine Factor Analysis

No.	Analyzed Points	Standard	Actual	Assessment
1	Grinding Machine Condition	<ul style="list-style-type: none"> ▪ GM: Good ▪ GT1: Good ▪ GT2: Good 	<ul style="list-style-type: none"> ▪ GM: Good ▪ GT1: Good ▪ GT2: Good 	OK
2	Grinding Machine RPM	<ul style="list-style-type: none"> ▪ GM: 1950 -2000 ▪ GT1: 1000 ▪ GT2: 1000 	<ul style="list-style-type: none"> ▪ GM: 1950 -2000 ▪ GT1: 1000 ▪ GT2: 1000 	NG OK OK
3	Grinding Stone Quality	<ul style="list-style-type: none"> ▪ Sharp machine grinding stone at 2000 rpm rotation ▪ Sharp machine grinding stone at 1000 rpm rotation 	<ul style="list-style-type: none"> ▪ Sharp machine grinding stone at 2400 rpm rotation ▪ Sharp machine grinding stone 	NG OK

			at 1000 rpm rotation	
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Table 3. Material Factor Analysis

No.	Analyzed Points	Standard	Actual	Assessment
1	Neck Fracture remainder adder and Line-In on Casting	<ul style="list-style-type: none"> ▪ Notch \pm 2 mm from the Object ▪ Fair thickness 	<ul style="list-style-type: none"> ▪ Notch \pm 2 mm from the Object ▪ Fair thickness 	OK OK
2	Casting conditions regarding the fins on the Casting	<ul style="list-style-type: none"> ▪ Casting fin is small or absent 	<ul style="list-style-type: none"> ▪ Casting fins are thick and unnatural 	NG

Table 4. Factor Analysis Method

No.	Analyzed Points	Standard	Actual	Assessment
1	Working Method of Each Element	<ul style="list-style-type: none"> ▪ Notch \pm 2 mm from the Object ▪ Fair thickness 	<ul style="list-style-type: none"> ▪ Notch \pm 2 mm from the Object ▪ Fair thickness 	NG
2	Additional Tools related to the Finishing Process	-	There is no use of tools to simplify and speed up the process of finishing	NG

Table 5. Environment Factor Analysis

No.	Analyzed Points	Standard	Actual	Assessment
1	Finishing Area	Wider Area	Wide enough for the Finishing Process	OK
2	Finishing Area Layout Arrangement	Neat, Well Arranged, Clear Area Markers	Neat, Well Arranged, Clear Area Markers	OK
3	Finishing Area Lighting	Simply illuminate all parts	Simply illuminate all parts	OK
4	Temperatur atau Suhu di Area Finishing	Cool, a little dust, and comfortable	Cool, a little dust, and comfortable	OK

The analysis result using 4M1E method identifies that the problem lies in the finishing line; machine, material and method factors.

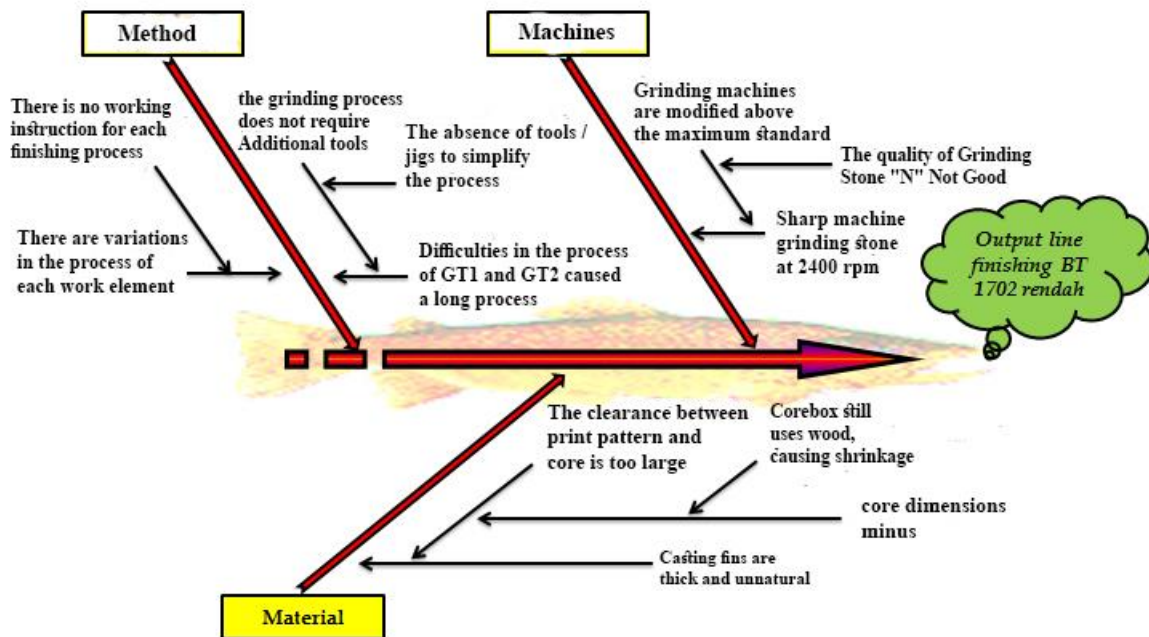


Figure 3. Fishbone diagram

4.2 Treatment Implementation

The result plan to improve the machine factor is by replacing the grindstone machine with the one whose brand is “K” with grindstone spesification of 2000 Rpm. The improvement is done by the maintenance team of PT BAP under the supervision of the maintenance supervisor. The replacement was done on the first week of February 2, 2015.

The result plan to improve the material factor is by making a new corebox using iron, RCS sand (burning core), the method of making it uses automatic machine utilizing RCS core machine. The improvement is done by the engineering team of PT BAP under the supervision of the engineering supervisor. The improvement was done in the first week of February on February 3, 2015.

The result plan to improve the method factor is by making a jig in manual grinding process 1 and manual grinding 2 using a steel plate and and making work instruction for every finishing process. The improvement was done in the first week of February on February 5, 2015.

4.3 Result Evaluation

In this stage, the Standardd finishing output is done after the improvement and through some steps such as time measurement, bottleneck identification, setting the number of cycles, setting the number of observation, testing the data uniformity, adjusting work time and work performance, setting the loose time and fixed time. Moreover, the advantages of the improvement result are explained using the QCDSMPE method.

4.3.1 The Time Measurement Average during the Finishing Line Process and Identification of Bottleneck in the Finishing Line (after improvement)

Time measurement is done by the writer. The average time and the identification of bottleneck finishing can be seen in Table 6.

Table 6. Data of average time in the finishing line of Bracket FWD RR Spring after improvement

Process	Average Time (Second)
Grinding Machine	31
Hand Grinder 1	60
Hand Grinder 2	33
Final Inspection	19
Keeper	13
<i>Bottleneck</i>	60

The bottleneck of the finishing line takes place during the manual grinding 1, adequacy test, data uniformity and fixed time measurement will be done in manual grinding 1.

4.3.2 Adequacy Test and Data Uniformity (after improvement)

The data of elements in the manual grinding process can be seen in Table-7.

Table 7. Data of sampling method in the number of observation manual grinding process 1 of Bracket FWD RR Spring

Element	Observation Time														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
2	5	4	4	5	5	4	4	5	4	4	5	5	4	5	5
3	6	5	5	5	6	5	6	5	5	6	6	6	5	5	6
4	11	10	10	10	10	11	11	11	10	11	10	11	10	11	10
5	20	20	21	21	20	21	20	21	20	21	20	20	20	21	21
6	6	5	5	5	5	6	6	6	5	6	5	6	5	6	6
7	9	9	9	9	9	9	8	8	9	8	8	8	9	8	8
8	2	2	2	2	2	3	3	2	3	3	3	3	2	3	3

Data management to see confidence test 95% and accuracy 5% in work element 1 in manual grinding process can be seen in Table-8.

Table 8. Data checking in level of confidence and accuracy in work element 1 in manual grinding 1

(X)	(X ²)	(X)	(X ²)	(X)	(X ²)
3	9	2	4	3	9
3	9	3	9	3	9
3	9	3	9	3	9
3	9	3	9	3	9
3	9	3	9	3	9
Total $\sum X = 44$					
Total $\sum X^2 = 130$					

$$N' = \left(\frac{40 \sqrt{(15 \times 130) - (44)^2}}{44} \right)^2 = 12 \text{ times observations, 15 times actual measurement time data after the adequacy test.}$$

Result of data uniformity test in manual grinding 2 process of every element can be seen in Table 9.

Table 9. Data of data uniformity test in manual grinding 1 process after improvement

Working Element	BKA	BKB	Data Uniformity
1	3.23	2.64	Uniform
2	5.13	3.94	Uniform
3	6.06	4.87	Uniform
4	11.06	9.87	Uniform
5	21.06	19.87	Uniform
6	6.13	4.94	Uniform
7	9.13	7.94	Uniform
8	3.13	1.94	Uniform

The data of uniformity test in manual grinding 1 process shows that it is still in the range of upper control limit and lower control limit.

The result of fixed time and Standardd output can be seen in Table-10.

Table 10. Data result of fixed time calculation and the Standardd output finishing line

Working Element	\bar{x} (Second)	p (Second)	Wn (Second)	Wn (Total Menit)	% Allowence	Ws Jam/ Unit	Output Pcs/Jam
1	2.93	0.99	2.90	0.99	10.41	0.0185	53
2	4.53	0.99	4.48				
3	5.47	0.99	5.42				
4	10.47	0.99	10.37				
5	20.47	0.99	20.27				
6	5.53	0.99	5.47				
7	8.53	0.99	8.44				
8	2.53	0.99	2.50				

1.3.3 Comparison between Before and After Improvement

4.3.3 .1 Productivity

It is to measure the previous target with the achieved productivity after the improvement. The comparison between product output of *Bracket FWD RR Spring* before and after the improvement can be seen in Table 11.

