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MENGKAJI KADAR PENCAHAYAAN DI KOMPLEKS SUKAN JABATAN SUKAN KOKURIKULUM DAN KEBUDAYAAN, POLITEKNIK SULTAN MIZAN ZAINAL ABIDIN

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ABSTRAK

Berdasarkan kamus dewan, pencahayaan merujuk kepada jumlah fluks berkilau menuju ke permukaan per unit luas. Ia merupakan pengukuran keamatan cahaya tuju yang dicerap. Pencahayaan amatlah penting dan perlu dititik beratkan pada bangunan agar tiada ganguan terhadap keterangan cahaya ketika proses pengajaran dan pembelajaran dijalankan. Kajian ini dijalankan adalah bertujuan untuk menguji kadar pencahayaan di Kompleks Sukan Jabatan Sukan, Kokurikulum dan Kebudayaan. Politeknik Sultan Mizan Zainal Abidin. Hasil pengujian akan dianalisis berasaskan standard yang dikeluarkan oleh Chartered Institution of Building Services Engineers (CIBSE). Pengujian dijalankan dengan menggunakan alat penguji jumlah pencahayaan yang disukat dalam unit lux. Alatan pengujian yang digunakan adalah dari jenis Extech Light Meter (type 401026). Sistem pencahayaan di dalam bilik darjah perlu dipertimbangkan dengan sewajarnya dalam mereka bentuk bangunan dan pengurusan tenaga juga harus dioptimumkan. Penggunaan sistem pencahayaan yang buruk di sebabkan oleh rekabentuk lampu sedia ada tiddak mengikut spesifikasi standard yang dikeluarkan oleh CIBSE boleh menyebabkan produktiviti yang rendah, keselesaan dan juga menyebabkan pembaziran tenaga. Hasil kajian ini perlu dipanjangkan kepada Unit Pembangunan dan Penyelenggaraan Politeknik Sultan Mizan Zainal Abidin untuk tujuan penambahbaikan. Penambahbaikkan yang dicadangkan adalah menambah lampu Philip LED T5 pada bahagian tepi setiap gelanggang.

1. Pengenalan

Politeknik Sultan Mizan Zainal Abidin (PSMZA) ditubuhkan pada tahun 2001 yang dulunya dikenali sebagai Politeknik Dungun Terengganu. Kompleks sukan ini dilengkapi dengan tiga (3) gelanggang badminton dan 2 (dua) gelanggang sepak takraw bagi membolehkan pelajar dan kakitangan PSMZA menjalankan aktiviti sukan.

Rajah 1: Kedudukan Kompleks Sukan, Politeknik Sultan Mizan Zainal Abidin.

Pencahayaan amatlah penting dan perlu dititikberatkan pada bangunan ini agar tiada ganguan terhadap keterangan cahaya ketika aktiviti sukan badminton dijalankan. Gangguan seperti cahaya yang malap boleh menyebabkan aktiviti sukan ini terganggu seterusnya boleh menyebabkan ianya tidak dapat dilaksanakan dengan baik.

Berdasarkan kamus dewan, pencahayaan merujuk kepada jumlah *fluks* berkilau menuju ke permukaan per unit luas. Ia merupakan pengukuran keamatan cahaya tuju yang dicerap. Dalam unit terbitan SI, kedua-dua ini diukur menggunakan unit *lux (lx)* atau *lumen* per meter persegi (cd·sr·m-2) (Randall McMullan 2012).

Murujuk kepada Evi Puspita Dewi yang bertajuk Optimasi Desain Pencahayaan Ruang Kelas SMA Santa Maria Surabaya, (Dimensi Interior 2016). Sistem pencahayaan di dalam bilik darjah perlu dipertimbangkan dengan sewajarnya dalam mereka bentuk bangunan dan pengurusan tenaga juga harus dioptimumkan. Penggunaan sistem pencahayaan yang buruk menyebabkan produktiviti yang rendah, keselesaan dan juga menyebabkan pembaziran tenaga.

1.1 Tujuan Kajian

Kajian ilmiah ini dilaksanakan adalah untuk mengetahui tahap pencahayaan di ruang gelanggang badminton dan sepak takraw di Kompleks Sukan, Jabatan Sukan, Kokurikulum dan Kebudayaan PSMZA. Tujuan yang ingin dicapai adalah:
a)Untuk menguji kadar pencahayaan di ruang gelanggang badminton dan sepak takraw di Kompleks Sukan, Jabatan Sukan, Kokurikulum dan Kebudayaan PSMZA.
b)Untuk menganalisis hasil ujian berdasarkan standard yang dikeluarkan oleh *Chartered Institution of Building Services Engineers (CIBSE).*

1.2 Pernyataan masalah.

Politeknik merupakan institusi yang melahirkan altet sukan negara. Kelengkapan dan fasiliti sukan yang baik diperlukan bagi melahirkan altet sukan politeknik yang cemerlang. Kelengkapan fasiliti yang kurang sempurna akan fasiliti akan menggangu prestasi pemain akan tergangu. Permainan badminton amat mementingkan faktor pencahayaan bagi membolehkan permainan dijalankan.

2. Kajian Terdahulu

Kekurangan pencahayaan akan menyebabkan isu kurang selesa dikalangan pemain. Berdasarkan tinjauan bersama wakil rakyat Luyang; Dr. Hiew Keng Chiew mendapati kedudukan lampu limpah ketika ini, sangat tidak selesa untuk para pemain, dan boleh mendatangkan masalah penglihatan dalam jangka masa panjang (Desmond Qwek Utusan Borneo 2017).

Kadar pencahayaan gelanggang perlu mengikut standart yang telah ditetapkan. Pengubahsuaian terhadap pencahayaan yang kurang adalah perlu untuk memastikan setiap sesi Latihan dan pertandingan sukan dapat berjalan dengan lancar. Pencahayaan lampu limpah Stadium Sultan Ismail Nasiruddin dinaik taraf. Kerajaan negeri Terengganu akan menaik taraf pencahayaan lampu limpah Stadium Sultan Ismail Nasiruddin Shah di sini dari 800*lux* kepada 1,200*lux* untuk mengadakan perlawanan bola sepak (Bernama 2013).

3. Kaedah Kajian

Komplek sukan ini terbahagi kepada beberapa ruang iaitu, ruang gelanggang badminton dan sepak takraw, ruang bilik kebudayaan, ruang *indoor games*, ruang *squasy*, ruang tandas, ruang stor utama dan ruang bilik wataniah. Salah satu ruang di kompleks sukan ini terdiri daripada ruang gelanggang badminton dan sepak takraw. Ruang berukuran 128 meter panjang dan 22 meter lebar. Ruangan ini mempunyai bukaan sebanyak 2816m². Kajian ini adalah untuk menguji kadar pencahayaan buatan di dalam kompleks sukan berdasarkan standart yang di keluarkan oleh *Chartered Institution of Building Services Engineers (CIBSE*).

3.1 Pemeriksaan alatan pengujian.

Alat pengujian yang digunakan adalah *lux meter* iaitu alat untuk mendapatkan jumlah pencahayaan yang disukat dalam unit lux. *Lux meter* yang digunakan adalah dari jenis *Extech Light Meter (type 401026)*. Alat ini adalah alat yang telah dikenalpasti sebagai alat pengujian yang jitu dan mengikut standart yang dikeluarkan oleh SIRIM. Sebelum pengujian dilakukan, terlebih dahulu alat ini perlu menjalani pengujian penentukuran (*calibration*) bagi mendapatkan bacaan yang lebih tepat. Setiap kali sesi bacaan diambil, proses penentukuran akan dilakukan.

Lux meter ini mempunyai dua komponen utama iaitu bahagian meter bacaan dan sensor. Meter akan menunjukkan bacaan pencahayaan yang diperolehi. Manakala sensor pula berperanan untuk menyukat jumlah pencahayaan yang diterima dan dihantar ke meter. Sensor pada alat ini amat sensitif terhadap sebarang perubahan pencahayaan, oleh itu perlu dipastikan sensor ini tidak dihalang ketika kajian di setiap stesen dijalankan. Bacaan yang digunakan untuk menyukat pencahayaan ialah dalam unit *lux*.

Rajah 2: *Extech Light Meter (type 401026).*

3.2 Jenis Lampu.

Lampu yang digunakan pada Kompleks Sukan PSMZA ialah lampu *Light-emitting diode* (LED) jenis pandaflour T8 Philip (TL8 *Essential* 28W/8401SL/40) dengan kuasa sebanyak 20 *watt*. Lampu jenis ini menghasilkan suhu warna korelasi iaitu *Correlated Color Temperature* (CCT) sebanyak 6500 °K (cool daylight). Manakala nilai *fluks* minimum bagi lampu jenis ini adalah 2100 *lumen*. Pada ruangan bangunan ini, lampu ini di susun secara am iaitu secara grid

mendatar sebanyak 7 perumah padan setiap baris dengan setiap satunya dilengkapi dengan 4 batang lampu. Terdapat sebanyak 15 baris lampu lengkapan perumah bagi kumpulan lampu T8 Philip (TL8 *Essential* 28W/8401SL/40) yang ada di ruangan gelanggang tersebut. Jumlah lampu lampu T8 Philip (TL8 *Essential* 28W/8401SL/40 yang digunakan di ruangan tersebut adalah sebanyak 420 biji keseluruhan bagi menerangi gelanggang tersebut.

Rajah 3: Lampu T8 Philip LED.

3.3 Warna ruang bangunan.
Warna dinding ruangan ini adalah berwarna putih manakala bumbung ruangan ini berwarna gelap yang tidak dilengkapi dengan siling. Warna pada dinding ruangan ini merupakan warna yang dapat memantulkan cahaya yang baik (Randall McMullan 2012). Warna berkenaan akan dapat membantu menerangi ruang melalui pantulan cahaya lampu.

3.4 Pengukuran ruang bangunan.
Pengukuran terhadap bangunan ini diambil dalam meter persegi (m^2). Pengukuran dijalankan dengan mengambil panjang dan lebar bangunan, dan diukur dalam unit meter (m). Dimensi bangunan berkenaan berukuran 128 meter panjang dan 22 meter lebar dengan ketinggian aras lantai ke siling ialah 15meter. Keluasan bangunan adalah berukuran 2816m^2, dengan isipadu bangunan bersaiz 42240m^3. Saiz bukaan pintu berkeluasan diukur dengan jumlah keseluruhan ialah sebanyak 6.40m^2. Ketika pengujian dijalankan, kesemua bukaan seperti pintu ditutup agar cahaya semulajadi tidak dapat masuk dalam ruangan gelanggang.

3.5 Pengrekodan jam masa ketika bacaan diambil.
Jam masa direkodkan ketika bacaan diambil bagi setiap sesi pengujian, untuk mendapatkan julat waktu yang hampir sama bagi setiap minggu pengujian diadakan. Pengujian dijalankan pada waktu kelas kokurikulum pada jam 3 petang sehingga 5 petang yang diadakan di ruangan gelanggang tersebut yang digunakan oleh pelajar. Pengujian dijalankan dalam tempoh empat (4) minggu bermula pada 17 Mei 2023, 24 Mei 2023, 31 Mei 2023 dan 7 Jun 2023. Pengujian dijalankan dalam tempoh ini bagi mendapat bacaan yang tepat memandangkan terdapat pencahayaan luaran yang akan mempengaruhi bacaaan. Pencahayaan luaran dipengaruhi oleh faktor cuaca dimana pencahayaan semulajadi akan sedikit ketika cuaca mendung.

3.6 Bacaan diambil dalam ruangan.
Bacaan diambil dalam ruangan dengan mengambil kira bukaan yang tertutup bagi mendapatkan bacaan cahaya buatan yang tepat. Perkara ini bagi mengelakkan ralat bacaan yang mungkin berlaku jika bukaan dibuka disebabkan oleh cahaya semulajadi. Bacaan ketika lampu dihidupkan sepenuhnya merupakan bacaan jumlah pencahayaan buatan. Kedua-dua bacaan ini kemudiannya akan di analisa untuk mendapatkan bacaan dari lampu buatan sahaja.

3.7 Bacaan keputusan pengujian pencahayaan dalaman.

Bacaan diambil dalam keadaan lampu tertutup dan semua lampu terbuka. Bacaan diambil untuk pencahayaan semulajadi dan cahaya buatan. Angin akan mempengaruhi pergerakan bulu tangkis, bukaan seperti tingkap dan pintu perlulah ditutup. Fakor ini secara tidak langsung akan menghadkan cahaya semulajadi memasukki ruang gelanggang. Ketika menggunakan *lux meter*, pemerhatian perlu dilakukan pada sensor *lux meter*, sensor berkenaan hendaklah tidak dilindungi dengan apa-apa objek bagi mengelakkan ralat pada bacaan yang diperolehi. Bacaan perlu diambil sebanyak tiga (3) kali bagi mendapatkan bacaan purata untuk setiap titik.

3.8 Kaedah bacaan dilakukan.

Pengujian dijalankan di dalam bangunan dengan mengenal pasti titik bacaan yang akan diambil di dalam bangunan dengan merujuk kepada teknik pengukuran lapangan basket (Agityawan Ranga Manyurang 2022). Bacaan dalam ruangan tersebut diambil pada bahagian lantai gelanggang disebabkan oleh permainan pemain badminton memerlukan penglihatan yang jelas ketika berada di gelanggang. selain itu, ianya juga memenuhi etika mendapatkan bacaan pencahayaan bersadarkan *Chartered Institution of Building Services Engineers (CIBSE)*.

Bacaan diambil dalam bentuk grid di kawasan dalam gelanggang badminton dan sepak takraw. Hal ini bertujuan untuk memastikan kajian akan dilakukan pada tempat yang sama selama empat (4) minggu bacaan juga direkodkan. Sebanyak dua belas (12) titik bacaan dikenal pasti dan bacaan diambil dalam bentuk tiga (3) baris mendatar dan empat (4) baris menegak dengan 3meter ukuran selanya.

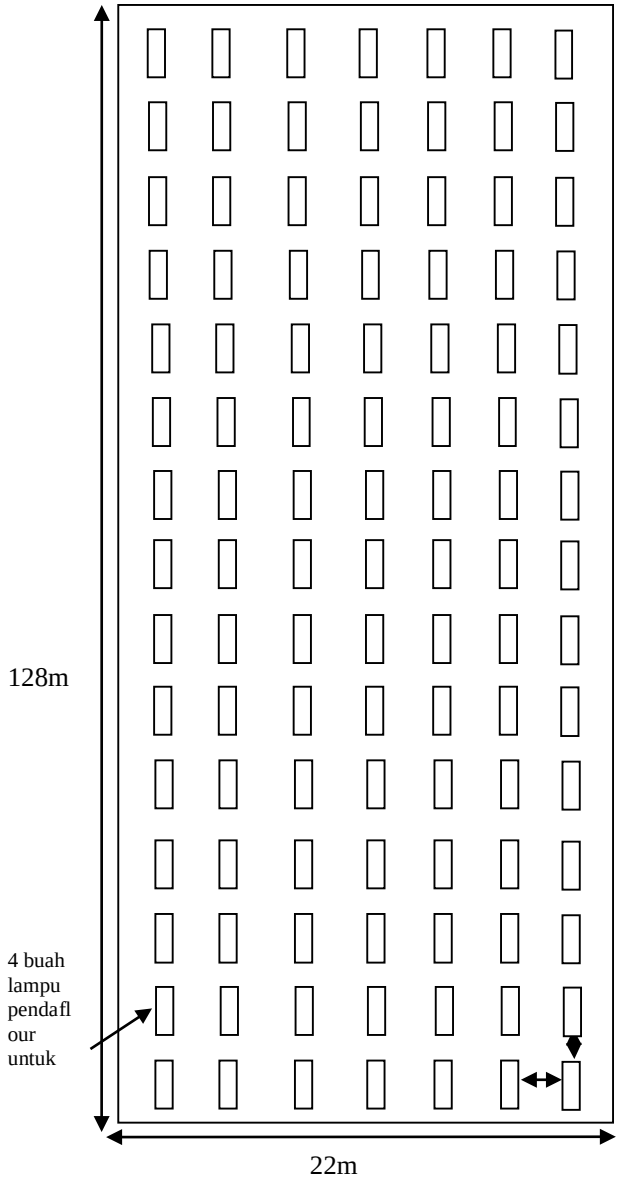
Rajah 4: Susun atur lampu kompleks sukan.

Rajah 5: *Gelanggang Badminton.*

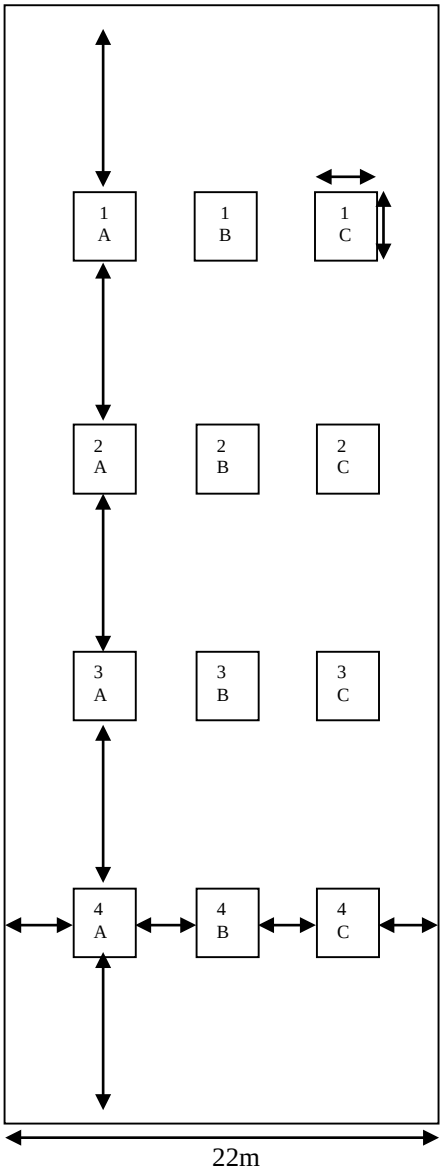
3.9 *Work bench* (titik pengujian pengujian).

Pengujian di jalankan pada aras lantai gelanggang. Setiap titik bacaan data disusun dengan secara melintang dan mendatar. Ianya juga dilabelkan dalam 3 kumpulan iaitu:

a) Kumpulan pertama ialah pada barisan tepi dilabelkan dengan 1A, 1B dan 1C.
b) Kumpulan kedua ialah pada barisan tengah dilabelkan dengan 2A, 2B dan 2C.
c) Kumpulan ketiga ialah pada barisan tepi dilabelkan dengan 3A, 3B dan 3C.
d) Kumpulan keempat ialah pada barisan tepi dilabelkan dengan 4A, 4B dan 4C.



Rajah 6: Pelan susun atur lampu di dalam ruangan gelanggan



Rajah 7: Pelan titik pemerhatian bacaan cahaya

4. Keputusan

Bacaan diambil dalam keadaan lampu tertutup dan semua lampu terbuka. Bacaan diambil untuk pencahayaan semulajadi dan cahaya buatan sahaja yang akan diuji. Memandangkan permainan badminton memerlukan bukaan semua ditutup untuk mengelakkan angin, bukaan seperti pintu adalah perlu ditutup. Hal ini akan menghadkan kemasukkan pencayaan ke dalam dewan gelanggang. Pencahayaan buatan iaitu dari cahaya yang dikeluarkan oleh lampu-lampu yang terdapat dalam ruang dewan berkenaan. Bacaan diambil dalam jangka masa empat (4) minggu pengujian dijalankan. Ketika menggunakan *lux meter*, pemerhatian perlu dilakukan pada sensor *lux meter*, yang mana sensor berkenaan hendaklah tidak dilindungi dengan apa-apa

objek bagi mengelakkan ralat pada bacaan yang diperolehi. Bacaan perlu diambil sebanyak tiga (3) kali bagi mendapatkan bacaan purata untuk setiap titik.



Rajah 8: Kajian dijalankan di ruangan gelanggang badminton.

Jadual 1: Bacaan sebelum (pencahayaan semulajadi)

.

Bacaan	Minggu Pertama *(lux)*			Minggu Kedua *(lux)*			Minggu Ketiga *(lux)*			Minggu Keempat *(lux)*		
1	10	10	13	11	12	13	11	11	13	12	15	14
2	7	7	6	7	6	6	6	6	6	9	8	7
3	2	2	2	1	2	2	2	2	2	3	2	2
4	3	3	3	3	3	3	3	3	3	3	4	3

Merujuk kepada jadual 1, didapati bacaan yang paling tinggi adalah 15*lux* iaitu pada minggu keempat pada titik bacaan 1B. Manakala bacaan yang paling rendah ialah 1*lux* berada pada minggu kedua pada titik 3A.

Jadual 2: Bacaan selepas (jumlah pencahayaan semulajadi dan pencahayaan lampu).

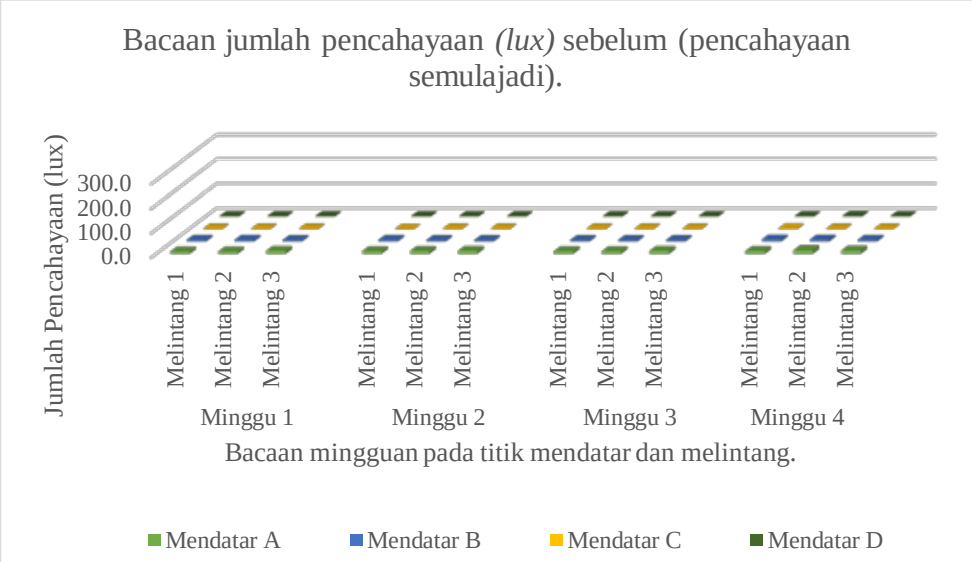
Bacaan	Minggu Pertama *(lux)*			Minggu Kedua *(lux)*			Minggu Ketiga *(lux)*			Minggu Keempat *(lux)*		
1	111	152	130	105	150	131	113	151	131	115	155	138
2	116	150	127	114	151	127	115	149	127	118	152	131
3	151	192	163	149	193	164	153	194	164	156	200	166
4	142	162	142	143	161	143	145	161	144	148	168	146

Merujuk kepada jadual 2, didapati bacaan yang paling tinggi adalah 200*lux* iaitu pada minggu keempat pada titik bacaan 3B. Manakala bacaan yang paling rendah ialah 105*lux* berada pada minggu keempat pada titik 1A.

Jadual 3: Bacaan jumlah pencahayaan buatan

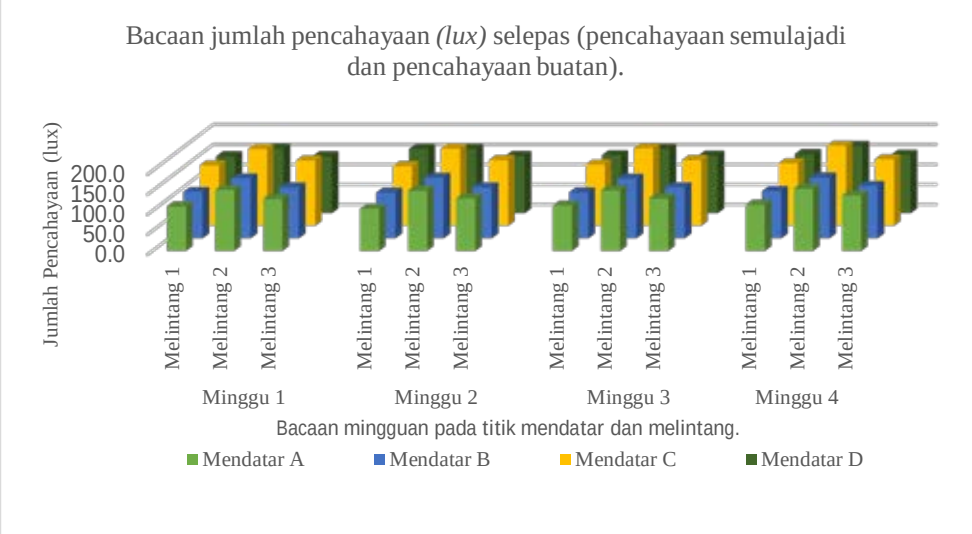
Bacaan	Minggu Pertama *(lux)*			Minggu Kedua *(lux)*			Minggu Ketiga *(lux)*			Minggu Keempat *(lux)*		
1	111	142	117	94	138	118	102	140	118	103	140	124
2	109	143	121	107	145	121	109	143	121	109	144	124
3	149	190	161	148	191	162	151	192	162	153	198	164
4	139	159	139	140	158	140	142	158	141	145	164	143

Merujuk kepada jadual 3, didapati bacaan yang paling tinggi adalah 198*lux* iaitu pada minggu keempat pada titik bacaan 3B. Manakala bacaan yang paling rendah ialah 94*lux* berada pada minggu keempat pada titik 1A.



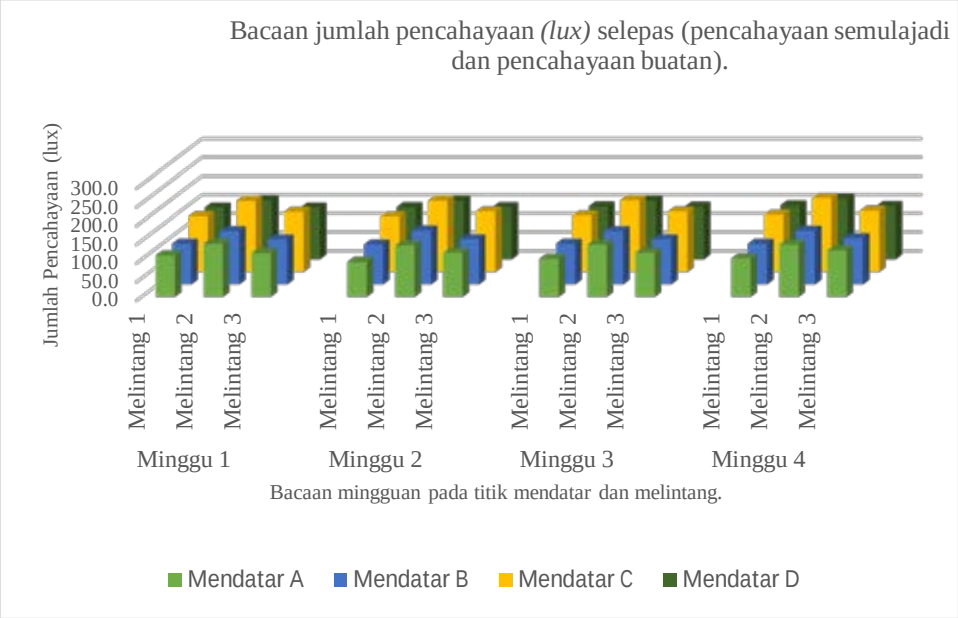
Rajah 9: Graf bar bacaan jumlah pencahayaan *(lux)* sebelum (pencahayaan semulajadi).

Berdasarkan rajah 9, didapati pencahayaan semulajadi paling banyak masuk ke dalam ruang bengkel pada minggu ketiga kajian iaitu pada 19 Julai 2016 dan bacaan ini berlaku pada titik-titik melintang D. Berdasarkan graf plot didapati bacaan cahaya siang yang memasuki ruang adalah sekata pada semua titik bacaan. Bacaan adalah dalam julat 0*lux* hingga 50*lux* sahaja.