Table 11. Data of comparison between cycle time and output before and after the improvement

The Control Point	Numbers		
	Before	Target	Actual
Goods That Can Be Produced (Pcs)	3300	5845	6360

Cycle time (Second)	142.5	73.9	66.74
Target per Hour (Pcs)	25	49	53

The data proves that the improvement done in the finishing line when producing *Bracket FWD RR Spring* using 8 steps 7 tools Toyota Production System can decrease the cycle time in the finishing line to 75 seconds and increase the output finishing line to 28 pcs per hour. Production plan for production target in February was 5845 pcs (before the improvement), but now it can reach to 6630 pcs (after the improvement). Overall, the improvement done using the 8 steps 7 tools Toyota Production System method can increase the output in the finishing line to produce *Bracket FWD RR Spring* to 112%.

4.3.3.2 Quality

The data comparing the rejection of *Bracket FWD RR Spring BT 1702* during the period of January to March 2015 can be seen in Table 12.

Table 12. Data comparing the rejection before and after the improvement

Final Inspection	Before	After	
	Jan	Feb	Mar
Inspect	3300	6360	3230
Reject OG	0	0	0
%	0%	0%	0%

Based on the data acquired, the rejection over grinder from January to March 2015 was 0%.

4.3.3.3 Safety

The acquired data proves that the improvement done in the finishing line to produce the *Bracket FWD RR Spring* using 8 steps 7 tools Toyota Production System can decrease the potentials of accidents in the finishing process. Work safety increases, work method is more effective and work process is faster.

4.3.3.4 Cost

The data show that there is a production increase for 112% and the the quality of products is good, stable and is able to estimate. The improvement using the 8 steps 7 tools Toyota Production System related to cost is effective as the company's spending is accurately precise and resulting in big profits from the production.

4.3.3.5 Morale

Improvement regarding morale is the comparison in spirit or motivation of the operators before and after the improvement. After the improvement with 8 steps 7 tools Toyota Production System method, the operators become more motivated to make improvement in all job sectors.

4.3.3.6 Delivery

Comparison between the total order with the ability to deliver *Bracket FWD RR Spring* before and after the improvement can be seen in Table-13.

Table 13. Data comparing the total order with the ability to deliver the products before and after the improvement

<i>Delivery</i>	<i>Before</i>	<i>After</i>
<i>Order</i>	4845	5845
Produced Capacity	3300	6360
<i>Outstanding</i>	1545 (<i>minus</i>)	515 (<i>stock</i>)

Based on the data acquired, outstanding (incomplete) order of *Bracket FWD RR Spring* before the improvement is 1545 pcs and there are more orders in the following month. After treated with 8 steps 7 tools Toyota Production System method with 5845 pcs per moth, now it can reach to 6360 pcs per month. The conclusion is after the improvement is made, there is no minus in delivery causing no order debt in the following months, the production is over the stock and ease the production in the following months.

4.3.3.7 Environment

The data acquired show that the improvement using *8 steps 7 tools Toyota Production System* can avoid dirty area in the finishing line, the clean area can make the operators more motivated and bring higher productivity in the finishing line.

Conclusion

Based on the application of 8 steps 7 tools Toyota Production System in the finishing line for Bracket FWD RR Spring, it is shown that this method can decrease the cycle time in the finishing line from 142,5 seconds to 66 seconds and the output finishing line from 25 pcs to 53 pcs. The output finishing line improvement reaches 112%. The result after the application of 8 steps 7 tools Toyota Production System in the finishing line when producing Bracket FWD RR Spring -in February 2015 was only 5845 pcs per month- is now 6360 pcs per month. There was no minus in delivery which affects no delivery debt in the following month. The production is over orders (stocks are available) and can ease up the following month production which causes no late delivery to customers.

In general, the analysis or improvement using the application of *8 steps 7 tools Toyota Production System* method supports the increase of output in the finishing line for *Bracket FWD RR Spring* and creates a better work Standard.

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MEASUREMENT OF THE OVERALL EQUIPMENT EFFECTIVENESS (OEE) AND THE PROCESS IMPROVEMENT ON RADIATOR CRIMPING LINE

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Abstract. *PT SS.Tbk is a producer of several high-quality automotive components that have a market share in the country and abroad. One of the products is Radiator. The study was conducted on the crimping line because this line still has many obstacles in production. One of them is low production capacity and is not in accordance with machine standards. OEE Method is a calculation of several elements, namely Availability, Performance Efficiency, and Rate of Quality Products. The beginning of the research is to find supporting data to calculate the three elements. From the available data and through the calculation phase can produce 99% availability, performance of 50.9%, and quality rate of 99.68%. From the results of the three elements, the OEE value can be determined by multiplying the three elements and the result is 49.23%. From these results it can be seen that the element that must be improved is performance by increasing production capacity. After doing research, the main problem is the handling and movement of operators that require a long time. This can be determined by comparing the processing time of the machine with the handling or movement of the operator. From the available data can be generated for the process of the engine its capacity is able to produce 193.54 pcs per hour, while the calculation of handling and movement of the operator generated 47.26 pcs per radiator. From this it can be planned several improvements to minimize handling and movement of the operator, namely the first, by approaching the crimping machine and radiator forming components and the second, by making conveyors for radiator components.*

Key Words: *Line Crimping, OEE, Availability, Performance, Quality Product, Handling*

Introduction

The improvement of the manufacturing system is one of the efforts made by the company, in order to be able to respond to changes that must be controlled at all times to see market conditions in the world. To produce radiators that meet the needs of consumers abroad, quality change and improvement is very important for automotive companies to do. Various processes need to be improved starting from making components, assembly, testing, and packaging.

The general way to do this is continuous improvement, but not the real problem, due to the ineffectiveness of the system or method of measuring performance, equipment and solutions to existing problems.

The choice of improvement method is very important to see how far the method is suitable or not in the process improvement. The radiator product itself has an ongoing process, from components to packaging. Many methods are used to produce radiators that meet the standards, but these methods are not feasible to use because of high costs and long cycle times.

For this reason, process improvement requires the use of new methods aimed at obtaining appropriate and effective methods in the process of making radiators.

One method of measuring performance that is widely used by companies is "Overall Equipment Effectiveness (OEE)". OEE is a measuring tool to determine the effectiveness of the performance of the process. OEE is also an open way in terms of providing information in handling problems of a work system. OEE helps maximize the company's assets to the availability of time (Availability) in producing output (Performance) with the best product quality (Quality).

This measurement method consists of three main interrelated factors namely Availability (availability), Performance (ability), Quality (quality). With the OEE method, the authors conducted research to improve one of the processes in making radiators. The author takes the radiator crimping process that requires repairs because there is a bottleneck of all radiator making processes. OEE measurements are carried out before and after the process improvement in the radiator crimping line.

There are several factors that can cause low capacity, namely the engine itself, operator movements, poor working methods, and factory environmental conditions. The main factors that we will observe are machines and operators.

Formulation of the problem

The problem with line crimping in the process of making radiators is low production capacity and not in accordance with standards. OEE's ability is very good in identifying problems to the root of the problem so that the problem-solving action can be right on target. For this reason, the focus of the problem in this study is the calculation of the OEE value of the machine in the radiator crimping process and the process improvement plan which aims to increase the value of OEE so as to increase production capacity.

Research purposes

The objectives achieved in this study are

1. Understand and understand OEE methods and at the same time be able to apply in the world of work.
2. Obtain OEE value on the machine or equipment that has been determined by the object of research.
3. Summing up the results of OEE and knowing the relationships of OEE elements that influence each other.
4. Develop an improvement plan to increase the value of OEE.

Scope of problem

The scope of the study includes taking data for the purpose of calculating OEE values. The author will take the data for one month to be processed and obtained the results of OEE calculations in the radiator crimping process. After that, a process improvement plan is conducted to produce a positive OEE value. For improvement, I will first see which parts will be repaired. With this scope, it is hoped that there will be improvements to the OEE method.

Literature review

5.1 Total productive Maintenance (TPM)

In order to be able to compete in global competition and change rapidly, it is necessary to implement a strategy that can manage all resources in the organization appropriately, effectively and efficiently. Just in Time (JIT) and Total Quality Management (TQM) are some of the strategies that have been widely used by the industrial world and in recent times Total Productive Maintenance is present as a strategy that is believed to be capable of being a strategic quality maintenance tool.

Total Productive Maintenance stems from the premise of PM (Preventive Maintenance and Productive Maintenance) from America entering Japan and developing into a new Japanese system that became known as TPM (Total Productive Maintenance).

Total Productive Maintenance is a maintenance concept that involves all workers who aim to achieve effectiveness in the entire production system through productive, proactive, planned participation and maintenance activities (Suzaki Kyoshi, 1999).

TPM consists of three syllables namely:

1. Total
This indicates that TPM considers aspects and involves all existing personnel, starting from the top level to the bottom line.
2. Productive
Focusing on all efforts to carry out maintenance with production conditions running and minimize the problems that occur produced at the time of maintenance is carried out.
3. Maintenance
Means that maintaining and maintaining the equipment independently is carried out by the production operator so that the condition of the equipment remains good and maintained by cleaning it, lubricating it and paying attention.

Nakajima (1989) defines TPM as an innovative maintenance approach that optimizes equipment effectiveness, reduces breakdowns, and encourages autonomous maintenance by operators through daily activities that involve workers as a whole.

TPM is a form of good cooperation between the maintenance and production department in the organization to improve product quality, reduce waste, reduce manufacturing costs, increase equipment availability, and improve the company's maintenance conditions.