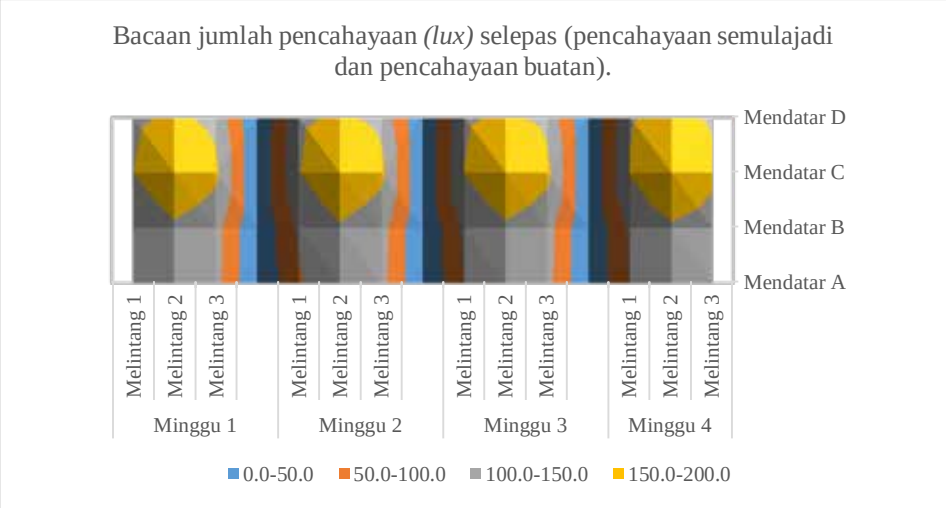
Rajah 10: Graf bar bacaan jumlah pencahayaan *(lux)* selepas (pencahayaan semulajadi dan pencahayaan buatan).

Berdasarkan rajah 10, didapati pencahayaan semulajadi dan buatan pada ruang kajian paling banyak diperolehi pada minggu keempat iaitu kajian yang dijalankan pada 26 Julai 2016 dan bacaan ini berlaku pada titik-titik melintang D. Berdasarkan graf plot didapati bacaan cahaya siang yang memasuki ruang adalah sekata pada semua titik bacaan. Bacaan adalah dalam julat 100*lux* hingga 300*lux*.



Rajah 11: Graf bar bacaan jumlah pencahayaan perbezaan selepas dan sebelum (pencahayaan buatan sahaja).

Berdasarkan rajah 11, didapati pencahayaan buatan pada ruang kajian paling banyak diperolehi pada minggu keempat iaitu kajian yang dijalankan pada 26 Julai 2016 dan bacaan ini berlaku pada titik-titik melintang D.



Rajah 12: Graf plot bacaan jumlah pencahayaan.

Berdasarkan analisa bacaan graf rajah 12, didapati plot pencahayaan menunjukkan bahawa taburan pencahayaan adalah tidak sekata. Plot pada graf menunjukkan pencahayaan lebih tinggi di bahagian tengah gelanggang. Manakala bacaan pada tepi bawah gelanggan menunjukkan pengurangan yang ketara. Faktor ini boleh menyebabkan pemain akan merasa kurang selesa dengan kadar pencahayaan yang tidak seimbang. Plot graf juga menunjukkan purata bacaan yang diperolehi adalah 150*lux*. Bacaan keputusan ini adalah kurang daripada 300*lux* seperti yang disyorkan oleh *Chartered Institution of Building Services* Engineers *(CIBSE)*. Oleh itu gelanggang ini tidak sesuai untuk diadakan pertandingan badminton.

5. Kesimpulan

Setelah semua ujian dijalankan pada hampir keseluruhan ruang gelanggang yang dikenalpasti, didapati bacaan secara keseluruhan adalah di antara 1*lux* sehingga kurang dari 300*lux*. Rujukan dilakukan terhadap jadual yang dikeluarkan oleh CIBCE untuk kategori gelanggang sukan badminton. Berdasarkan jadual ini, didapati jumlah pencahayaan minimum sepatutnya untuk gelanggang badminton yang adalah sebanyak 300*lux* bagi tujuan rekreasi. Manakala bagi tujuan pertandingan bacaannya memerlukan sehingga 1000*lux*. Data menunjukkan jumlah pencahayaan pada ruangan gelanggang dalam Kompleks Sukan Politeknik Sultan Mizan Zainal Abidin adalah tidak menepati standard yang dikeluarkan oleh CIBSE. Ketinggian lampu adalah kurang sesuai untuk sukan badminton. Bilangan lampu juga adalah tidak mencukupi dengan jarak antaranya tidak sesuai, rujukan teori jarak maksimum lampu adalah perlu untuk mendapatkan pencahayaan yang lebih baik. Hasil kajian ini perlu dipanjangkan kepada Unit Pembangunan dan Penyelenggaraan Politeknik Sultan Mizan Zainal Abidin untuk tujuan penambahbaikan. Penambahbaikkan yang dicadangkan adalah menambah lampu Philip LED T5 pada bahagian tepi setiap gelanggang. Lampu cadangan hendaklah di letakkan lebih rendah dari siling bangunan dengan penggunaan kabel dan motor secara boleh laras untuk mengangkat dan menurunkan lampu mengikut kesesuaian.

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KEHARMONIAN NEGARA MALAYSIA MELALUI RUKUN NEGARA: TINJAUAN TERHADAP MAHASISWA POLITEKNIK UNGKU OMAR

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ABSTRAK

Rukun Negara adalah manifesto falsafah negara yang telah ditetapkan selama bertahun-tahun. Ia bertujuan untuk memastikan masyarakat dari pelbagai kaum di negara ini hidup bersama dan bersatu padu. Artikel ini ditulis adalah untuk mengkaji tahap kesedaran tentang peranan Rukun Negara sebagai medium keharmonian di Malaysia dan keprihatinan dalam memastikan prinsip rukun negara terus relevan sebagai medium pembinaan dalam kalangan para pelajar Politeknik Ungku Omar (PUO). Kajian ini melibatkan 212 responden yang dipilih secara rawak. Kajian ini menggunakan kaedah pengumpulan data secara kuantitatif dengan melihat data secara diskriptif iaitu kekerapan, peratus, min dan sisihan piawai. Perisian digunakan untuk menganalisis keputusan kajian iaitu dengan menggunakan IBM Statistical Package for Social Science (SPSS) versi 25.0. Hasil kajian menunjukkan bahawa keprihatinan pelajar PUO terhadap prinsip rukun negara dan tahap kesedaran para pelajar di PUO tentang peranan Rukun Negara sebagai medium keharmonian di Malaysia berada pada tahap yang sangat tinggi dengan keseluruhan min item melebihi 4.21. Ini jelas menunjukkan bahawa para pelajar di PUO menyedari akan peranan Rukun Negara dalam mengharmonikan hubungan masyarakat majmuk di Malaysia. Secara keseluruhannya, kajian ini adalah penting untuk meningkatkan pemahaman tentang kedudukan prinsip-prinsip Rukun Negara dalam pengetahuan generasi yang akan memimpin negara pada masa hadapan. Kajian ini perlu dibuat secara meluas lagi di seluruh institusi di Malaysia supaya dapat mengenalpasti tahap kesedaran golongan muda terhadap prinsip Rukun Negara.

1. Pendahuluan

Rukun Negara ialah sebuah ideologi kebangsaan Malaysia yang semestinya perlu menjadi pegangan seluruh rakyat negara ini. Ia digagaskan antaranya apabila kerajaan mula sedar bahawa perpaduan rakyat merupakan asas kepada cita-cita ke arah pembentukan bangsa dan negara. Ia terdiri daripada set prinsip atau prinsip yang digunakan oleh masyarakat untuk menjalani kehidupan, dan ia merangkumi semua aspek kehidupan negara. Nilai-nilai sosial dan kenegaraan juga termasuk dalamnya. Dengan kata lain, Rukun Negara bertujuan untuk mewujudkan perpaduan kaum untuk kemakmuran dan keharmonian Malaysia.

Setahun sebelum kemerdekaan, 1956, kekacauan berlaku di Pulau Pinang semasa perayaan pemberian taraf bandaraya. Pertikaian yang sama turut berlaku di Pulau Pangkor pada tahun 1960, di Bukit Mertajam pada tahun 1966, dan sekali lagi di Pulau Pinang pada tahun 1967. Kekacauan ini berlaku secara kecil-kecilan. Kerajaan telah mengambil langkah tegas untuk mencari penyelesaian kepada isu ini supaya ia tidak berulang lagi. Berikutan itu Majlis Perundingan Negara telah ditubuhkan oleh Pengarah MAGERAN di bawah Undang-Undang Darurat yang diwartakan pada 29 Januari 1970. Allahyarham Tun Abdul Razak Bin Dato' Hussein, Pengarah MAGERAN, mengadakan mesyuarat pertama pada 27 Januari 1970. Majlis Perundingan Negara akhirnya mencapai kata sepakat bahawa ideologi yang boleh mengatasi perbezaan kaum perlu dibangunkan di negara ini selepas beberapa bulan perbincangan dan kajian mendalam. Berasaskan keputusan tersebut, maka lahirlah Rukun Negara yang telah diisytiharkan oleh yang di-Pertuan Agong Keempat, Al-Marhum Tuanku Ismail Nasiruddin Shah Ibni Al-Marhum Sultan Zainal Abidin, pada 31 Ogos 1970 sempena ulang tahun ke-13 kemerdekaan negara. Oleh itu, Mohammad Ghazali (1978) menyatakan bahawa Rukun Negara adalah panduan dan pegangan negara yang akan menyatukan rakyat dengan menyampaikan tanggapan, kepercayaan, dan keazaman rakyat Malaysia.

Pada asasnya, Rukun negara terdiri daripada dua bahagian. Bahagian pertama membincangkan matlamat yang ingin dicapai oleh masyarakat Malaysia. Antara matlamatnya adalah untuk mewujudkan masyarakat yang lebih bersatu padu, mengekalkan sistem demokratik, mewujudkan masyarakat yang adil di mana kemakmuran negara dibahagikan secara saksama, dan membina sebuah masyarakat progresif yang menggunakan teknologi dan sains moden. Manakala bahagian kedua pula menggariskan lima prinsip rukun negara iaitu kepercayaan kepada tuhan, kesetiaan kepada raja dan negara, keluhuran perlembagaan, kedaulatan undang-undang serta kesopanan dan kesusilaan.

Menurut Abdul Rahman dan Muhamed Nor Azman (2008), kunci kepada keharmonian dan perpaduan kaum Malaysia terletak pada prinsip-prinsip yang terkandung dalam Rukun Negara. Lee dan Sarjit (2008) juga mencadangkan Rukun Negara sebagai asas untuk membina modal insan oleh semua pihak. Sudah tentu, Rukun Negara adalah suatu ideologi yang bertujuan untuk menyatukan kepercayaan pelbagai kaum dalam masyarakat negara ini. Selain itu, matlamat Rukun Negara juga perlu diterapkan dalam diri semua rakyat Malaysia untuk mewujudkan rakyat yang benar-benar patriotik dan mengekalkan kemakmuran, keamanan dan kesejahteraan (Abdul Rahman, 2010).

Jelaslah bahawa penghayatan Rukun Negara adalah penting untuk membina negara yang rakyatnya bersatu padu dan liberal terhadap budaya lain. Rukun Negara merupakan ideologi yang dikongsi semua rakyat Malaysia dan mampu mewujudkan dan membina masyarakat yang demokratik, progresif dengan sains dan teknologi.

2. Tinjauan Literatur

Malaysia kerap dijadikan sebagai satu negara yang menunjukkan contoh dan suri teladan sebagai satu negara yang bersatu padu dan harmoni dek kerana kepelbagaian kaum, budaya, etnik, dan agama (Mohamed Ali et al. 2021). Walaupun begitu, adakalanya wujud persaingan, perbezaan dan konflik, tetapi disebabkan oleh kesepaduan sosial yang wujud sekian lama dalam diri masyarakat telahberjaya mengekalkan perpaduan dalam negara kita. Konsep rukun negara telah diisytiharkan oleh Almarhum Tuanku Ismail Nassiruddin Shah, Yang di-Pertuan Agong

Keempat pada Tarikh 31 Ogos 1970 bersempena dengan Hari Kemerdekaan ke-13. Rukun Negara yang terdiri daripada lima prinsip adalah hasil daripada garis panduan yang dibuat oleh Majlis Gerakan Negara (MAGERAN). Terdapat banyak pencanggahan di dalam usaha untuk mewujudkan Rukun Negara, terutamanya apabila Tanah Melayu semakin hampir kepada kemerdekaan (Eddin Khoo, 2020). Tahap literasi, pemahaman dan penghayatan lima prinsip rukun negara oleh rakyat Malaysia terhadap kebebasan bersuara dalam rangkaian sosial tanpa had menjadi persoalan (Mohamed Ali et al. 2021). Ini juga termasuk dalam menangani isu sensitif antara etnik, tidak menghormati kerajaan dan sebagainya. Kunci bagi sebuah kejayaan perpaduan adalah bergantung pada rakyat yang mengambil tahu dan memahami tentang prinsip-prinsip dasar negara yang mencerminkan kepelbagaian. Oleh hal yang demikian, adalah sangat penting untuk mengekalkan nilai perpaduan dalam hati rakyat Malaysia agar tidak mensia-siakan pengorbanan para pejuang kemerdekaan kita sebelum ini.

Kajian Ahmad Zaharuddin et al. (2014), menyatakan nilai patriotisme yang semakin kurang dalam kalangan belia akan menimbulkan masalah-masalah sosial yang semakin kritikal. Sikap tidak menghormati rukun negara boleh dilihat apabila lagu kebangsaan negara iaitu “Negaraku” telah dihina (Sinar Harian, 30 september 2019). Antara jenis penghinaan ialah rentak dan lirik telah diubah dan telah dinyanyikan dalam Bahasa bukan kebangsaan dengan objektif utama untuk menghina negara. Ini jelas menunjukkan bahawa orang cuba mengingkari nilai dan autonomi Rukun Negara. Terdapat beberapa peristiwa sejak kebelakangan ini yang menunjukkan bahawa prinsip Rukun Negara seumpama tidak lagi penting dalam konteks kehidupan masyarakat dan telah dilupakan. Menjelang Hari Kebangsaan, perkara ini sering berlaku, contoh seperti isu mengibarkan bendera secara terbalik dengan sengaja, menukar jata negara dan bendera terbalik masih wujud dan semestinya adalah bertentangan dengan undang-undang negara.

Malaysia telah dikejutkan dengan satu kejadian dimana dapat dirakam melalui kamera litar tertutup (CCTV) yang menunjukan perbuatan dua orang Wanita yang telah dianggap sebagai dalang utama kerosakan mural barisan pemimpin negara di Taman Cahaya Alam, Seksyen U12. Rakaman video yang berdurasi dua minit dua puluh saat itu memaparkan sebuah kereta yang diletakkan di sebelah lorong lukisan mural sebelum muncul kelibat dua wanita tersebut melakukan kerosakan ataupun vandalisme terhadap mural itu. Sebelum beredar dari kawasan itu mereka menconteng kata-kata kesat di gambar pemimpin-pemimpin negara termasuklah Yang di-Pertuan Agong, Al Sultan Abdullah Ri’ayatuddin Al-Mustafa Billah Shah. Mural itu telah dihasilkan oleh tiga anak muda sebagai tanda untuk mengucapkan terima kasih kepada pemimpin negara, terutamanya mereka yang membantu menangani pandemik COVID-19 (Berita Harian Online, 20 Julai 2020). Perbuatan memuat naik juga digunakan untuk menghina institusi beraja paparan yang dipaparkan di laman Facebook. Ini dilakukan oleh pemilik Facebook "Sabah Sarawak Merdeka yang memuat naik gambar yang menghina Yang di-Pertuan Agong (Wan Amizah & Muhammad Adnan, 2017). Institusi diraja Malaysia jelas mempunyai kepentingan sama ada dalam nilai bangsa dan sejarahnya. Institusi Raja Berperlembagaan adalah penting dari segi roh kenegaraan kerana ia melindungi negara dan semua agama. Institusi ini memainkan peranan penting dalam memastikan kestabilan negara. Oleh itu, prinsipkedua Rukun Negara adalah penting untuk menghormati Raja. Kedudukan Yang di-Pertuan Agong sebagai Ketua Negara adalah sama seperti yang dinyatakan dalam Perkara 32 PertamaPerlembagaan Persekutuan (Mohd Sufiean Hassan, 2013).

Perlembagaan mesti menghormati dan melindungi rukun negara. dan perundangan. Walau bagaimanapun, situasi kontemporari yang berlaku secara tersurat atau tersirat ia menunjukkan

bahawa sesetengah rakyat Malaysia tidak menghormati Rukun Negara. Rasa tidak puas hati terhadap kedudukan politik dan pentadbiran tempatan membawa kepada sebilangan kecil rakyat Malaysia membuat kritikan yang tidak beretika tanpa mengambil kira kesan tindakan mereka ini. Malahan lebih buruk lagi apabila sebilangan besar rakyat Malaysia yang kini tinggal di luar negara dipengaruhi oleh permusuhan ini dan memburukkan kedudukan negara di arena antarabangsa. Tindakan ini adalah sangat tidak wajar dan tidak bertanggungjawab.

Menurut kepada beberapa isu yang disebutkan, jelaslah bahawa kajian tentang Rukun Negara sebagai alat untuk membina bangsa perlu dilihat dan dinilai semula dengan mengambil kira peristiwa yang telah berlaku dalam negara. Justeru itu membina negara dan membangunkan golongan muda ke arah berciri maju, progresif serta mengamalkan lima prinsip Rukun Negara adalah penting bagi meningkatkan kesedaran sivik agar generasi muda terutamanya golongan belia berasa bertanggungjawab terhadap tuntutan negara dan masyarakat.

Natijahnya, kajian ini dilaksanakan untuk melihat dengan lebih menyeluruh tahap kesedaran tentang peranan Rukun Negara sebagai medium keharmonian di Malaysia dan keprihatinan dalam memastikan prinsip rukun negara terus relevan sebagai medium pembinaan dalam kalangan para pelajar PUO. Hasil kajian dapat dijadikan panduan kepada mahasiswa, institusi pendidikan, badan-badan kerajaan untuk merangka perancangan bagi memantapkan segala aspek dan keperluan untuk meningkatkan nilai patriotisme dalam diri setiap pelajar.

3. Objektif Kajian

Kajian ini dijalankan untuk mendapatkan maklumat berdasarkan objektif berikut:

i. Mengenalpasti tahap kesedaran para pelajar di PUO tentang peranan Rukun Negara sebagai medium keharmonian di Malaysia.

ii. Mengenalpasti tahap keprihatinan para pelajar di PUO dalam memastikan prinsip Rukun Negara terus relevan sebagai medium keharmonian bangsa di Malaysia.

4. Metodologi Kajian

Kajian tinjauan ini menggunakan kaedah kuantitatif. Menurut Sekaran dan Bougie (2009) kajian tinjauan lebih mudah, cepat dan tepat kerana banyak data boleh dikumpul dalam satu masa. Selain itu, kajian tinjauan sesuai untuk sampel yang menggambarkan populasi kajian. Kajian ini melibatkan 212 pelajar mahasiswa yang terdiri dari pelbagai jabatan di Politeknik Ungku Omar, 100 daripadanya lelaki dan 112 daripadanya perempuan.

Kajian oleh Mohamed Ali et. al (2021) dan Ayu Nor Azilah et. al (2021) telah digunakan sebagai sumber soal selidik yang diambil dan diubah suai. Salah satu kaedah berkesan untuk mendapatkan maklumat daripada responden ialah soal selidik, menurut Tuckman (1985). Soal selidik, menurut Mohd Majid (1990), boleh digunakan untuk mendapatkan maklumat tentang fakta, kepercayaan, perasaan, kehendak dan sebagainya. Instrumen soal selidik terdiri daripada beberapa bahagian: bahagian A terdiri daripada 3 item mengenai demografi, bahagian B terdiri daripada 12 item mengenai tahap kesedaran mahasiswa tentang peranan rukun negara sebagai medium keharmonian di Malaysia, dan bahagian C terdiri daripada 12 item mengenai tahap keprihatinan mahasiswa dalam memastikan prinsip rukun negara terus relevan sebagai medium

pembinaan bangsa di Malaysia. Manakala nilai analisis reabiliti 0.937, ini menunjukkan instrumen yang digunakan mempunyai kebolehpercayaan yang sangat baik.

Instrumen ditadbir secara dalam talian, dan pautan dihantar secara rawak kepada kumpulan pelajar. Setiap responden kajian memberikan respons pada masa yang sesuai. Proses pengumpulan data menggunakan rakan pengkaji di Politeknik Ungku Omar mengambil masa sebulan. Aplikasi IBM *Statistical Package for Social Science* SPSS, versi 25.0 digunakan untuk menganalisis data yang diperoleh berdasarkan objektif kajian. Mohd Majid (1990) menyatakan bahawa program SPSS mempunyai keupayaan untuk menganalisis data dengan tepat dan bebas kesilapan. Data deskriptif dipaparkan menggunakan nombor dan peratus. Skala yang digunakan dalam instrumen adalah sekala kekerapan dan skalapersetujuan dan diperincikan dalam jadual 1 berikut:

Jadual 1: Skala Kekerapan dan Persetujuan

Skor	Skala Kekerapan	Skala Persetujuan
1	Tidak Pernah	Sangat Tidak Setuju
2	Tidak Kerap	Tidak Setuju
3	Kurang Kerap	Tidak pasti
4	Kerap	Setuju
5	Sangat Kerap	Sangat Setuju

Pentafsiran tahap bagi nilai skor min yang diperoleh dari kajian deskriptif adalah berdasarkan jadual 2 di bawah.

Jadual 2: Skala Interpretasi Nilai Skor Min

Nilai Skor Min	Tahap
1.00 – 1.80	Sangat rendah
1.81 – 2.60	Rendah
2.61 – 3.40	Sederhana
3.41 – 4.20	Tinggi
4.21 – 5.00	Sangat tinggi

Sumber: Green, Salkind dan Akey (1997)

5. Dapatan dan Perbincangan Dapatan Kajian

Dapatan kajian dan perbincangan dapatan kajian dipaparkan berdasarkan persoalan kajian bermula dengan demografi kajian.

5.1 Demografi Kajian

Kajian ini disertai oleh 212 pelajar Politeknik Ungku Omar, dengan majoriti 112 perempuan (52.8%) dan selebihnya adalah lelaki. Pelajar Semester 3 paling ramai menyertai kajian iaitu 73 orang (34.4%), diikuti semester 1, 41 orang (19.3%) semester 5 (40 orang iaitu 18.9%), semester 4 (37 orang iaitu 17.5%), dan semester 2 (21 orang iaitu 9.9%).

Kajian ini melibatkan semua pelajar dari enam jabatan di Politeknik Ungku Omar. JKA, JP, JKE, JTMK, JKM, JKM dan JMSK adalah antara jabatan yang terlibat. 72 daripada pelajar

JKA (34%) menyertai kajian. Pelajar JKM adalah jabatan kedua yang paling ramai menyertai kajian, dengan 44 orang (20.8%).

Jadual 3: Demografi Kajian

Perkara	**Item**	**(N=212)**	**%**
Jantina	Lelaki	100	47.2
	Perempuan	112	52.8
Semester	Semester 1	41	19.3
	Semester 2	21	9.9
	Semester 3	73	34.4
	Semester 4	37	17.5
	Semester 5	40	18.9
Jabatan	JKA	72	34
	JP	37	17.5
	JKE	27	12.7
	JTMK	22	10.4
	JKM	44	20.8
	JMSK	10	4.7

5.2 Tahap kesedaran para pelajar di Politeknik Ungu Omar tentang peranan Rukun Negara sebagai medium keharmonian di Malaysia

Analisis deskriptif telah dilakukan untuk memenuhi objektif pertama iaitu, "Tahap kesedaran para pelajar di Politeknik Ungu Omar tentang peranan Rukun Negara sebagai medium keharmonian di Malaysia Skor min dan sisihan piawai (SP) telah digunakan, dan hasilnya boleh didapati dalam Jadual 4 berikut:

Jadual 4: Tahap Kesedaran Para Pelajar di PUO Tentang Peranan Rukun Negara Sebagai Medium keharmonian di Malaysia

Bil	**Item**	**Skala Persetujuan (Bilangan & Peratus)**					**Skor Min**	**SP**
		1	**2**	**3**	**4**	**5**		
1	Rakyat Malaysia hebat apabila memegang teguh prinsip RukunNegara.	-	-	7	32	173	4.78	0.22
		-	-	3.3%	15.1%	81.6%		
2	Rukun Negara dapat membina sebuah masyarakat progresif dan moden.	-	1	5	38	168	4.76	0.24
		-	0.5%	2.4%	17.9%	79.2%		
3	Prasangka terhadap seseorang warganegara atas alasan agamaadalah dilarang sama sekali.	-	3	11	26	172	4.73	0.27
		-	1.4%	5.2%	12.3%	81.1%		
4	Bangsa dan negara ini diwujudkan atas kepercayaan yang kukuh kepada Tuhan.	-	-	8	29	175	4.79	0.21
		-	-	3.8%	13.7%	82.5%		
5	Warganegara Malaysia	-	-	2	28	182		

	hendaklah bersikap jujur, taat dan setia kepada Raja dan Negara	-	-	0.9%	13.2%	85.8%	4.85	0.15
6	Rakyat Malaysia tidak boleh memberi taat setia kepada negara lain.	2 0.9%	3 1.4%	10 4.7%	25 11.8%	172 81.1%	4.71	0.29
7	Setiap warganegara Malaysia bertanggungjawab mempertahankan Perlembagaan.	- -	- -	5 2.4%	28 13.2%	179 84.4%	4.82	0.18
8	Perlembagaan Persekutuan adalah kontrak sosial yang tidak boleh dipersoalkan.	- -	- -	9 4.2%	36 17%	167 78.8%	4.75	0.25
9	Hak sebagai warganegara bolehdigunakan dengan bebas asalkan tidak melanggar undang-undang.	1 0.5%	1 0.5%	6 2.8%	33 15.6%	171 80.7%	4.75	0.25
10	Kedaulatan undang-undang terjamin dengan adanya sebuahbadan kehakiman yang bebas.	4 1.9%	1 0.5%	11 5.2%	21 9.9%	175 82.5%	4.71	0.29
11	Setiap orang tidak boleh melanggar batas dan tatasusila.	- -	- -	1 0.5%	27 12.7%	184 86.8%	4.86	0.24
12	Kesopanan dan kesusilaan dapat menghalang perbuatan angkuh dan menyinggung perasaan golongan lain.	- -	- -	4 1.9%	27 12.7%	181 85.4%	4.83	0.17

Jadual 4 di atas menunjukkan taburan responden mengikut tahap kesedaran para pelajar di PUO tentang peranan Rukun Negara sebagai medium keharmonian di Malaysia. Dapatan kajian menunjukkan tahap kesedaran para pelajar di PUO berada pada tahap sangat tinggi. Kajian mendapati daripada 12 item, terdapat 4 item berada pada tahap yang sangat memuaskan iaitu item 5,7,11,12. Skor min yang paling tinggi adalah pada item 11 iaitu 'Setiap orang tidak boleh melanggar batas dan tatasusila' (M=4.86; SP=0.24). Selain itu, item kedua tertinggi adalah item 5 iaitu 'Warganegara Malaysia hendaklah bersikap jujur, taat dan setia kepada Raja dan Negara' (M=4.85; SP=0.15). Seterusnya, item 7 dan 12 berada pada tahap yang tinngi iaitu 'Setiap warganegara Malaysia bertanggungjawab mempertahankan Perlembagaan' (M=4.82; SP=0.18) dan 'Kesopanan dan kesusilaan dapat menghalang perbuatan angkuh dan menyinggung perasaan golongan lain' (M=4.83; SP=0.17). Daripada dapatan kajian yang lepas, ia menunjukkan tahap kesedaran pelajar PUO lebih tinggi terhadap peranan Rukun Negara sebagai medium keharmonian di Malaysia. Hal ini kerana, dapatan kajian yang lepas menunjukkan nilai min dan sisihan piawai yang paling tinggi adalah (M=4.54; SP=0.56) manakala (M=4.86; SP=0.14) adalah yang paling tinggi bagi dapatan kajian yang dijalankan di PUO.

Secara keseluruhannya hasil kajian menunjukkan kesedaran pelajar PUO terhadap Rukun Negara berada pada tahap yang sangat tinggi. Sehubungan itu, meningkatkan penghayatan terhadap Rukun Negara amatlah penting bagi mempertingkatkan peneguhan jati diri nasional dalam kalangan belia dan secara tidak langsung dapat mengelakkan diri daripada terpengaruh

dengan budaya barat ataupun kuasa asing. Menurut Ruhanie (2005), sikap, persepsi dan perilaku terhadap budaya barat boleh dipengaruhi secara tidak langsung oleh elemen negatif yang dibawa oleh neoimperialisme budaya. Kecelaruan identiti nasional dan salah laku boleh diatasi jika golongan muda hari ini menghayati sepenuhnya elemen Rukun Negara. Oleh itu, mempunyai kesedaran tentang Rukun Negara membantu membina jati diri nasional yang kukuh dan teguh serta memupuk semangat patriotisme.

5.3 Tahap Keprihatinan Mahasiswa di Politeknik Ungku Omar Dalam Memastikan Prinsip Rukun Negara Terus Relevan Sebagai Medium Keharmonian Bangsa

Analisis deskriptif telah dilakukan untuk memenuhi objektif kedua iaitu, "Mengenalpasti tahap keprihatinan para pelajar di Politeknik Ungku Omar dalam memastikan prinsip rukun negara terus relevan sebagai medium keharmonian bangsa di Malaysia." Skor min dan sisihan piawai (SP) telah digunakan, dan hasilnya boleh didapati dalam Jadual 5.