Blancard (1997) says that TPM is a life-cycle approach that is integrated with plant maintenance. TPM can be effectively utilized by organizations to develop worker involvement at every step of the manufacturing process and maintenance of facilities to better streamline production flow, improve product quality, and reduce operating costs. Total employee involvement, autonomous maintenance by the operator, small group activities to increase reliability, maintainability, equipment productivity and continuous improvement (kaizen) are the principles covered by TPM.

5.2. Overall Equipment Effectiveness (OEE)

Total Productive maintenance (TPM) is an original idea from Nakajima (1988) that emphasizes the utilization and involvement of human resources and preventive maintenance systems to maximize the effectiveness of equipment by involving all departments and organizational functions. Total productive maintenance is based on three interconnected concepts, namely:

1. Maximizing the effectiveness of machinery and equipment

2. Independent maintenance by workers
3. Small group activities

In this context OEE can be considered as a process of combining operation and maintenance management and resources.

TPM has two objectives namely zero breakdown and zero defect. With the reduction of the two things mentioned above, the level of use of operating equipment will increase costs and supply will decrease and further employee productivity will also increase. Of course it takes a process to achieve this and even requires a time that according to Nakajima ranges from three years depending on the size of the company. As a first step, companies need to set a budget for improving machine conditions, training employees in equipment and machinery. Actual costs depend on the initial quality of equipment and the expertise of the maintenance staff. Once productivity increases, of course all these costs will be covered quickly.

All activities to increase the company's work is done by minimizing input and maximizing output. Output does not only concern productivity but also better quality, lower costs, timely delivery, improved occupational safety and health, better morale and conditions and a more pleasant work environment. The relationship between input and output can be seen in Figure 1 below:

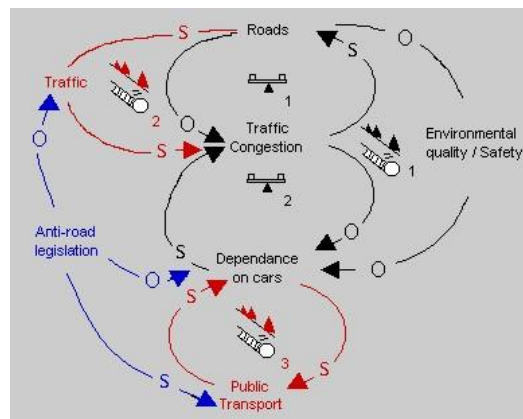


Figure 1. Matrix The relationship between input and output in production activities
(Source: Nakajima, S, 1988)

In the matrix above it is evident that engineering and care are directly related to all output factors namely production, quality, cost, surrender, safety and morals. With increased automation and reduced labor, the production process shifted from manual with the hands of workers to machinery. In this position, equipment and machinery are crucial in increasing output. All of the output factors mentioned above are very much influenced by the condition of the equipment and machinery.

The purpose of TPM is to enhance the effectiveness of the equipment and optimize the output of the equipment (PQCDSM) by trying to maintain and maintain optimal conditions with a view to avoiding machine damage, loss of speed, damage to goods in the process. All efficiencies including economic efficiency are achieved by minimizing maintenance costs, maintaining optimal equipment conditions for their useful life or in other words minimizing equipment life cycle costs. The effectiveness and minimization of equipment life cycle costs is achieved by involving all members of the organization in reducing the six big losses which reduce the effectiveness of the equipment.

Nakajima also suggested evaluating the development of the TPM because the accuracy of the production equipment data is essential to the long-term success of continuous improvement. If the data on damage to production equipment and the reasons for production losses are not understood, any activities carried out will not be able to solve the problem of the decline in operating system work. Production losses together with indirect and hidden costs make up the majority of total production costs. That is why Nakajima said OEE as a measurement that tries to reveal the hidden costs. This is one of the important contributions of OEE with the identification of hidden losses which is a big waste that is not realized.

Research Methodology

Research methodology is a procedure that contains clear stages that are arranged systematically in the research process. Each stage and section determines the next stage so it must be passed carefully.

Place and Time of the Research

The study was conducted at PT. Selamat Sempurna Radiator Tbk (ADR Group) especially in the crimping radiator line, which is located at Jalan Kamal No. 88 North Jakarta. The study was conducted for one month, from 1 May 2015 to 31 May 2015.

Object of the Research

PT. Selamat Sempurna Tbk is an Autopart Manufacturing company whose production is in the form of car radiators. The main subject of this research is to find OEE in the crimping line and make improvements so that the OEE value is better than before.

Preliminary Studies

are needed to further examine what will be the problem. Preliminary studies consist of literature studies and direct observations in the field.

9.1 Method of Collecting Data

Data collection method is a way of procuring primary and secondary data for research purposes. In general, data collection, both primary and secondary, can be divided into several ways, namely:

Data collection methods used in carrying out this research are:

1. Primary Data is data obtained from direct observation and research in the field. The collection of primary data is done by observing directly in the factory and asking for information and interviewing employees directly involved in the operational process. The data obtained included data regarding production results and a description of the production process.
2. Secondary data is data that is not directly observed by researchers. This data is company documentation, past research results and other data.
3. Data collected will be used later in data processing. Data collected includes:
 - a. Company production data
 - b. Loading Time
 - c. Operating Time
 - d. Process Time
 - e. Defect Amount
 - f. Planned Downtime
 - g. The type of machine used and some time the damage.

9.1 Data Processing

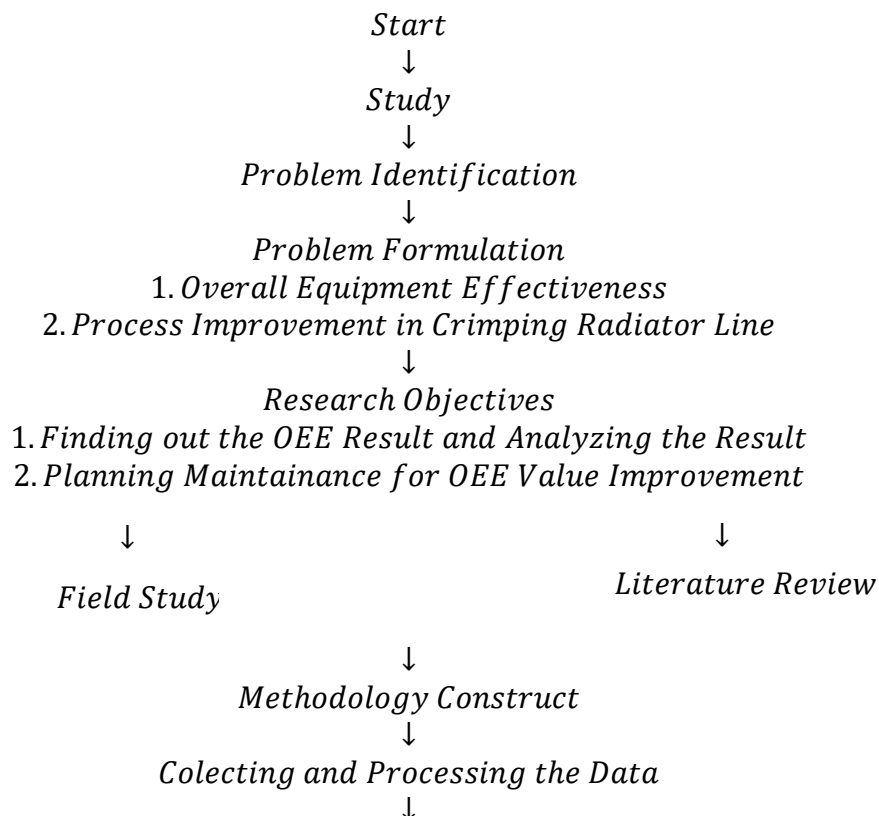
is performed by the Overall Equipment Effectiveness (OEE) method with the following steps:

1. Availability
is a comparison between the actual operating time (actual operating time) and the loading time (planned operating time).
2. Performance Efficiency
is the ratio of the quantity of products produced multiplied by the ideal cycle time to the time available to carry out the production process (operating time)
3. Quality Rate
The determination of the value of this quality product is measured by the ability of a machine to produce a production that meets the quality standards that have been standardized by the company.
4. Overall Equipment Effectiveness (OEE)
After the Availability, Performance and Quality rate values on the crimping machine are obtained, the OEE value calculation is used to determine the effectiveness of the machine.
5. Defining the real problem is done using a Cause and Effect Diagram.

9.3 Analysis and Problem Solving

Analyzing the results of data processing to find out how much the change in the level of effectiveness of the use of production machines and to obtain a solution of existing problems, including:

1. Analysis of OEE calculations
2. Analysis of Cause and Effect Diagrams
3. Evaluation and Proposed problem solving



Result and Analysis
↓
Conclusion and Suggestion

9.4 Data Collection and Processing

To calculate the OEE value, data is needed in accordance with the formulas in finding OEE values. Data obtained directly in the field (production line) for one month. For data collection carried out in April 2015.

The data includes several items, as follows

1. Data downtime

Downtime is the time that should have been used in the production process but because of damage to the machine resulting in the production does not match as it should. Process failure on the machine is a loss that results in no product output. Downtime data can be seen in table 1.

Table 1. Data of the Breakdown Time in April 2015

NO.	Date	Availability	Down Time
1	01 April 2015	22	0.5
2	20 April 2015	22	3.5
3	27 April 2015	22	1.38

Source: PT. Selamat Sempurna Tbk

2. Data Planned Production Downtime

is the planned time in the production unit where the machine stops operating, including downtime needed for planned maintenance and management activities (eg morning meetings).

3. Production Set-up Time Data

is the time required to produce one product after another product has been completed. The time needed to carry out the machine setup starts from the machine stops until the next production process.

9.4.1 Availability

is the ratio of the operation time to loading time. The availability value is calculated using the following formula:

$$Availability = \frac{Operating}{Loading Time} \times 100\%$$

9.4.2 Performance Efficiency

is the multiplication between the operation speed rate and the net operation rate, or the ratio of the quality of the product produced multiplied by the ideal cycle time to the time available to carry out the production process (operation time).