Jadual 5: Tahap Keprihatinan Mahasiswa di Politeknik Ungku Omar Dalam Memastikan Prinsip Rukun Negara Terus Relevan Sebagai Medium Keharmonian Bangsa

Bil	Item	Skala Persetujuan (Bilangan & Peratus)					Skor Min	SP
		1	2	3	4	5		
1	Ketiadaan agama boleh meruntuhkan kepribadian seseorang.	-	2	3	33	174	4.79	0.21
		-	0.9%	1.4%	15.6%	82.1%		
2	Kesopanan dan kesusilaan dapat mewujudkan masyarakatMalaysia yang harmoni dan bersatu padu.	-	-	2	34	176	4.82	0.18
		-	-	0.9%	16%	83%		
3	Agama merupakan tonggak kekuatan bangsa dan negara.	-	-	3	27	182	4.84	0.16
		-	-	1.4%	12.7%	85.8%		
4	Kesetiaan kepada Raja dan Negara dapat menyatupadukan semua kaum menjadi satu bangsa.	-	-	5	29	178	4.82	0.18
		-	-	2.4%	13.7%	84%		
5	Institusi Beraja merupakan lambang perpaduan rakyat Malaysia.	-	-	8	29	175	4.79	0.21
		-	-	3.8%	13.7%	82.5%		
6	Rukun Negara membentuk individu berdisiplin dan bermoral.	-	-	6	27	179	4.82	0.18
		-	-	2.8%	12.7%	84.4%		
7	Perlembagaan merupakan sumber rujukan berkaitan sistem pemerintahan, perundangan, kedudukan danhak sosioekonomi.	-	1	6	34	171	4.77	0.23
		-	0.5%	2.8%	16%	80.7%		
8	Rukun Negara menjadi formula untuk mengatasi masalah pergaduhan kaum	-	-	5	27	180	4.83	0.17
		-	-	2.4%	12.7%	84.9%		
9	Perlembagaan memberi hak dan keistimewaan kepada setiap warganegara.	-	-	2	33	177	4.83	0.17
		-	-	0.9%	15.6%	83.5%		

10	Rukun Negara merupakanidealogi nasional.	- -	- -	7 3.3%	31 14.6%	174 82.1%	4.79	0.21
11	Kedaulatan undang-undang menjamin hak kebebasan asasi semua warganegara.	- -	1 0.5%	3 1.4%	36 17%	172 81.1%	4.79	0.21
12	Perlembagaan memberi seseorang hak mengeluarkanidea, berhimpun dan menubuhkan persatuan	1 0.5%	1 0.5%	10 4.7%	29 13.7%	171 80.7%	4.74	0.26

Jadual 5 di atas menunjukkan taburan responden mengikut tahap keprihatinan para pelajar di PUO dalam memastikan prinsip Rukun Negara terus relevan sebagai medium pembinaan bangsa di Malaysia. Dapatan kajian menunjukkan tahap keprihatinan para pelajar di PUO berada pada tahap sangat tinggi. Kajian mendapati daripada 12 item, terdapat 6 item berada pada tahap yang sangat tinggi iaitu item 2, 3, 4, 6, 8, dan 9. Skor min tertinggi adalah bagi item 3 iaitu 'Agama merupakan tonggak kekuatan bangsa dan negara' (M=4.84; SP=0.16). Seterusnya, item kedua yang tertinggi adalah 8 dan 9 iaitu 'Rukun Negara menjadi formula untuk mengatasi masalah pergaduhan kaum' dan 'Perlembagaan memberi hak dan keistimewaan kepada setiap warganegara (M=4.83; SP=0.17). Jika dibandingkan dengankajian sebelumnya, pelajar PUO lebih prihatin untuk memastikan rukun negara kekal relevan di Malaysia. Hal ini kerana, dapatan kajian yang lepas menunjukkan nilai min dan sisihan piawai yang paling tinggi adalah (M=4.59; SP=0.66) manakala (M=4.84; SP=0.16) adalah yang paling tinggi bagi dapatan kajian yang dijalankan di PUO.

Secara keseluruhan, kajian menunjukkan bahawa generasi muda lebih memahami tujuan dan kepentingan Rukun Negara. Mereka juga membuktikan bahawa Rukun Negara bukanlah sekadar perkataan yang diucapkan dan dilafazkan. Sebagaimana yang dinyatakan oleh Lee dan Sarjit (2008), pembentukan Rukun Negara tidak begitu dihayati kerana keadaan semasa menunjukkan bahawa pelaksanaan Rukun Negara hanya disebut dalam perhimpunan. Oleh itu, pendedahan dan pembelajaran adalah dua komponen penting dalam membina pemahaman belia terhadap Rukun Negara. Belia yang memahami dengan jelas akan menerima tanggapan yang positif (Adlina, 2009). Oleh itu, peningkatan kefahaman dalam kalangan belia boleh memberi manfaat kepada negara.

6. Kesimpulan

Kesimpulannya, kajian ini signifikan dan penting dalam mengkaji keprihatinan pelajar PUO terhadap peranan dan prinsip Rukun Negara bagi membina bangsa Malaysia yang harmoni. Oleh itu, tindakan yang berkesan untuk meningkatkan kesedaran rakyat Malaysia mesti dilakukan secara konsisten. Kerana kerencaman komposisi rakyat Malaysia yang boleh menimbulkan prejudis, agenda ini harus diutamakan. Memahami dan mengambil berat terhadap prinsip Rukun Negaramempunyai keupayaan untuk mengukuhkan perpaduan rakyat dan mewujudkan masyarakat yang mempunyai matlamat yang sama.

Selain itu, kajian ini juga menunjukkan bahawa tahap kesedaran pelajar PUO tentang peranan dan prinsip Rukun Negara sebagai medium keharmonian di Malaysia adalah sangat tinggi dengan memperoleh keseluruhan nilai item min melebihi 4.21. Hasil ini jelas menunjukkan bahawa pelajar memahami matlamat Rukun Negara untuk mewujudkan perpaduan yang lebih kukuh dalam masyarakat. Selain itu, matlamat Rukun Negara adalah untuk mengekalkan cara

hidup demokratik dengan membina masyarakat yang adil untuk memastikan keuntungan negara dibahagikan secara adil.

Untuk meningkatkan kesedaran pelajar terhadap prinsip-prinsip Rukun Negara, antara langkah yang efektif boleh diambil bagi memastikan pemahaman yang dan penghayatan yang mendalam terhadap Rukun Negara adalah program pendidikan yang khusus dan holistik perlu diperkenalkan di dalam sistem pendidikan negara. Ini melibatkan penerapan kurikulum yang mencakupi elemen-elemen tentang sejarah pembentukan Rukun Negara, serta aktiviti-aktiviti yang mempromosikan pemahaman yang mendalam mengenai makna dan kepentingan nilai-nilai seperti kesopanan, patriotisme, dan kepercayaan kepada Tuhan.

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READINESS OF ACADEMIC LIBRARIES FOR BLOCKCHAIN TECHNOLOGY: A CONCEPTUAL EXPLORATION

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ABSTRACT

The acceptance of blockchain technology have begun to benefit developed nations, and developing countries have shown interest in implementing the technology. However, it still has relatively few applications. Blockchain technology is still in its early stages of development, with a lack of studies on its acceptance, especially in the context of libraries. Emerging as a disruptive force across various industries, blockchain promises increased transparency, security, and efficiency in data management. In the realm of academic libraries, where information integrity and accessibility are paramount, the adoption of blockchain holds immense potential. This conceptual paper explores the theoretical foundations and practical implications of integrating blockchain technology within Malaysian academic libraries. By examining the benefits, challenges, and potential applications, this paper aims to provide insights into how this innovative technology can revolutionize information management practices in the Malaysian educational landscape. Factors consist of technological, organizational, and environmental contexts. Based on a literature review, the technological context includes relative advantage and compatibility, while the organizational context includes organizational readiness and top management support. Meanwhile, the environmental context includes government support and library user readiness. The analysis also reveals the relationship between technological, organizational, and environmental factors (independent variables) and the intention to adopt blockchain (dependent variable).

1. Introduction

Organizations play a pivotal role in today's commercial landscape, particularly amidst the fourth industrial revolution (4IR) which has ushered in a wave of transformative technologies such as cloud computing, robotics, artificial intelligence, and the Internet of Things. These modern technologies are instrumental in driving growth and innovation. One notable example

is blockchain, which stands out as the most renowned application of distributed ledger technology. Recognized as one of the top ten emerging technologies of 2016 by the World Economic Forum, blockchain comprises data transaction records known as blocks. Each block is characterized by a block header, a hash, a transaction counter, and its corresponding transactions.

Unlike for-profit organizations that rely on profit and loss statements to assess, motivate, and implement changes, libraries operate with different metrics. They serve as a reliable repository of knowledge, excelling in this aspect according to Cabello, JanBen, and Mühle (2017). The emergence of the Blockchain Network, a decentralized chain network, has significantly influenced the development of online systems for storing, managing, and retrieving transactions and information. Individuals in industrialized nations are beginning to reap the benefits of emerging technologies, with a notable focus on blockchain. However, Tella, Amuda, and Ajani (2022) report that libraries in developing countries are also expressing interest in leveraging technologies like blockchain, though the adoption and implementation seem to progress at a slower pace.

Prior research underscores that blockchain technology (BT) is opening up new avenues for libraries. The blockchain-based approach holds promise for various library-related domains, including digital preservation, tracking, and interlibrary lending services. Notably, blockchain technology bolsters security by utilizing a network of numerous computer nodes for transaction processing (Ahram et al., 2017).

Despite the potential of BT to enhance library operations, instances of its practical application are relatively scarce. A paucity of research on the implementation of BT in libraries persists, primarily due to the technology's nascent developmental stage. Many studies indicate that initiatives are in the planning stages, and the current technological infrastructure may not fully support advanced applications. Paulavičius, etc (2019) aim to ensure that practical applications meet the essential criteria of compatibility, scalability, and long-term viability. This study thus delves into examining the factors influencing the adoption of blockchain technology in libraries. While early blockchain research primarily focused on technological facets, there is a growing emphasis on understanding its uptake and utilization, as noted by Janssen et al. (2020).

1.1 Problem Statements

According to Van Hoek and Saberi (2019), highlighted that reliance on both intra- and inter-organizational connections presents a substantial challenge to the successful implementation of permissioned blockchains. This challenge encompasses financial constraints, a lack of managerial commitment, and opaque information disclosure policies. Unlike profit-driven organizations, libraries base their operational decisions not solely on financial metrics but on the need to provide reliable and accessible information. The advent of blockchain presents libraries with new possibilities, such as enhancing digital preservation, tracking, and interlibrary loan systems. However, the adoption of BT in libraries is still in its nascent stages globally, with limited implementations and a lack of comprehensive studies on its adoption

factors. Thus, the key contribution of this research will identify the factors of readiness of blockchain technology application among academic libraries.

In a comprehensive analysis of existing research, Mohanta et al. (2019) identified privacy and security as the primary hurdles in the implementation of blockchain technology. Moreover, the consideration of interoperability is crucial when introducing any new technology. Interventionary studies involving animals or humans, and other studies that require ethical approval, must list the authority that provided approval and the corresponding ethical approval code.

In this study, the researchers will use TOE framework and combine with other models' variables that relate to the topic in order to examine the inter-organizational innovation adoption and organizational level, and the role of the external environment. This study aims to investigate the factors influencing the adoption of blockchain technology among academic libraries in Malaysia. The primary objectives are to:

i. To identify the level of awareness among librarians regarding blockchain technology;
ii. To examine the factors in technological context that influence the adoption of blockchain in libraries;
    To examine the factors in organizational context that influence the adoption of blockchain in libraries.
iii. To examine the factors in environmental context that influence the adoption of blockchain in libraries.

2. Literature Review

In this study, technological, organizational, and environmental context are the independent variables and intention to adopt blockchain is the dependent variable. That means, in order to identify the factors that influence the adoption of blockchain technology in Malaysian's libraries technological, organizational, and environmental context play their respective roles. The technological context includes relative advantage and compatibility while for organizational context include organizational readiness and top management support. For environmental context, the factors that include are government support and user readiness. However, Du, Pan, Leidner, & Ying (2019) explained that the adoption of blockchain is usually a specific case phenomenon that often necessitates a thorough experimentation phase to 201determine whether the technology is suitable for its intended purpose.

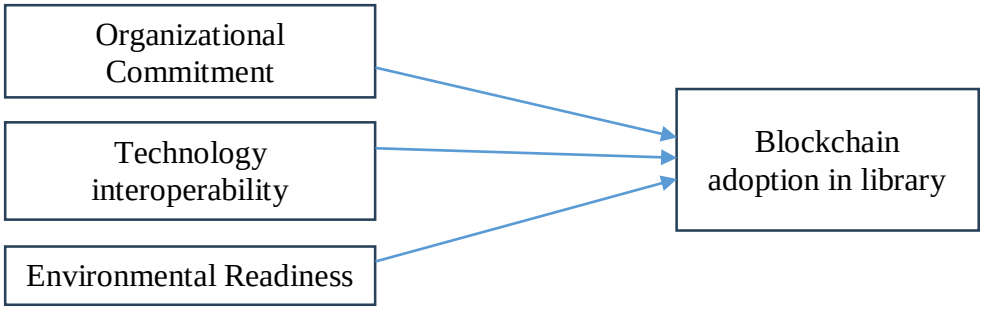

Figure 1: Conceptual framework of intention factors to adopt blockchain

This research framework draws upon a synthesis of models from the study by Asare, Brashear Aleja, and Kang (2016), particularly the TOE framework. In the present investigation, the independent variables include elements related to technology (such as relative advantage and compatibility), organization (specifically, IT readiness and organizational preparedness for change, as well as top management support), and environment (including government support and library user readiness). These independent variables are examined in relation to the dependent variable, which is the intention to adopt blockchain technology. To tailor the framework to the current study's focus, adjustments have been made to the independent variables, with IT readiness now encompassing organizational readiness for change, industry support being modified to government support, and Library user readiness reflecting the influence of customer pressure.

2.1 Organizational Commitment

The features and resources that an organisation has that may be limiting or facilitating elements for the aim to adopt innovation are referred to as the organisational context. In this study, organisational context is described by two factors which are organizational readiness and top management support.

Clohessy and Acton (2019) stated that three categories of organisational resources, including the availability of workers with the necessary IT knowledge and skills, financial resources for adopting IT innovations (such as an IT budget), and infrastructure on which blockchain applications can be built, were examined in terms of organisational readiness with regard to adopting new IT innovations. According to Toufaily, Zalan, Dhaou, (2021) the capacity of an organization to adopt new technologies and leverage existing knowledge is often referred to as organizational readiness. It can also be described as the organization's absorptive capacity. It is doubtful that businesses without the necessary technical, human, and financial resources will be willing to adopt new technologies. In the study of big data and business analytic, researchers and practitioners agree that organizational readiness is required for BD adoption (Wahab et al., 2021). As a result, this study contends that organisation readiness is one of the top crucial drivers of BT adoption in libraries.

2.2 Technological Interoperability

The term “technological context” refers to all important internal and external technologies to the organization, even if they have not yet been adopted by the organization. To determine the intention to adopt blockchain technology among libraries, researcher examined two factors that are frequently utilize in the new innovation adoption.

2.2.1 Relative advantage

Studies by Nezamdoust et al. (2022) revealed that relative advantage is a significant affects the adoption of mobile applications in health application in healthcare by nurse. Blockchain has several benefits to the library services or application as was demonstrated above and thought to have a positive effect on the intentions to use the technology, which will eventually affects adoption. According to Adeyinka Tella, Halimah Odunayo Amuda and Yusuf Ayodeji Ajani (2022), blockchain technology is more appropriate for maintaining unalterable records and is most effective for

straightforward transactional records. It has the capability to reconcile the library community's principles of individual confidentiality and accessibility, as well as transparency and responsibility. Studies of Hashimy et al. (2022) discovered that relative advantages has the greatest impact on adoption intention adoption of blockchain in Spanish firms. They also examine the importance of the indirect effects of relative advantage towards intention to adopt to adoptions, is the product of the path coefficient from relative advantage to intention to adopt and from intention to adopt relative advantage. As demonstrated before in chapter two, blockchain has numerous advantages. These benefits are thought to have a positive impact on the intention to adopt the technology, which will eventually impact adoption.

2.2.2 Compatibility

According to Thong (1999), technological compatibility refers to the degree to which an innovation is perceived as agreeable with existing business processes, experiences and needs of a given organization. Rogers, (2003) stated in general, the acceptance of technology is heavily influenced by how well it aligns with the existing values, experiences, and requirements of potential users. This factor is critical in determining the compatibility of an innovation. According to Mishra and Swain (2018), in the context of mobile payment system should compatible with the lifestyle of a merchant. Mobile payment compatibility is defined as the similarity of the mobile payment process to existing transaction procedures. This also will likely influence the adoption of BT in libraries when libraries perceive that BT is compatible with their existing library system and management also, lifestyle among library patrons, they are more likely to adopt the technology, which benefits their organization’s performance even more.

2.3 Environment Context

According to Saleem, et al. (2022), the environmental context refers to the impact of the external and inter-organizational surroundings in which an organization conducts its operations. There are two dimensions in order to measure factors in adopting Blockchain:

2.3.1 Government Support

Government support includes assistance from industry organisations and the availability of existing industry standards that are intended to manage and promote emerging technology. Workshops are typically held by associations to educate personnel and give members access to digital infrastructure. These programs give businesses the confidence they need to employ cutting-edge technologies. They identified that the availability of specific BCT tools, infrastructural facility, and government policy and support are the main significant factors for BCT adoption; Wong, et al. (2019). According to De Castro, Tanner, and Johnston (2020), the government must offer adequate support, such as the creation of regulations, in order for BT to be widely adopted by organizations. According to Wong et al. (2019) and

Kulkarni and Patil (2020), government assistance is a key element in the deployment of BT.

2.3.2 Library's User Readiness

According to Kulkarni and Patil (2020) research, in context of banking industry, consumer readiness is a strong predictor of BT adoption. According to Balasubramanian et al. (2021), the most popular and eagerly anticipated blockchain elements in the healthcare sector were accurate electronic health records (EHRs), data exchange, and interoperability. More than 85% of poll participants indicated that they had heard of or had some familiarity with blockchain technology and were willing to implement it in a network. This support that in adopting blockchain in libraries, user readiness also play an important role. It has been discovered that satisfying customer needs electronically for improved communications drives the adoption of innovations. In the framework of the study, libraries will be concern to adopt blockchain technology because they think it will enable them to better serve their patrons as stated by Lengoatha and Seymour (2020).

3. Methodology

3.1 Instrument

In this section, the research will be conducted using quantitative research methods for its research design. The questionnaire included indicators or items derived from previous literature (Masrek et al., 2017) to assure the reliability of data collection for perceptual measurement. Every construct consisted of five indicators or items, and participants are asked to indicate their level of agreement using a 5-point Likert scale, which ranged from "1²Strongly Disagree" to "5²Strongly Agree."

The collected data will be analyzed to examine the objectives of the research. The data obtained from the questionnaire responses will be analyzed using the Statistical Package for the Social Sciences (SPSS). SPSS is a widely used software for statistical analysis, particularly in social science research. By employing SPSS, researchers can conduct various statistical tests to find data source based on objective which suits the study within the data.

The methodology indicates the consideration of three main categories of factors:

- Technological aspects
- Organizational aspects
- Environmental aspects

These are the independent variables that are presumed to influence the dependent variable, which is the adoption of blockchain technology in libraries. Through the questionnaire responses and subsequent SPSS analysis is aim to identify and measure the relationships between these independent variables and the adoption of BT.

3.2 Population, sampling and sample size

According to Saunders, etc. (2000), the selection of a sampling technique relies on the

feasibility and practicality of gathering data to address the research questions and objectives from the entire population. This research focuses on understanding the readiness factors affecting the adoption of blockchain technology in Malaysian libraries. A questionnaire will be distributed via email to eight academic libraries in Malaysia, targeting a total of 202 librarians and staff members. This approach allows for a broad sampling of individuals involved in library operations, potentially providing a comprehensive view of their perceptions and readiness regarding BT adoption.

The target population of this study is academic libraries in public universities because this study will be evaluated under the same entities on the readiness of academic libraries. The choice of a descriptive research design aligns with the objectives of this study. In this case, it involves describing the factors that contribute to or hinder the adoption of blockchain technology in academic libraries. This design allows researchers to summarize, organize, and present the data obtained from the questionnaire responses in a meaningful and insightful manner.

4. Conclusion

This study offers valuable insights for academic libraries, shedding light on the factors that influence the adoption of blockchain technology and its impact on libraries' intentions to adopt. The conceptual framework developed in this study holds potential not only for immediate application but also for guiding future research endeavors aimed at implementing blockchain technologies in academic libraries across Malaysia.

In conclusion, the adoption of blockchain technology presents significant opportunities for Malaysian academic libraries aiming to modernize their information management systems. By harnessing the principles of decentralization, immutability, and transparency, libraries can bolster data security, streamline operations, and cultivate a culture of innovation within the educational sphere. Despite existing challenges, the substantial benefits of blockchain outweigh these obstacles, rendering it a compelling pathway for advancing scholarly pursuits in Malaysia.

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KAJIAN MAKLUMBALAS TAHAP KEPUASAN KAKITANGAN POLITEKNIK UNGKU OMAR TERHADAP MODUL eCERT LATIHAN DI SISTEM iPUO

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ABSTRAK

Perkembangan teknologi maklumat dan perkhidmatan dalam talian semakin popular di Malaysia. Trend ini memberi peluang kepada individu atau agensi untuk mereka bentuk aplikasi perkhidmatan dengan lebih mudah dan efisien. Tujuan kajian ini dijalankan adalah untuk mengukur tahap kepuasan kakitangan Politeknik Ungku Omar terhadap modul ecert latihan di sistem iPUO. Sebelum modul ecert ini digunakan, sijil-sijil kursus disedia dan diedar secara manual dimana melibatkan proses dan tempoh masa yang panjang. Setelah digunakan, proses menyedia dan mengedar disingkatkan dari 15 langkah ke 4 langkah dan tempoh keseluruhan dikurangkan dari 7 hari ke 27 minit. Model kajian yang digunakan adalah Model Penerimaan Teknologi (TAM) dimana data dikumpul menggunakan instrumen soal selidik secara online menggunakan Google Form dan dianalisis menggunakan Statistical Packages for Social Sciences Version 29 (SPSS). Sampel yang digunakan adalah seramai 283 orang kakitangan Politeknik Ungku Omar yang pernah mengikuti kursus secara dalaman. Dapatan kajian menunjukkan tahap kecenderungan yang cemerlang bagi semua bahagian soalan. Kesimpulannya kakitangan Politeknik Ungku Omar dapat menerima dan berpuas hati terhadap penggunaan modul ecert latihan di sistem iPUO.

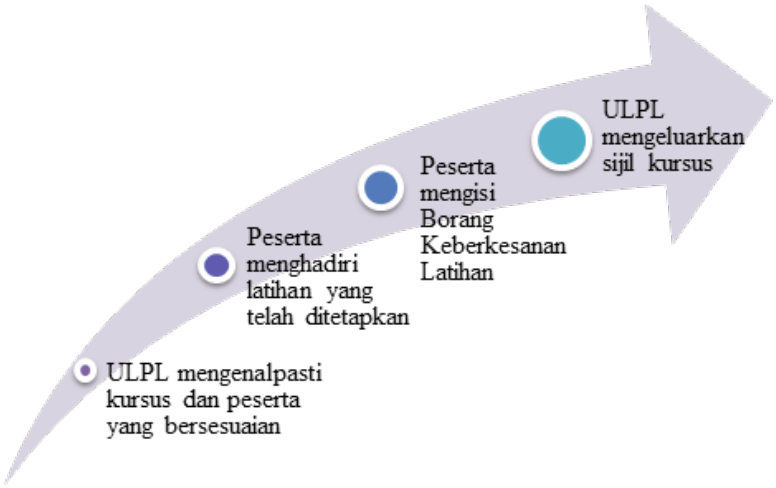
1. Pengenalan

Dasar Latihan Sumber Manusia Sektor Awam melalui Pekeliling Perkhidmatan Awam Bilangan 6, tahun 2005 telah mentakrifkan kompetensi merujuk kepada pengetahuan, kemahiran dan ciri-ciri peribadi yang perlu bagi melaksanakan sesuatu tugas dan tanggungjawab. Prinsip asas kompetensi menyatakan bahawa prestasi seseorang anggota perkhidmatan awam akan meningkat jika ia mempunyai semua kompetensi yang diperlukan bagi melaksanakan tugas atau tanggungjawab jawatan yang disandangnya. Asas keperluan dasar latihan ini telah digariskan melalui Dasar Wawasan Negara bagi menjadikan Malaysia sebuah negara maju menjelang tahun 2020 serta melalui Pelaksanaan Sistem Saraan Malaysia pada November 2002 yang berteraskan kompetensi dan pembelajaran berterusan adalah bertujuan untuk menggalakkan pembangunan diri, penguasaan pengetahuan, kemahiran,

kreativiti dan inovasi.

Umumnya, Unit Latihan dan Pendidikan Lanjutan (ULPL) berperanan dalam mengenalpasti, merancang, melaksana dan menilai pengurusan latihan staf akademik dan bukan akademik dengan efektif bagi memastikan semua latihan yang dilaksanakan adalah mengikut perancangan sama ada latihan dalaman, luaran, formal, tidak formal serta memastikan setiap staf yang dikenalpasti mengikuti program peningkatan kemahiran yang diperlukan. Melalui Objektif Kualiti PUO pula, ULPL bertanggungjawab memastikan kecemerlangan staf dicapai dari segi:

a. Memastikan setiap staf menghadiri kursus / menjalani latihan / seminar / bengkel / persidangan / konvensyen / taklimat sekurang-kurangnya 5 hari setahun.
b. Memastikan sekurang-kurangnya 6% PPPT mengikuti program pembangunan bakat dalam tahun semasa.
Politeknik Ungku Omar, melalui ULPL juga berperanan melaksanakan latihan melalui proses berikut:



Rajah 1: Proses pelaksanaan latihan

Sijil merupakan dokumen rasmi yang memberi pengesahan terhadap pencapaian atau kelayakan seseorang dalam sesuatu bidang atau kursus. Ia digunakan untuk menunjukkan kemahiran atau pengetahuan dalam bidang tertentu seperti pendidikan, latihan professional atau penyelidikan. Sijil ini membantu individu untuk memperoleh pekerjaan, kemajuan kerjaya, atau mendaftar untuk program lanjutan. Dokumen ini biasanya diberikan selepas seseorang individu menamatkan sesuatu kursus, latihan atau program yang diperlukan.

Melalui dasar ini juga telah dinyatakan, semua Ketua Jabatan perlu memastikan supaya:

a. Semua peserta kursus menyedia dan mengemukakan laporan kursus kepada Ketua Jabatan masing-masing setelah selesai menjalani kursus berkaitan;
b. Semua penyertaan dalam kursus-kursus hendaklah direkodkan di dalam Buku Perkhidmatan pegawai yang berkenaan; dan
c. Setiap peserta mengemukakan salinan sijil / dokumen berkaitan bagi tujuan pengesahan kehadiran kursus kepada Ketua Jabatan masing-masing sebaik sahaja tamat menghadiri kursus.

Turut dinyatakan melalui dasar yang sama, semua penjawat awam yang mengikuti mana-mana latihan perlu mengemukakan salinan sijil / dokumen berkaitan kepada jabatan masing-masing bagi tujuan pengesahan kehadiran kursus dan rekod. Melalui dasar latihan ini, jelas menunjukkan kepentingan setiap latihan yang dihadiri oleh staf, perlu diberikan sijil bagi tujuan pembuktian dan rekod latihan. Senarai kursus ini juga perlu dikemaskini melalui Laporan Penilaian Prestasi Tahunan (LNPT) yang menyumbang kepada % markah kecemerlangan staf.