9.4.3 *Ideal cycle time* is a standard cycle time that can be achieved under normal circumstances. Total production can be produced under normal conditions is 50 pcs / hour in one flow (in one flow there is a set of machines), for PT. Selamat Sempurna has three flow (three sets of machines). So that the total is 150 pcs / hour. Whereas the ideal cycle time is 1 hour / 80pcs (one flow) for three flows is 1 hour / 240 pcs = 0.0041 pcs / hour.

$$\text{Performance Efficiency} = \frac{\text{Processed Amount} \times \text{Ideal Cycle Time}}{\text{Operating Time}} \times 100\%$$

9.4.4 *Rate of Quality Product*

is comparing the ratio of the number of good products to the number of products processed.

$$\text{Rate of Quality Product} = \frac{\text{Processed Amount} - \text{Defect Amount}}{\text{Processed Amount}} \times 100\%$$

9.4.5 *Overall Equipment Effectiveness (OEE)*

is used to find out the effectiveness and productivity of the production process on the crimping line at PT. Selamat Sentosa Tbk.

OEE calculation is the product of Availability, performance efficiency, and product quality rate.

$$\text{OEE} = \text{Availability (\%)} \times \text{Rate of Quality Product (\%)} \times 100\%$$

Results and Analysis

10.1 *Results of Data Collection and Calculation*

The results of calculations of several supporters of OEE such as availability, performance efficiency, and rate of product quality can be explained as follows.

10.1.1 *Availability Value*

Obtained from the production process time compared with the planned process time. 100% availability can be interpreted as the production process always runs in time in accordance with the planned time (there is never a down time). In the production of crimping, several important things can be produced as follows:

10.1.2 *Performance Efficiency Value*

Interpreted as the ability to maximize the acceleration of production. If the value of performance efficiency is 100%, then the process has been running at maximum speed (theoretically, based on the ideal cycle time and total production. In the production of crimping can be seen that the value is very low because there are several things as follows.

1. For the processed amount does not match the ideal conditions. This can be seen the actual condition of the total production produced under normal conditions 50 pcs / hour. Ideally with normal conditions, the machine can produce 80 pcs / hour.

2. For the conditions of production as shown in table 4.6, low performance efficiency values can be produced. Almost all grades in April were low. The lowest was on April 4, 2015 because the lowest production yield was 763 pcs.
3. From these results must be immediately considered and analyzed how it can occur and solutions to increase that value. The author will focus on this problem and will plan improvements that must be made to increase the value of performance efficiency.

From these results it can be analyzed how much time is needed for crimping one radiator so that it can also be calculated how many hours it is produced. This is to compare with the ideal time so that the time difference is obtained which must be shortened again. For the calculation will be discussed further in the discussion about the improvement plan.

10.1.3 Rate of Quality Product

Product quality is determined based on the number of production, OK products and NG or nonstandard product results. In the table can be seen as follows.

1. The rate of quality product reaches 100% if there is no "NG" or nonstandard item on that date. This must be maintained because it will benefit the company.
2. The lowest rate of quality product on April 30, 2015 because of the highest number of rejects produced was 40 pcs from the production of 2815 pcs. This must be considered why the results of the highest reject. From the production data, it can be seen that there are many rejects because the tank broke. This must be further analyzed by checking the size of the tank against the core, or improper machine settings.

10.1.4 OEE Value

is obtained from the data that has been calculated it can be seen that the results are mostly still lacking or below standard. This is because the performance efficiency results are still low. From this we will analyze the causes of the low performance efficiency results.

10.1.5 Maintenance Plan

Because OEE results are low, improvements must be made to obtain OEE values that are in accordance with the standards. The focus of improvements is on performance efficiency, which results are very low. The causes of low performance results need to be analyzed. There are several factors that affect performance, namely machine, human, process layout. The research will be done by calculating the cycle time from the crimping process from the engine to the handling system. All movements will be calculated with the aim of whether there is a long movement on the engine or handling system that requires a lot of time.

Problems that arise if the handling time is long so that it will affect production results. So the movement of the operator must be considered and the layout of the process also considered.

So the line for repairing crimping is as follows

1. For layout changed again by bringing the side crimp machine closer to the crimp machine. When viewed by the operator in handling long enough because the core distance between the machines is quite far, which is about 180 cm. For this reason, to avoid the long handling side machine side crimp closer to the core and crimping machines.
2. Using conveyors for movement of cores so that the operator does not need to make a movement to take cores in a pallet. With the core conveyors coming by itself the funds will shorten the handling operator.

Conclusion

From the results of the study we can get the following conclusions:

1. Overall Equipment Effectiveness is the most powerful tool to find out problems in a company because OEE overcomes problems to the root of the problem.
2. The research that has been carried out produces values from several variables of OEE namely availability (an average of 99%), rate of product (an average of 99.68%), and performance efficiency (an average of 50.9%). From these results it can be seen that the performance efficiency results are not good so there is a need for improvement plans.
3. From the three variables above, an OEE value can be generated, which is the multiplication of the three variables. For the results of OEE itself is 49.23%. So it can be concluded that if one variable value is low it will produce a low value as well. In other words, the three variables affect each other. So to produce a good OEE value and in accordance with the standards, all three variables must produce a good value.
4. Improvement plans regarding productivity or performance effectiveness are changes in the layout of the crimping process by bringing the sidecrimp machine closer to the crimping machine with the aim of shortening handling so as to produce a shorter cycle time that will improve production results.
5. The other proposal is the manufacture of conveyors for the running of the core so that handling can be reduced.

Recommendations

From the results of the research and during the research process, there are a number of suggestions, namely:

1. Research is still simple and with tools as it is. For the future, research uses adequate and sophisticated tools so that results are more accurate.
2. With this final project, it is expected that what has been read by the reader can be applied in the workplace because OEE is very useful for improving the quality of a company.

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THE HYDROLOGICAL PERFORMANCE INVESTIGATION OF GREEN ROOF

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Abstract: *A green roof can be a way to navigate stormwater runoff and flooding in urban catchments in Malaysia. This is because green roofs can be used as temporary storage spaces and infiltration. This paper represents hydrological investigation findings in term of hydrograph and peak runoff for different types of materials used as drainage and filter layers. The data were collected from different test beds under simulated rainfall with the intensity of 200mm/h for 0%, 2% and 6% slope. Natural fibres were used as a filter layer and laid on top of the drainage layer. In this study, a total of 18 sets test beds with a dimension of 1.1 m x 1.17 m were used. This study used three types of waste materials (rubber crumbs, oil palm shells and polyfoam) and three types of natural fibres (coconut fibres, oil palm fibres and sugarcane fibres). The result indicates that the combination of oil palm shells with sugarcane fibres have the highest peak runoff value for 0%, 2% and 6% slope with a value of 4.01 mm, 6.29 mm and 7.77 mm respectively. Followed by oil palm shells with oil palm fibres (0%: 2.95 mm, 2%: 5.75 mm, 6%: 6.76 mm) and oil palm shell with coconut fibres (0%: 2.72 mm, 2%: 5.05 mm, 6%: 6.32 mm). The result proved that combination of oil palm shell and sugarcane fibres performance better in peak runoff value compared to other materials.*

Keywords: *Green roof, hydrological performance, natural fibres, filter, recycled waste materials, drainage layers*

Introduction

The concept of green roof nowadays is highly popular as it brings many benefits towards the environment and promotes a sustainable lifestyle. Green roofs can be categorized according to its growing media thickness, vegetation type, accessibility, the need for maintenance and origin. According to Berndtsson et al. (2006), vegetated roofs can play an important role in modern urban drainage because of its ability to slow down and reduce runoff response. Many researches discovered that green roofs have numerous environmental benefits such as reduce flood risk, improve rainwater runoff quality, mitigate urban heat island, building energy saving and provide urban wildlife habitat. Green roof is usually consists of vegetation layer, substrate layer, filter layer, drainage layer and waterproofing layer.

In Malaysia, climate is considered as a dry hot all over the year with heavy rain on specific periods. Due to its geographical location with an average rainfall over 2000 mm per year, is prone to suffer from floods and flash floods especially during cyclical monsoon cold surge episodes which are characterized by extreme rainfall from roughly November to February (Ayog, 2017). The conventional roof of buildings in Malaysia is made from concrete and zinc.

Thus, green roofs may work as a source control measure as they have capability of retaining the rainfall by and distributing the runoff slowly through the green roof layers. This technology helps in reducing the runoff discharges which contributing to reduce flash floods. Several researches have highlighted the importance of green roof application including the ability of green roof to retain stormwater (VanWoert et al., 2005), delay peak discharge time (Carter and Rasmussen, 2006) and attenuate peak discharge volume (Mentens, Raes, and Hermy, 2006; Stovin, Vesuviano, and Kasmin, 2012).

There are a few researchers in Malaysia looking into the hydrological performance of waste materials and ways on how the roof slopes influence the performance of green roofs. There were several literatures that studied the use of rubber crumbs in drainage layer in the green roof in terms of its hydrological properties; however, none on waste materials such as polyfoam and oil palm shells. In this study, different types of waste materials (rubber crumb, oil palm shells and polyfoam) and natural fibres (coconut fibre, oil palm fibre and sugarcane fibre) were used in the green roofs system as drainage and filter layer. The aim of this study is to investigate the hydrological performance in term of hydrograph shape and peak runoff made from natural fibres (NF) as a filter and recycled waste materials (RWM) as drainage layers in the green roof (GR) to mitigate stormwater runoff.