Melalui objektif kualiti PUO juga menyatakan setiap staf perlu menghadiri latihan sekurang-kurangnya 5 hari setahun. Tempoh perlaksanaan yang dikira sebagai satu hari latihan pula perlu memenuhi sekurang-kurangnya 6 jam latihan. Ini bermaksud setiap staf perlu menghadiri sekurang-kurangnya 5 kali latihan bagi memenuhi 5 hari berkursus atau minimum 5 hari latihan bagi satu kursus. Dengan mengambilkira sekiranya staf menghadiri sekurang-kurangnya 5 kali latihan bagi memenuhi 5 hari, perkara berikut perlu diambilkira semasa menyediakan sijil kursus.

a. Masa (time)
b. Penyimpanan (Storage)
c. Kos (Operational Cost)
d. Kakitangan ULPL (Staf)
e. Kecekapan / Kemahiran Staf ULPL
f. Pengurusan Rekod

2. Modul eCERT Latihan

eSijil merujuk kepada penggunaan teknologi dalam pemberian sijil secara elektronik. Ia merangkumi sistem di mana sijil-sijil atau dokumen-dokumen kelayakan disimpan, dikeluarkan, dan disahkan secara elektronik, tanpa perlu versi fizikal atau cetakan kertas. Ini sering digunakan dalam pendidikan dalam talian atau dalam pengurusan dokumen digital. Perbezaan utama eSijil dan sijil adalah cara dimana mereka dikeluarkan dan disampaikan. Sijil merujuk kepada dokumen fizikal yang biasanya dicetak dan diberikan kepada individu untuk mengesahkan pencapaian atau kelayakan dalam sesuatu bidang pendidikan atau professional manakala eSijil pula merujuk kepada versi elektronik atau digital sijil. Ini boleh disampaikan secara dalam talian, disimpan dalam sistem elektronik, dan sering kali dilengkapi dengan sistem pengesahan elektronik untuk menjamin kebolehpercayaan dan integriti dokumen tersebut. Walau bagaimanapun, kedua-dua versi ini mempunyai nilai yang sama dalam menunjukkan pencapaian atau kelayakan seseorang. Perbezaannya hanyalah dalam bentuk dan cara penyampaian.

Modul eCERTIFICATE (eCERT) latihan telah mula digunapakai bermula pada November, 2020. Modul ini dibangunkan bagi menggantikan proses menghasil dan mengagihkan sijil kursus secara manual kepada peserta setelah tamat kursus.

3. Kepuasan Pelanggan

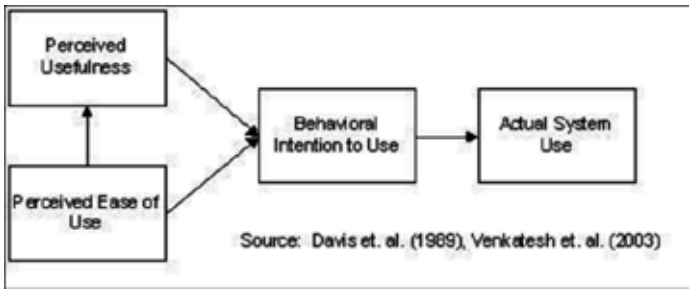
Kepuasan pelanggan dan kualiti perkhidmatan mempunyai perkaitan dimana ianya telah mendapat perhatian para pengkaji sejak kebelakangan ini (Sureshchandar, Rajendran & Anantharaman, 2002). Banyak kajian telah dijalankan dan didapati, hasil kajian menunjukkan hubungan positif antara kualiti perkhidmatan dengan tahap kepuasan pelanggan (Kouthouris

& Alexandris, 2005). Dari situ, kepuasan pelanggan terhadap kualiti perkhidmatan terus diberi penekanan oleh kerajaan agar perkhidmatan yang berkualiti dapat diberikan oleh organisasi dan seterusnya dapat mencapai jangkaan atau harapan pelanggan.

Kepuasan pelanggan juga merupakan satu kaedah dimana penilaian dilakukan samada terhadap perkhidmatan atau barangan yang ditawarkan yang boleh memenuhi jangkaan dan kehendak pelanggan. Menurut Zulkifli (2011), kepuasan pelanggan merupakan satu penilaian subjektif yang melibatkan beberapa faktor iaitu psikologi, emosi dan rohani seseorang individu yang akan menghasilkan penilaian terhadap tahap kepuasan berdasarkan pemerhatian, keyakinan, dan keamatan apabila menggunakan sesuatu perkhidmatan. Kepuasan pelanggan juga merupakan penerimaan minimum terhadap tahap perkhidmatan yang dapat memberikan kepuasan pelanggan dan meletakkan ia sebagai bahagian yang utama dan kritikal (Mwakaje, 2015).

4. Model Penerimaan Teknologi (TAM)

Model Penerimaan Teknologi (TAM) sering digunakan untuk menjelaskan mengenai penerimaan teknologi dan sistem maklumat (Lu, Yu, Liu, & Yao, 2003). Davis (1989) mengemukakan idea mengenai TAM untuk menerangkan penerimaan pengguna terhadap teknologi computer berdasarkan justifikasi teori yang jelas. Dua konstruk berkenaan kepercayaan dalaman sebagai penentu utama dalm TAM ialah tanggapan kebergunaan (Perceived Usefullness) iaitu, “tahap dimana seseorang percaya bahawa menggunakan sistem tertentu akan meningkatkan prestasi individu” (Davis, 1989, p.320) dan tanggapan mudah diguna (Perceived Ease of Use) yang membawa maksud “tahap dimana seseorang percaya bahawa menggunakan sesuatu sistem tidak memerlukan usaha yang bersungguh-sungguh” (Davis, 1989, p.320).



Rajah 2: Model Asas Penerimaan Teknologi (TAM)

5. Pernyataan Masalah

Sebelum eCERT dibangunkan melalui sistem iPUO, semua sijil kursus diproses dan diagihkan secara manual. Rajah 3 menunjukkan proses menyedia dan mengedarkan sijil dimana, terbahagi kepada 3 proses.

a. Proses Kemaskini Kehadiran Peserta
   Setelah kursus selesai dilaksanakan, urusetia kursus akan menghantar senarai kehadiran peserta ke ULPL dimana kehadiran akan dikemaskini kedalam system iPUO bagi membenarkan peserta mengisi Lampiran Keberkesanan Latihan.

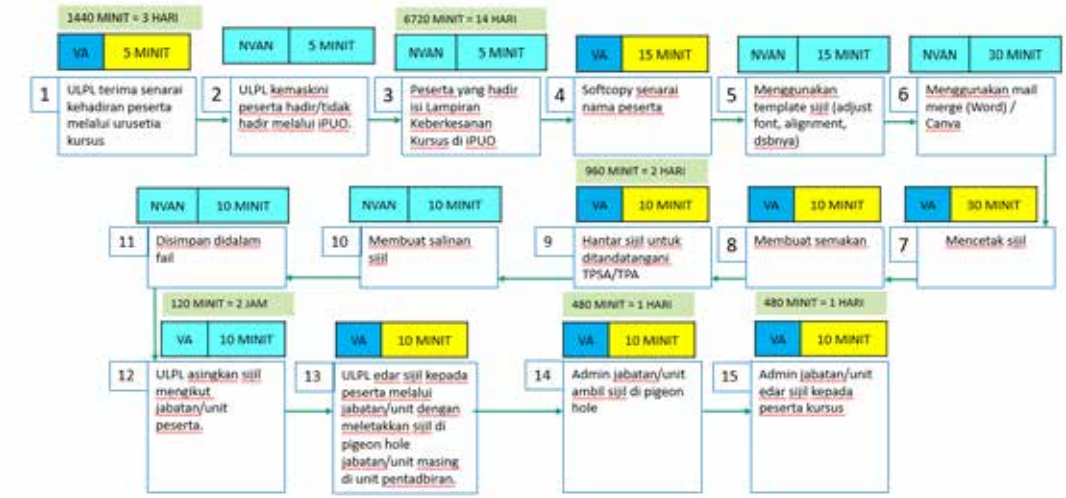
b. Proses Penyediaan Sijil
   Sijil disediakan secara manual bermula dari proses *setting* template sijil sehingga proses

mencetak diatas kertas sijil yang ditempah. Setelah selesai cetakan, sijil-sijil dihantar ke pejabat pengarah atau timbalan pengarah untuk ditandatangani. Setelah selesai, sijil diambil, dibuat salinan, disisihkan mengikut jabatan dan unit sebelum diletakkan ke dalam kotak surat masing-masing.

c. Proses Edaran Sijil kepada Peserta
Setelah diletakkan kedalam kotak surat, pembantu tadbir jabatan atau unit akan mengambil sijil dan seterusnya mengedarkan sijil.

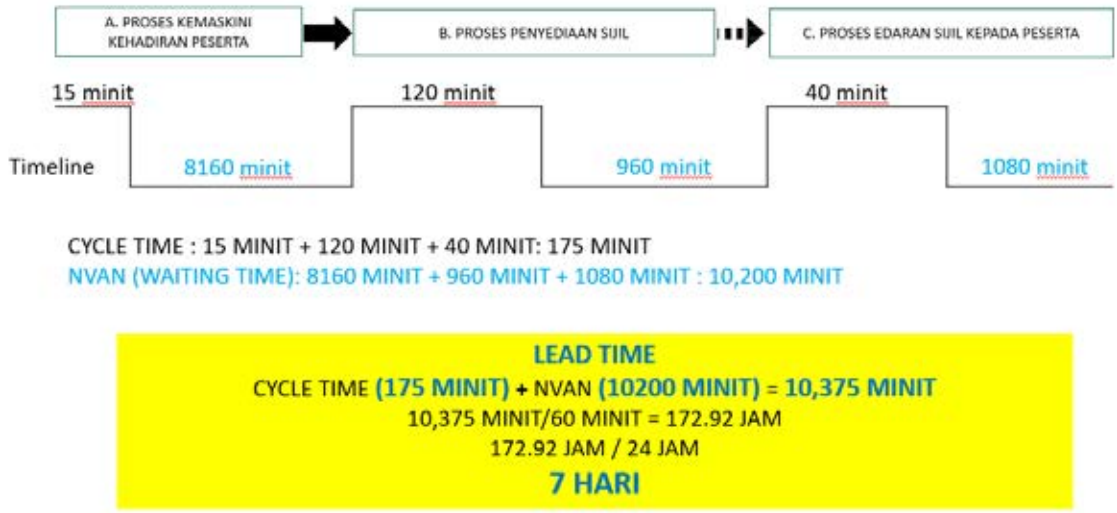
Rajah 3: Proses menghasil dan mengedarkan sijil

Rajah 4 menunjukkan masa yang diperuntukkan bagi setiap proses. Terdapat 15 langkah yang terlibat bagi proses menyedia dan mengedar dan masa yang diperuntukkan adalah sebanyak 7 hari.



Rajah 4: Masa yang diambil bagi setiap proses sebelum ecert latihan diperkenalkan

Rajah 5 pula menunjukkan kitaran masa yang diambil bermula dari proses kemaskini kehadiran peserta, proses menyediakan sijil sehinggalah proses edaran sijil. Didapati, proses keseluruhan adalah sebanyak 10, 375 minit bersamaan dengan 7 hari.



Rajah 5: Jumlah masa yang diambil sebelum ecert diperkenalkan

Setelah modul eCERT dibangun dan digunakan, didapati proses menghasil dan mengedarkan sijil lebih teratur dan sistematik. Jadual 1 menunjukkan perbandingan proses menghasil dan mengedar sijil kepada peserta latihan sebelum dan selepas eCERT latihan diperkenalkan.

Jadual 1: Perbandingan proses menghasil dan mengedar sijil kepada peserta latihan sebelum dan selepas eCERT latihan diperkenalkan.

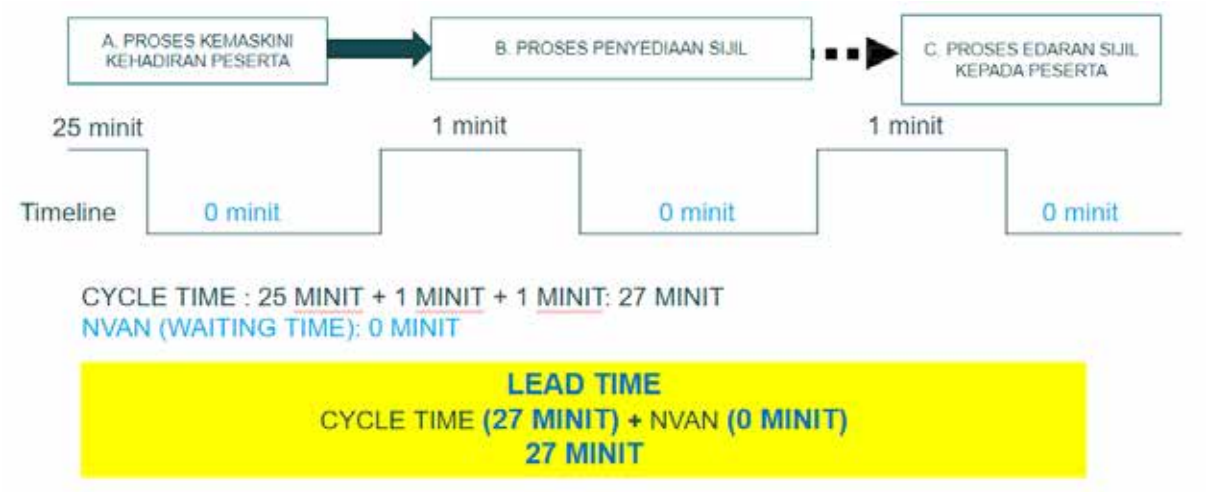
BIL	PERKARA	SEBELUM eCERT	SELEPAS eCERT
1.	Masa (time)	Mengambil masa	Tidak mengambil masa yang lama apabila terdapat beberapa proses sebelum yang dibuang.
2.	Penyimpanan (Storage)	Setiap sijil dibuat Salinan bagi tujuan rekod.	Tiada lagi ruang penyimpanan sijil kerana sijil disimpan secara dalam talian.
3.	Kos (Operational Cost)	Melibatkan kos penggunaan kertas dan toner printer.	Tiada kos yang terlibat bagi menghasilkan sijil secara manual.
4.	Kakitangan ULPL (Staf)	Melibatkan staf yang ramai apabila perlu menyediakan sijil lebih dari 2 kursus.	bilangan staf yang terlibat dalam memproses dan mengedarkan sijil sangat minimum.
5.	Kecekapan / Kemahiran Staf ULPL	Perlu tahap kompetensi tertentu bagi melancarkan proses menghasilkan sijil. Kakitangan yang tidak kompeten akan menyebabkan terdapat kesilapan semasa menyediakan sijil.	Proses menghasil dan mengedarkan sijil latihan kepada peserta kursus dengan pantas dan sistematik tanpa lagi menggunakan kaedah Manual atau MailMerge.

BIL	PERKARA	SEBELUM eCERT	SELEPAS eCERT
6.	Pengurusan Rekod	Peserta menyimpan rekod sijil secara hardcopy sahaja menyebabkan berkemungkinan hilang dari simpanan.	Menguruskan rekod sijil dengan lebih teratur dan sistematik dimana sijil boleh diakses dan di muaturun mengikut keperluan staf. Sijil juga boleh dicetak semula jika diperlukan.

Rajah 6 menunjukkan proses menyedia dan mengedar sijil yang panjang telah dikurangkan dari 15 langkah ke 4 langkah sahaja secara keseluruhan.