Methodology

a) Experimental Setup

The study was carried out in hydraulic laboratory, Faculty of Engineering, University Malaysia Sabah. A total of 18 test beds were constructed with a dimension of 1.1 m x 1.17 m (Figure 1) and tested under the rainfall simulator. The duration of simulation rainfall was 15 minutes. The value for outflow was taken for an hour continuously with five minutes interval. The rainfall intensity set for these experiments are based on the Malaysia Urban Stormwater Manual guideline for constructing roof gutters, which are 20-year and 100-year annual recurrence interval of 15 minutes duration for Kota Kinabalu. The rainfall intensity for the simulator used in this study was based on return period of annual maximum rainfall in Inanam, Kota Kinabalu. The data were collected from different test beds under simulated rainfall with the intensity of 200 mm/h and testing was done for 0%, 2% and 6% of slope. The design of green roof layers is shown in Figure 2.

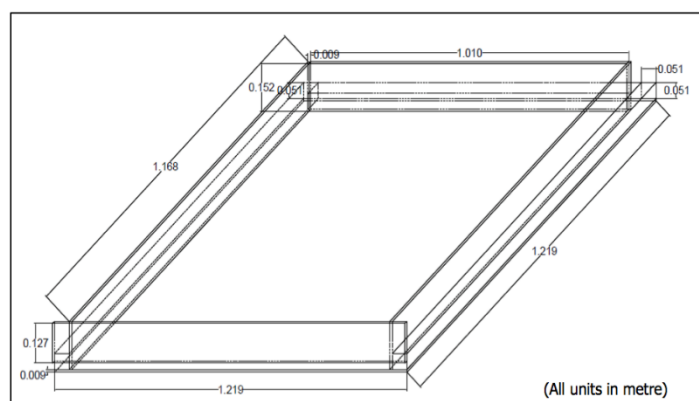


Figure 1: Test bed design

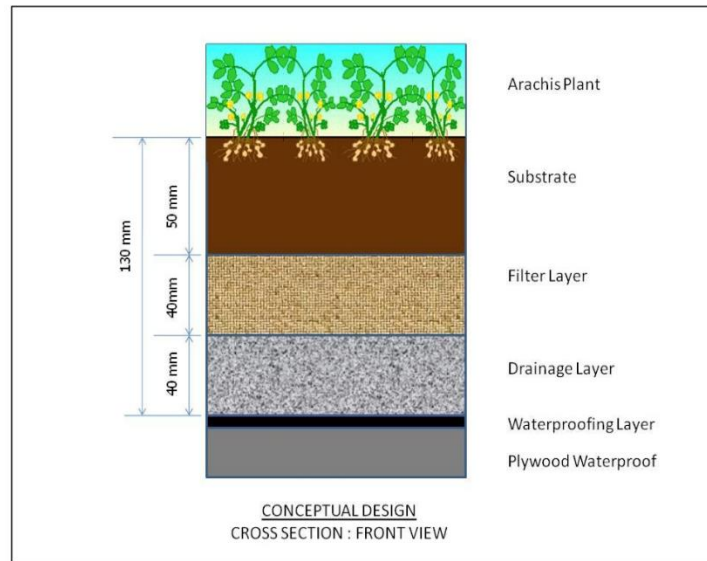


Figure 2: Green roof design layers

b) Materials

Waste materials and natural fibres used in this study were collected locally in Sabah. Three types of recycled waste were selected for each test bed, which are rubber crumbs, oil palm shell, and polyfoam. Natural fibres acted as the filter layer in green roofs are placed on top of the drainage layer. Natural fibres chosen are coconut fibre, oil palm fibre and sugarcane fibres. The plant used in the green roof system is Arachis Pintoi. Figure 3 show different types of materials and plants used in green roof design. Table 1 indicates key component names for each material.

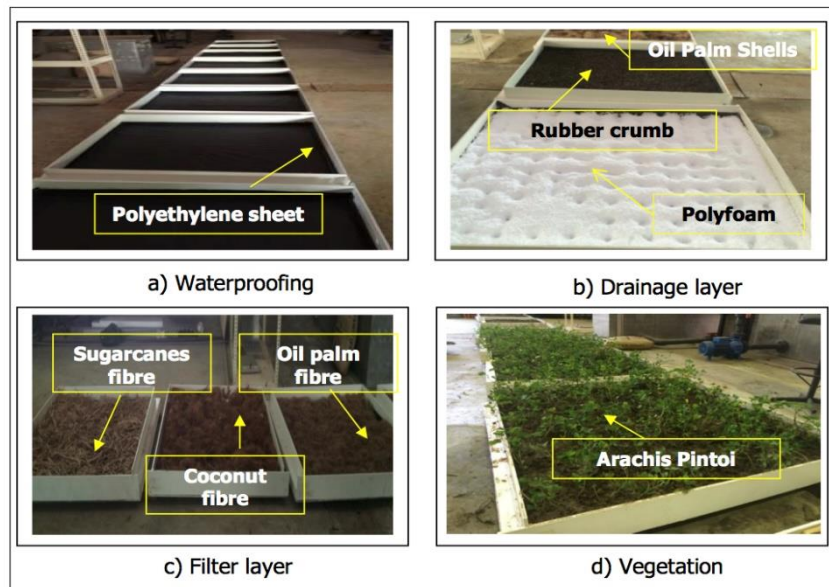


Figure 3: Green roof designs

Table 1: Key to Component Names

Green Roof Layer	Component Name	Key
Waterproofing	Control	C
	Rubber crumb	RC
Waterproofing Drainage	Oil palm shell	OPS
	Polyfoam	PF
Waterproofing Drainage Filter	Rubber crumb with sugarcane fibre	RCSF
	Rubber crumb with coconut fibre	RCCF
	Rubber crumb with oil palm fibre	RCOPF
	Oil palm shell with sugarcane fibre	OPSSF
	Oil palm shell with coconut fibre	OPSCF
	Oil palm shell with oil palm fibre	OPSOPF
	Polyfoam with sugarcane fibre	PFSF
	Polyfoam with coconut fibre	PFCF
	Polyfoam with oil palm fibre	PFOPF

c) Hydrological Performances Test

The hydrological performance of green roof in this study involved the performance investigation of runoff hydrograph shape and peak runoff. The test beds with treatments were tested under the rainfall simulator for hydrological performance. To test the effect of the green slope on the hydrological performance, a different slope with 0%, 2% and 6% were set up. The three stages are waterproofing with drainage layer (stage 1), waterproofing with drainage and filter layer (stage 2) and waterproofing with drainage, filter, substrate and vegetation layer (stage 3). Table 2 shows the stages with different combination of waste materials and natural fibres.

Table 2: Specimens for each stage

	Specimen							
	Waterproof layer	Waste materials			Natural Fibres			Plant
		OPS	RC	PF	SF	CF	OPF	Arachis Pintoi
Control	x							
Stage 1	x	x						
	x		x					
	x			x				
Stage 2	x	x			x			
	x	x				x		
	x	x					x	
	x		x		x			
	x		x			x		
	x			x	x			
	x			x			x	
	x	x			x			x
Stage 3	x	x				x		x
	x	x					x	x
	x	x					x	x
	x		x		x			x
	x		x			x		x
	x			x	x			x
	x			x		x		x
	x			x			x	x



Figure 4: Testing under a rainfall simulator

Results and Discussion

The hydrological performance investigations are involving the investigation of runoff hydrograph shape and peak runoff. The experimental green roofs are set up for complete green roof system on 0%, 2% and 6% of slope. The result on hydrological performances of GR using waste materials and natural fibres are discussed on each hydrological investigation. These results also give insights on hydrological performance of green roof using natural fibres as filter layer and waste materials as drainage layer for stormwater runoff mitigation.

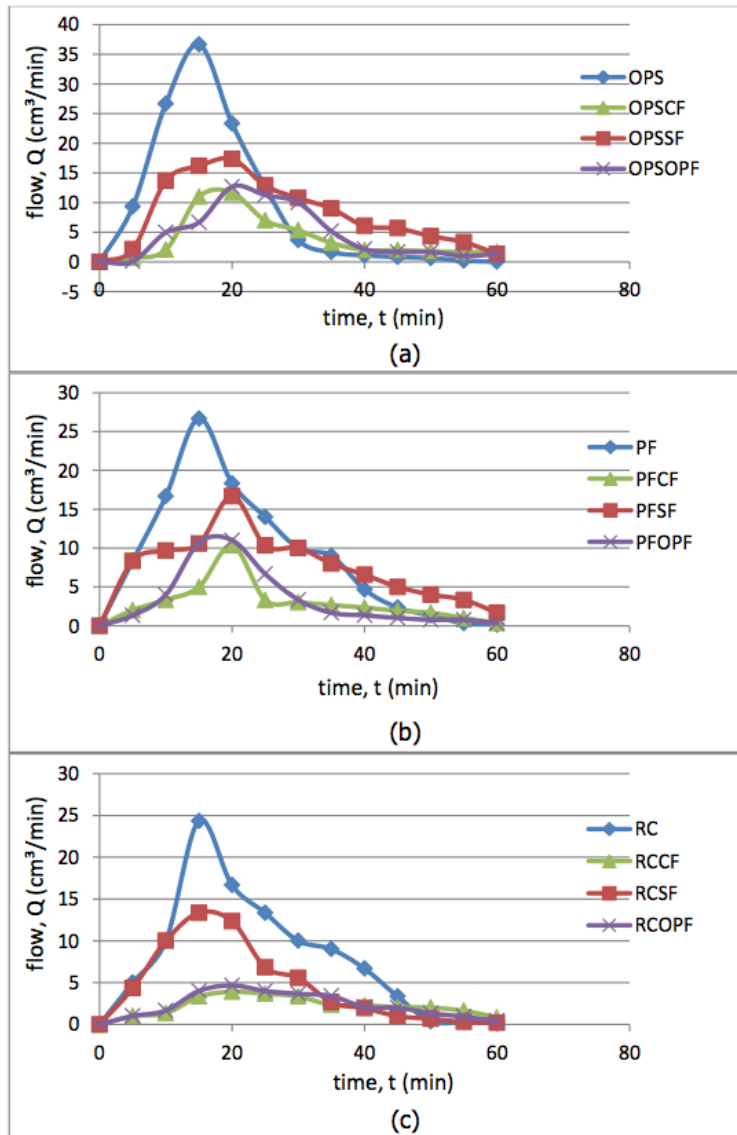


Figure 5: Hydrograph shape of complete GR system made from RWM and NF on 0% slope: (a) OPS with NF, (b) PF with NF, (c) RC with NF

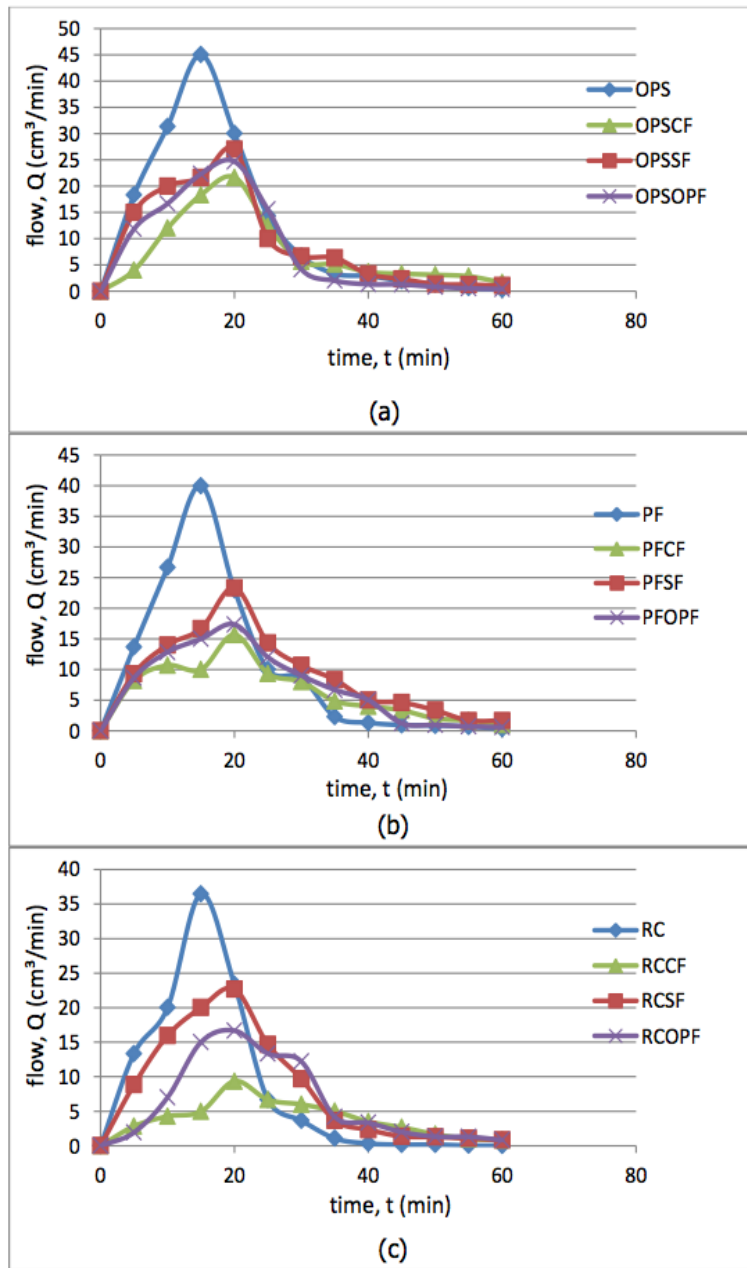


Figure 6: Hydrograph shape of complete GR system made from RWM and NF on 2% slope: (a) OPS with NF, (b) PF with NF, (c) RC with NF

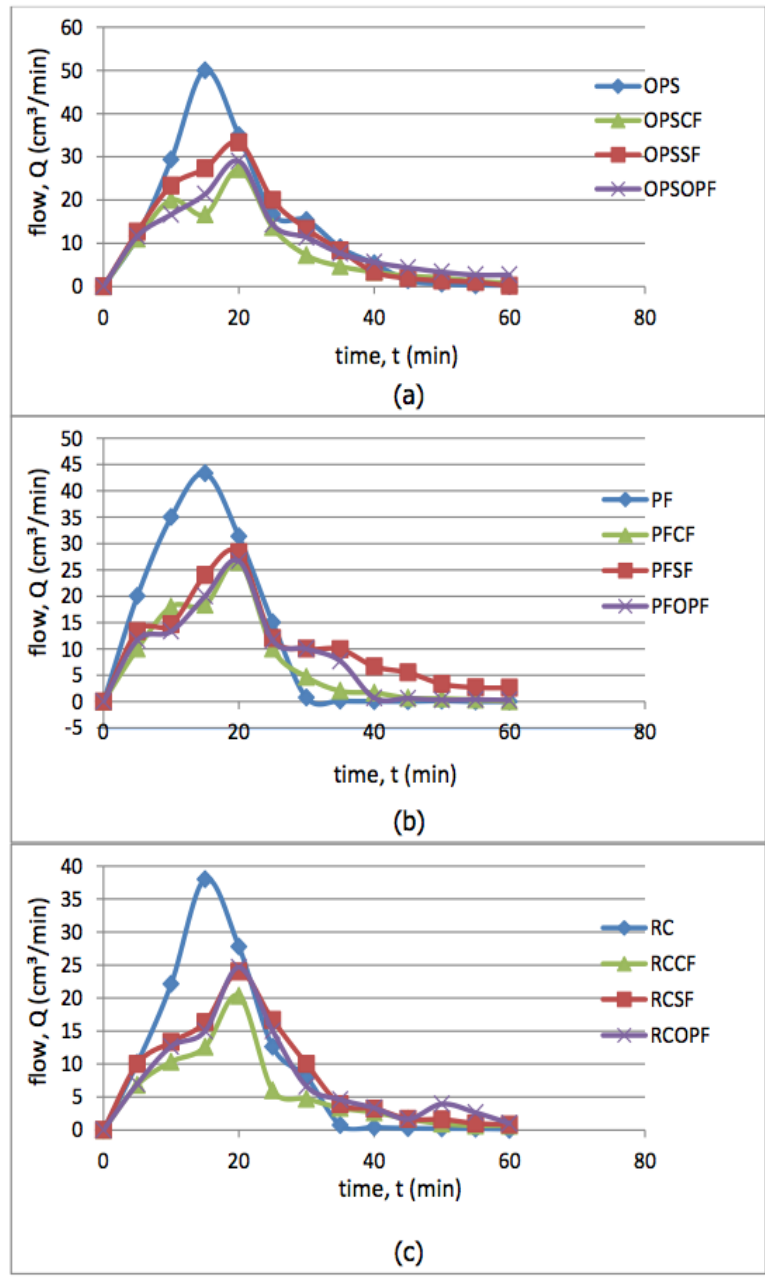


Figure 7: Hydrograph shape of complete GR system made from RWM and NF on 6% slope: (a) OPS with NF, (b) PF with NF, (c) RC with NF

Table 3: Peak runoff of green roof system

Materials		Peak Runoff (mm)											
		C			OPS			PF			RC		
Slope (%)		0	2	6	0	2	6	0	2	6	0	2	6
Waterproofing layer		11.66	13.21	14.76	-	-	-	-	-	-	-	-	-
Waterproofing with drainage layer		-	-	-	8.55	10.49	11.66	6.22	9.32	10.10	5.67	8.50	8.86
Waterproofing with drainage layer and filter layer	SF	-	-	-	6.22	8.55	10.10	5.35	7.73	8.12	4.66	6.99	7.61
	OPF	-	-	-	5.94	6.99	8.55	4.66	6.57	7.15	4.27	6.06	6.37
	CF	-	-	-	5.59	6.45	7.38	4.27	6.22	6.99	3.19	5.05	6.06
Waterproofing with drainage layer, filter layer, substrate and vegetation	SF	-	-	-	4.04	6.29	7.77	3.89	5.44	6.60	3.11	5.28	5.59
	OPF	-	-	-	2.95	5.75	6.76	2.56	4.04	6.22	1.09	3.89	5.75
	CF	-	-	-	2.72	5.05	6.32	2.41	3.65	6.17	0.91	2.18	4.74

Table 3 shows the peak runoff data extracted from the hydrograph. For waterproofing with drainage layer (Stage 1), OPS has the highest peak runoff (0%: 8.55 mm; 2%: 10.49 mm; 6%: 11.66 mm). Then followed by PF with a range of 6.22 mm (0% slope) to 10.10 mm (6% slope) and finally RC with the lowest peak runoff among the drainage layer (0%: 5.67 mm; 2%: 8.50 mm; 6%: 8.86 mm). Comparing with the control, all the materials used in the drainage layer of GR system reduced the value of peak runoff, as some of the water are being absorbed and filtered before the water passing through the drainage layer.

For the test bed GR on stage 2 (waterproofing with drainage and filter layer) and stage 3 (waterproofing with drainage layer, filter layer, substrate and vegetation), peak runoff is reduced after each stage. Addition of the GR layer causes a reduction in the peak runoff through the water absorption by GR and distributes the runoff slowly through the release of the excess water that is in the substrate pores (Mentens et al., 2006; Molineux et al., 2009).

For the complete GR system made from NF as filter layer and RWM as drainage layer (Stage 3), the combination of OPS with SF have the highest peak runoff value on 0% 2% and 6% of slope with a value of 4.01 mm, 6.29 mm and 7.77 mm, respectively. Followed by OPS with OPF (0%: 2.95 mm, 2%: 5.75 mm, 6%: 6.76 mm) and OPS with CF (0%: 2.72 mm, 2%: 5.05 mm, 6%: 6.32 mm).

Peak runoff on the cases where only drainage layer is considered, water can easily pass through the medium (Shahid et al., 2015). But after the substrate was added on top of the drainage layer, the peak runoff has been reduced. This was caused by the effect of substrate layer that has an ability to retain water and also due to the effect when water passes down through the soil particles to fill the pores in drainage layer. Thus, causes reduction value in the peak runoff. For the slope factors shows a linear relationship where the peak runoff increases as the slope are higher.

Conclusion

The result indicates that the combination of oil palm shells with sugarcanes fibres have the highest peak runoff value for 0%, 2% and 6% of slope with a value of 4.01 mm, 6.29 mm and 7.77 mm, respectively. Followed by oil palm shells with oil palm fibres (0%: 2.95 mm, 2%: 5.75 mm, 6%: 6.76 mm) and oil palm shell with coconut fibres (0%: 2.72 mm, 2%: 5.05 mm, 6%: 6.32 mm). The results proved that combination of oil palm shell and sugarcanes fibres give better performance in peak runoff value compared to other materials. From the investigations

of green roofs made from natural fibres and recycled waste materials, it can be concluded that it is possible to further in developing the green roofs system for stormwater runoff mitigation using these materials. However, there is a need to study in-depth on the saturated hydraulic conductivity of the material used in drainage and filter layer of the green roof as it can improve the permeability of water to enhance the runoff and preventing clogging.

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LIFE CYCLE ASSESSMENT OF INTERLOCKING COMPRESSED EARTH BRICK AND CONVENTIONAL FIRED CLAY BRICK FOR RESIDENTIAL HOUSE

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Abstract. *The conventional fired clay brick (FCB) is a significant building material in the construction industry. However, Besides, the construction field nowadays is designed and constructed without the considerations on the environmental impacts. Thus, the interlocking compressed earth brick (ICEB) was introduced replacing the conventional brick where the brick is not fired, thus contribute to carbon emissions reduction and in line with environmental issues regarding air pollution and global warming. In this paper, a comparative study on Life Cycle Assessment (LCA) is carried out for a residential house using conventional FCB and ICEB as the wall system by focussing on the global warming potential (GWP) impact. The adoption of the ICEB in green building construction can lower energy consumption and reduce the overall environmental impact and has the potential in carbon footprint reduction.*

Introduction

The fired clay bricks (FCB) or burnt clay brick were used in construction industries as a significant building material throughout the world. The FCB is strong, hard, durable, resistive to abrasion and fire, which make it suitable to be used as a structural material, especially in building construction. However, the manufacturing process of the FCB which involving the fuel burning for the firing process cause pollutants and ash emission into the air. Also, the conventional construction method using FCB and reinforced concrete (RC) framing is time-consuming and costly. Thus, ICEB becomes as an alternative to conventional production and system where the brick is fabricated by compressed method (not fired) thus reduce carbon emissions. Furthermore, the interlocking design made the house construction easy to construct with no formwork wastage. The use of ICEB has gained rapid popularity in many foreign countries as an alternative to conventional bricks for sustainable housing.

Nowadays, environmental issues have reached worldwide attention. Quantification analysis using Life Cycle Assessment (LCA) is used to measures the environmental impact in building construction. This paper is focussing on the materials used as a wall system in the residential or building construction. The adoption of the ICEB system in green building construction can lower the energy consumption and reduce the overall environmental impact and has the potential in carbon footprint reduction, in line with Malaysia goals to reduce the carbon emission by the year 2020.

Literature Review

Razman, Abdullah, Md Noh, and Abd Wahid [1] summarized that the building envelopes contribute the significant proportion of the materials used in the residential buildings, walls contributing 46% and roofs 16%. In masonry construction, brick is used to make walls,

pavements, and other elements. In general, there are five common types of brick which are conventional brick (FCB), engineering brick (ICEB), sand-lime bricks, concrete brick, and fly ash brick. This paper compares the conventional FCB (used in general work) with the ICEB (excellent load-bearing capacity) by using LCA in term of GWP.

Fired Clay Brick (FCB) ‘vs’ Interlocking Earth Brick (ICEB)

Conventional fired clay brick (FCB) used as a traditional wall material in the building construction. It is a solid unit of building with standard size and weight. The FCB produced in different colours (dark brown, dull brown, or dark red) depending on the fire temperature during manufacturing process of the bricks which varies from 900°C to 1200°C [2]. In the construction system, the usage of bricks as structural and non-structural elements are unreplaceable, and the conventional brick required burning process during manufacturing. However, this is not in line with environmental issues regarding air pollution and global warming due to increased production of carbon dioxide gas in the conventional combustion bricks process [3].

Recently in Malaysia, ICEB in the building construction receive varied recognition. There is an increasing interest due to its green characteristics and economic factors [1]. Interlocking block or interlocking brick is IBS block type system where the brick are made of soil, cement, and water, which the ideal soil composition for the mixture to produce the bricks is sandy soil with a clay content of 30% and soil content of 70%. However, if the soil contains too high of the clay content, more sand is added to achieve the desired proportions. The mixture is then compressed in a hydraulic press machine, which results in a compacted brick with high density. The ICEB is different from the conventional FCB as no mortar work is required for the masonry work since the brick is interlocked with each other and preventing horizontal movement between them. Due to this characteristic, Asman et al. (2018) and Nasly & Yassin (2010) also mentioned that the walling process of construction could be improved as the process of building walls is faster and requires less skilled labour as the blocks are laid dry and lock into place [4][5]. These bricks can be used for all kinds of structures like load-bearing walls, lintels, sills and wall corners [6]. Interlocking bricks system produced without the burning process, thus contribute to carbon emissions reduction as mentioned by Zultiniar et al. [3] in their study that brick making without combustion process is capable of reducing carbon dioxide emissions. Figure 1 shows the properties comparison of FCB and ICEB.

Table 1. Properties comparison of FCB and ICEB [1]

Properties	FCB	ICEB
Density (kg/m ³)	1400-2400	Dry: 1687.2 Wet: 1898.9
Compressive strength (N/mm ²)	5-60	Dry: 14.8 Wet: 12.5

Life Cycle Assessment (LCA)

Life cycle assessment (LCA) is a support tool for environmental management, through quantitative analysis the environmental impact in the whole life cycle of product or service [7]. Others study by Biswas [8] define LCA as a support for decision-making process with quantitative data in reviewing alternative management scenarios to improve environmental performances. While Hoon [9] mentioned that LCA is a framework and methodology for the identification of environment-friendly products or processes characterized by the analysis of cumulative environmental impacts overextended system boundaries. The carbon footprint or carbon dioxide emission can be measured by using the LCA approach. The LCA analysis is the dominant method for project carbon footprint evaluation [10]. Figure

1 shows the Life cycle stages of construction works by BS EN 15978: 2011 [11]. In this paper, the LCA boundary is from ‘cradle-to-gate’ which focuses on the construction process stage.

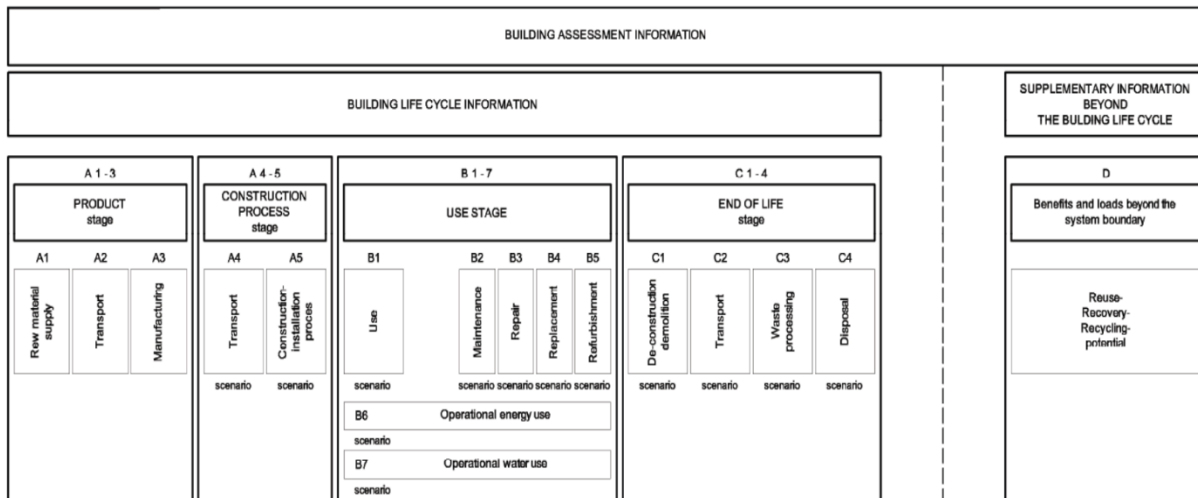


Figure 1. Display of modular information for the different stages of the building assessment [11]

Carbon emission

A recent review of building life cycle assessments demonstrated that embodied carbon could account for anywhere between 2% and 80% of whole-life carbon emissions [12]. A recent study by Abubakar, Mohammed, Abubakar, & Ikara [13] analyzes the Embodied Energy (EE) and Carbon IV Oxide (CO₂) emission of Sandcrete Blocks (SCB) and Compressed Earth Bricks (CEB) houses. The comparison revealed that the Compressed Earth Brick house is more sustainable and environmentally friendly in terms of EE and CO₂ emission than the Sandcrete Blockhouse.

Studies by Maheshwari & Jain [14] and Vishwavidhyalaya [15] done on carbon dioxide emission per 1000 bricks of bricks manufacturing having conventional fired brick, fly ash brick and autoclaved aerated block with a CO₂ emission of 427.99 kgCO₂, 1.326 kgCO₂ and 99.26 kgCO₂, respectively. Technical manual by UNIDO reported that compressed earth brick (CEB) produced 56.79 kgCO₂ per m³ wall, 230.06 kgCO₂ per m³ wall of kiln-fired brick and 547.30 kgCO₂ per m³ wall of country fired brick.

A study by Abd Rashid, Idris, & Yusoff [16] found that the carbon emission of the energy-efficient house using autoclave aerated block reduced the carbon emission compared to a semi-detached house using the conventional clay brick.

Methodology

Case Studies Details

Universiti Malaysia Sabah’s project in Tawau, Sabah using ICEB construction system are selected as a case study. Figure 2 and 3, show the floor plan and the elevation view of model house, respectively. As shown in Figure 4 is Tawau Community Housing using ICEB system having the area 57.14 m² (615 ft²). The construction stage from life cycle assessment (LCA) method was used to calculate the carbon footprint with boundary limitation of “Cradle to gate” without considering the transportation. In this paper, the amount of carbon emission for each project has been extracted from the Bill of Quantities (BQ) in the contract document.

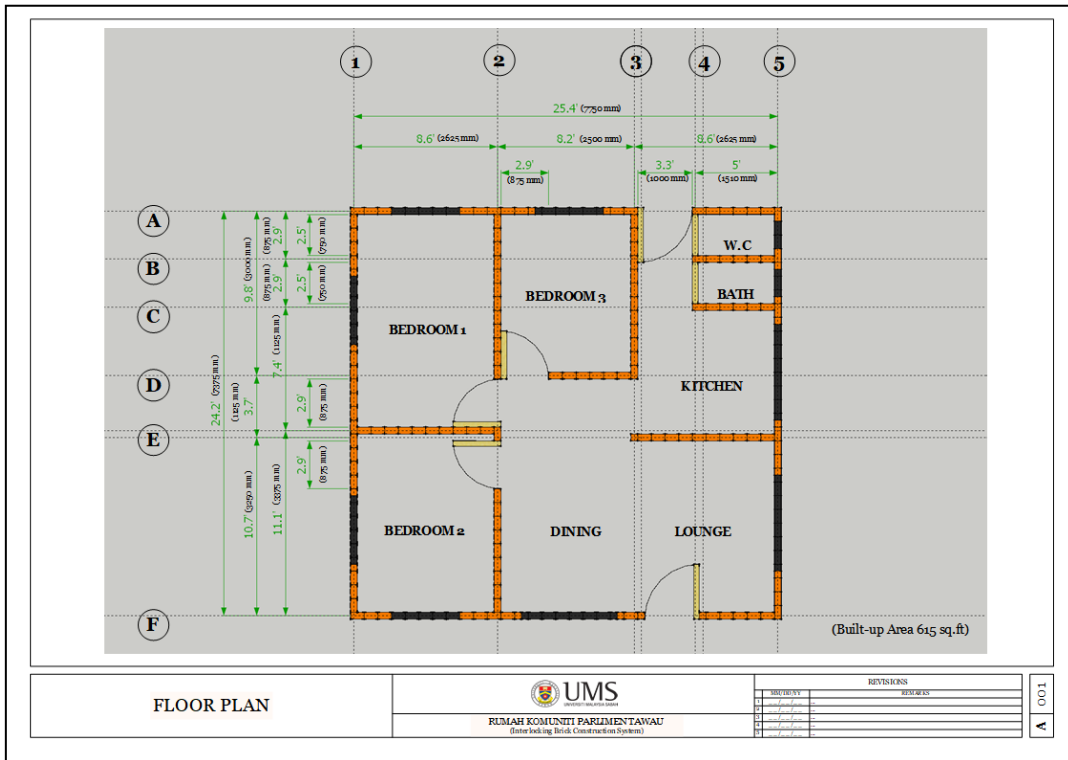


Figure 2. Floor plan of the model house (sketch-up layout).

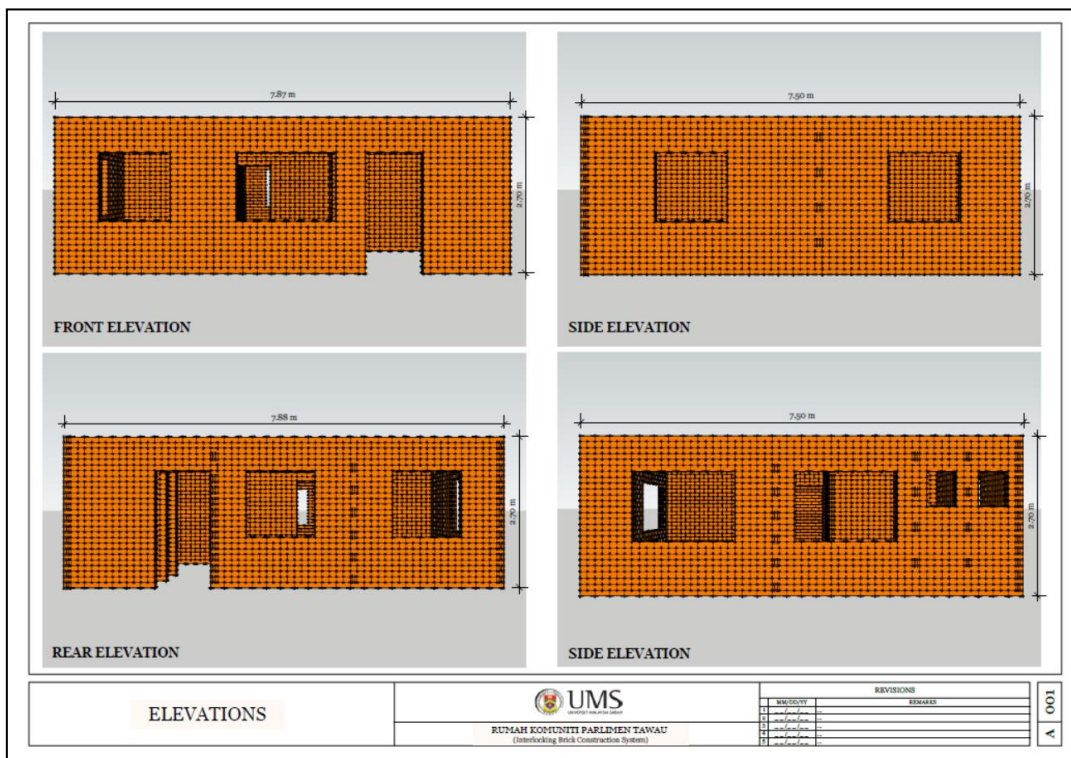


Figure 3. Elevation view of the model house (sketch-up).



Figure 4. Tawau Community Residential Housing using ICEB system.

Result and Discussion

From the BQ of Tawau community residential houses project (Table 2), the application of ICEB in building construction eliminates the frame for column and beam (formwork) during construction and reduce the cement intake as no plastering work involved. This can lead to lower energy and reduce the carbon footprint in building construction compared to the conventional construction using the FCB.

Table 2. Quantity of materials for residential houses using FCB and ICEB.

Element	Description	FCB	ICEB
A - Works below ground floor	Excavation (Not exceed 1.0m deep)	65 m ²	65 m ²
	Lean Concrete Grade 15 to Ground floor (50mm thk.)	3 m ³	3 m ³
	Installation of damp proof membrane (0.25 mm thk.)	65 m ²	65 m ²
	Installation of BRC A8 (2 layers)	130 m ²	130 m ²
	Concrete Grade 30 to Ground floor (150 mm thk.)	9 m ³	9 m ³
	Floor Finishing; Cement & Sand rendered (1:3)	65 m ²	65 m ²
B - Frame (Column GF-RB)	Column GF-RB		
	Vibrated reinforced concrete Grade 30	13 m ³	-
	HT Dia. 12mm	129 kg	-
	MT Dia. 8mm	106 kg	-
	Class F1 Formwork	35 m ²	-
	Roof Beam		
	Vibrated reinforced concrete Grade 30	3 m ³	-
	HT Dia. 12mm	110 kg	-
	MT Dia. 8mm	53 kg	-
	Class F1 Formwork	33 m ²	-
FCB			

C – Internal and External Wall	230 mm Thick common brick wall jointed in cement mortar (1:3) as specified and reinforced with and including brick reinforcement at every third course and all necessary bonding ties	88 m ²	-
	Bituminous felt damp proof course as described laid horizontally under brick wall 300mm wide	23 m	-
	<i>Cement and sand (1:3) with an approved plasticiser as specified trowelled smooth to:-</i>		
	Wall, column & roof beam	200 m ²	-
	Approved 2 Coats of Nippon Acrylic Coating state finish	200 m ²	-
ICEB			
	ICEB walling	-	200 m ²
	2 Coats clear paint finish	-	200 m ²
D - Roofing	Galvanised lightweight truss system	70 m ²	70 m ²
	Roofing sheet G28 Long run	70 m ²	70 m ²
	Ridge clapping	9 m ²	9 m ²
	Long Facia board	34 m ²	34 m ²
E - Windows & doors	Natural anodised aluminium with 5mm thk. Tinted glass window 1400mm x 1900mm	8 Nos	8 Nos
	Installation of wood single leaf door including ironmongers, accessories and frame	5 Nos	5 Nos
F - Ceiling finishes	Ceiling board 2'x4'9.5mm (Hanging ceiling)	65 m ²	65 m ²

Conclusion

It can be concluded that ICEB having a less carbon dioxide emission compared to the conventional FCB in building construction. Thus, the ICEB able to reduce the carbon footprint for the global warming potential of the residential building.

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Acknowledgements

Authors wishing to acknowledge the financial support from Translational Research Grant Scheme (LRGS0008-2017) of Ministry of Higher Education Malaysia. Authors also would like to express thanks to Miss Masnih Mansur, a Project Engineer for providing information for this study.

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eISBN 978-967-2245-17-9



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