Rajah 6: Masa yang diambil bagi setiap proses selepas ecert latihan diperkenalkan

Rajah 7 menunjukkan jumlah masa yang diambil untuk proses menyedia dan mengedarkan sijil telah berkurang dari 7 hari ke 27 minit selepas modul ecert latihan diperkenalkan.



Rajah 7: Jumlah masa yang diambil selepas ecert diperkenalkan

Sati kajian telah dijalankan bagi mengenalpasti tahap kepuasan kakitangan PUO terhadap modul ecert selepas diperkenalkan melalui sistem iPUO. Objektif kajian adalah bagi:

a. Mengukur tahap persepsi kakitangan PUO bahawa modul ecert latihan ini mudah untuk digunakan.
b. Mengukur tahap persepsi kakitangan PUO bahawa modul ecert latihan ini berfaedah untuk digunakan.
c. Mengukur tahap persepsi kakitangan PUO bahawa modul ecert latihan ini menggunakan konsep amalan hijau.

d. Mengukur sikap positif terhadap tahap kepuasan pengguna terhadap modul ecert latihan.

6. Metodologi Kajian

5.1 Sampel Kajian.

Kajian ini menggunakan persampelan tak rawak dengan saiz sampel, S sebanyak 283 orang. Persampelan tak rawak melibatkan pemilihan sampel daripada sebuah populasi yang telah dikenalpasti berdasarkan ciri ciri yang telah dikenal pasti. (Noraini Idris, 2013). Sampel yang dipilih adalah kakitangan Politeknik Ungku Omar Pensyarah yang mempunyai akses kepada modul latihan melalui sistem iPUO masing-masing. Persampelan adalah menggunakan persampelan Krejcie and Morgan's berikut:

Jadual 1: Persampelan Krejcie and Morgan's

TABLE FOR DETERMINING SAMPLE SIZE FROM A GIVEN POPULATION

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	246
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	351
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	181	1200	291	6000	361
45	40	180	118	400	196	1300	297	7000	364
50	44	190	123	420	201	1400	302	8000	367
55	48	200	127	440	205	1500	306	9000	368
60	52	210	132	460	210	1600	310	10000	373
65	56	220	136	480	214	1700	313	15000	375
70	59	230	140	500	217	1800	317	20000	377
75	63	240	144	550	225	1900	320	30000	379
80	66	250	148	600	234	2000	322	40000	380
85	70	260	152	650	242	2200	327	50000	381
90	73	270	155	700	248	2400	331	75000	382
95	76	270	159	750	256	2600	335	100000	384

Note: "N" is population size
"S" is sample size.

Krejcie, Robert V., Morgan, Daryle W., "Determining Sample Size for Research Activities", Educational and Psychological Measurement, 1970.

Saiz populasi Politeknik Ungku Omar, N: 610 Orang, Saiz Sampel, S: 283 Orang

5.2 Instrumen Kajian

Borang soal selidik dibina secara online menggunakan Google Form dan diemail kepada semua staf Politeknik Ungku Omar. Hasilnya, seramai 283 staf telah menjawab soal selidik. Respon daripada responden direkod dan dianalisis menggunakan perisian SPSS version 29.

Penyelidik memilih untuk membina soal selidik secara online kerana:

a. respon dapat diterima dengan cepat,
b. tiada kos penghantaran dan fotokopi,
c. data dapat dikumpulkan kedalam pangkalan data secara terus.
d. kesilapan soal selidik dapat dibetulkan dengan cepat.

Kandungan soal selidik adalah berasaskan kepada objektif kajian. Data yang diperolehi dikategorikan sebagai jenis kuantitatif kerana penganalisaan data adalah menggunakan kekerapan dan peratus serta analisis skor min.

5.3 Pengukuran

Bahagian A: Maklumat Demografi Responden (4 Item)

Maklumat diri responden. (Nama, Jantina, Jabatan/Unit dan Kategori akademik)

Bahagian B: Objektif Kajian (21 Item)

a. Persepsi Mudah Untuk Digunakan - Perceive Ease of Use (PEOU) (5 Item)
b. Persepsi Faedah Penggunaan - Perceive Usefullness (PU) (5 item)
c. Amalan Hijau - Green It Attitude (4 item)
d. Kepuasan Pengguna Terhadap Penggunaan Ecert Latihan (Customer Satisfaction/Attitude Towards Ecert Latihan) (7 item)

Item item soal selidik yang digunakan adalah menggunakan skala perkadaran kelakuan dimana responden mempunyai pendapat tersendiri terhadap item soalan. Sesuatu sikap boleh diketahui dengan memberi peluang kepada individu untuk memberi respons kepada satu siri penyiasatan berhubung dengan kecenderungan mereka. Cara responden menjawab boleh dianggap sebagai bukti responden. (Noraini Idris, 2013).

Skala asas yang digunakan adalah menggunakan skala Likert. Skala ini membenarkan penyelidik untuk mengukur sikap subjek terhadap sesuatu konsep.

Jadual 2: Skala Likert

Skala	Penilaian Item
5	Sangat Setuju
4	Setuju
3	Tidak pasti
2	Tidak setuju
1	Sangat Tidak Setuju

5.4 Kesahan dan kebolehpercayaan Item

Kesahan dan kebolehpercayaan item dianalisis dengan menggunakan perisian SPSS. Perisian ini dipilih kerana ia dapat memenuhi hampir semua teknik pemprosesan dan penganalisaan data sesuai dengan objektif sesuatu penyelidikan yang dijalankan. (Majid Konting, 2000). Perisian ini boleh menyimpan data, mengira statistik dan seterusnya membina laporan dengan mudah. (Mohd Salleh Abu Bakar dan Zaidatun Tasir, 2000).

Analisis kesahan dan kebolehpercayaan item bagi soalselidik yang dibina dianalisis dengan menggunakan prosedur Reliability Analysis, model Alpha (Cronbach). Penyelidik memilih model Alpha Cronbach kerana mengikut Lim Chap Sam dan Chee Kim Mang, 2013 Alpha Cronbach digunakan untuk instrumen yang berskala pelbagai (Multipoint Scaled Item) seperti Skala Likert, Thurstone atau Guttman. Setelah dianalisis, nilai pekali kebolehpercayaan item secara keseluruhannya bernilai 0.986. Ia menunjukkan bahawa konsistensi yang tinggi bagi keseluruhan pemboleh ubah yang dikaji, serta membuktikan bahawa analisis data boleh dijadikan sandaran.

Jadual 3: Reliability Analisis, model Alpha (Cronbach)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.986	.986	21

Menurut Mohd Salleh Abu Bakar dan Zaidatun Tasir, nilai maksimum bagi pekali kebolehpercayaan ialah 1. Sekiranya nilai pekali tersebut kurang dari 0.6, maka dianggap instrumen yang digunakan dalam kajian mempunyai kebolehpercayaan yang rendah. Item soalan didalam soal selidik telah disesuaikan dan diubah untuk mendapatkan nilai Alpha yang baik.

7. Analisis Data Dan Perbincangan Dapatan Kajian

Analisis Bahagian A (Demografi)

Sebanyak 283 sampel borang selidik telah diemail kepada semua kakitangan. Maklumat demografi responden yang diperolehi dianalisis menggunakan Statistik Deskriptif iaitu menggunakan taburan kekerapan dan peratusan.

Jadual 4 menunjukkan responden wanita lebih ramai dengan bilangan 178 orang (62.9%). Manakala responden lelaki seramai 105 orang (37.1%) daripada keseluruhan responden seramai 283 orang.

Jadual 4: Kekerapan dan Peratus mengikut Kategori Jantina

		Frequency	Percent	Valid Percent	Cumulative Percent
JANTINA					
Valid	LELAKI	105	37.1	37.1	37.1
	PEREMPUAN	178	62.9	62.9	100.0
	Total	283	100.0	100.0	

Jadual 5 menunjukkan responden dari JHEP adalah seramai 6 orang (2.1%), JKA 45 orang (15.9%), JKE 30 orang (10.6%), JKM 39 orang (13.8%), JKP 4 orang (1.4%), JMSK 40 orang (14.1%), JPA 13 orang (4.6%), JP 22 orang (7.8%), JSKK 5 orang (1.8%), JTMK 24 orang (8.5%), PT 1 orang (0.4%), CISEC 3 orang (1.1%), UKK 1 orang (0.4%), ULPL 3 orang (1.1%), UPPSI 1 orang (0.4%), UPK 41 orang (14.5%), UPIK 1 orang (0.4%) dan ULib 3 orang (1.4%). Didapati responden dari UPK adalah paling ramai.

Jadual 5: Kekerapan dan Peratus mengikut Kategori Jabatan/Unit Responden

		Frequency	Percent	Valid Percent	Cumulative Percent
JABATAN/UNIT					
Valid	JABATAN HAL EHWAL PELAJAR	6	2.1	2.1	2.1
	JABATAN KEJURUTERAAN AWAM	45	15.9	15.9	18.0
	JABATAN KEJURUTERAAN ELEKTRIK	30	10.6	10.6	28.6
	JABATAN KEJURUTERAAN MEKANIKAL	39	13.8	13.8	42.4
	JABATAN KEJURUTERAAN PERKAPALAN	4	1.4	1.4	43.8
	JABATAN MATEMATIK DAN SAINS KOMPUTER	40	14.1	14.1	58.0
	JABATAN PENGAJIAN AM	13	4.6	4.6	62.5
	JABATAN PERDAGANGAN	22	7.8	7.8	70.3
	JABATAN SUKAN, KOKURIKULUM DAN KEBUDAYAAN	5	1.8	1.8	72.1
	JABATAN TEKNOLOGI MAKLUMAT DAN KOMUNIKASI	24	8.5	8.5	80.6
	PENGURUSAN TERTINGGI	1	.4	.4	80.9
	UNIT CISEC	3	1.1	1.1	82.0
	UNIT KOMUNIKASI KORPORAT	1	.4	.4	82.3
	UNIT LATIHAN DAN PENDIDIKAN LANJUTAN	3	1.1	1.1	83.4
	UNIT PENGURUSAN PSIKOLOGI	1	.4	.4	83.7
	UNIT PENTADBIRAN DAN KEWANGAN	41	14.5	14.5	98.2
	UNIT PENYELIDIKAN. INOVASI DAN KOLABORASI	1	.4	.4	98.6
	UNIT PERPUSTAKAAN	4	1.4	1.4	100.0
	Total	283	100.0	100.0	

Jadual 6 pula menunjukkan responden dari kategori Akademik menjawab soalselidik lebih ramai 214 orang (75.6%) berbanding Bukan Akademik seramai 69 orang (24.4%).

Jadual 6: Kekerapan dan Peratus mengikut Kategori Perjawatan Responden

		Frequency	Percent	Valid Percent	Cumulative Percent
KATEGORI PERJAWATAN					
Valid	AKADEMIK	214	75.6	75.6	75.6
	BUKAN AKADEMIK	69	24.4	24.4	100.0
	Total	283	100.0	100.0	

Analisis Bahagian B

Hasil kajian bagi bahagian B dikumpul dan dianalisis untuk menentukan skor min yang dikategorikan kepada 4 bahagian. Menurut Landell (1997), tahap kecenderungan keputusan responden adalah seperti jadual dibawah:

Jadual 7: Tahap kecenderungan mengikut skor min

Kod Kumpulan	Julat	Tahap
1	1.00-2.39	Rendah
2	2.40-3.79	Sederhana
3	3.80-5.00	Cemerlang

a. Persepsi Mudah Untuk Digunakan - Perceive Ease of Use (PEOU)

Pada bahagian ini, item soalan diberi berpandukan kepada Pembolehubah Persepsi Mudah Untuk Digunakan dimana menilai tahap kepercayaan pengguna bahawa teknologi/sistem secret mudah untuk digunakan dan bebas dari masalah. Pengguna merasakan teknologi (computer) mudah dikendalikan dalam melaksanakan tugas-tugas yang diberikan.

Melalui analisis dapatan kajian, penilaian tahap Persepsi Mudah Untuk Digunakan terhadap ecert latihan adalah pada tahap kecenderungan cemerlang dengan skor min 4.38. Analisis kebolehpercayaan bagi item soalan adalah sebanyak 0.942.

Jadual 8: Skor min bagi tahap Persepsi Mudah Untuk Digunakan

Statistics

TANGGAPAN MUDAH GUNA

N	Valid	283
	Missing	0
Mean		4.38

Jadual 9: Analisa Kebolehpercayaan item soalan Persepsi Mudah Untuk Digunakan

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.942	.943	5

Jadual 10 adalah hasil analisis bagi soalan berkenaan Persepsi Mudah untuk Digunakan. Soalan kedua, *Modul eCERT Latihan ini boleh digunakan pada bila-bila masa mengikut keperluan saya* adalah pada tahap kecenderungan cemerlang dengan nilai min 4.43 dan soalan keempat, *Menjana dan mengedar sijil menggunakan eCERT Latihan tidak memerlukan tahap pengetahuan ICT yang terlalu tinggi* juga berada pada tahap kecenderungan cemerlang dengan nilai min 4.31.

Jadual 10: Skor min bagi tahap Persepsi Mudah Untuk Digunakan mengikut item soalan

Statistics						
		1. Modul eCERT Latihan ini senang, jelas dan mudah untuk digunakan/dikendalikan.	2. Modul eCERT Latihan ini boleh digunakan pada bila-bila masa mengikut keperluan saya.	3. Modul eCERT Latihan ini boleh diakses melalui iPUO masing-masing menggunakan pelbagai peranti. (Handphone, laptop, tablet dan sebagainya)	4. Menjana dan mengedar sijil menggunakan eCERT Latihan tidak memerlukan tahap pengetahuan ICT yang terlalu tinggi.	5. Interaksi antara saya (pengguna) dengan modul eCERT Latihan adalah jelas dan mudah difahami.
N	Valid	283	283	283	283	283
	Missing	0	0	0	0	0
Mean		4.42	4.43	4.38	4.31	4.36

b. Persepsi Faedah Penggunaan - Perceive Usefullness (PU)

Pada bahagian ini, item soalan diberi berpandukan kepada Pembolehubah Persepsi Faedah Penggunaan dimana menilai tahap kepercayaan pengguna nahawa dengan menggunakan teknologi akan meningkatkan prestasi kerja dan seterusnya akan meningkatkan kauliti dan produktiviti kerja. Tanggapan kebergunaan juga sebagai tahap kepercayaan seseorang bahawa sesuatu sistem meningkatkan prestasi kerja (Davis et al., 1989)

Melalui analisis dapatan kajian, penilaian tahap Persepsi Faedah Penggunaan terhadap ecert latihan adalah pada tahap kecenderungan cemerlang dengan skor min 4.43. Analisis kebolehpercayaan bagi item soalan adalah sebanyak 0.956.

Jadual 11: Skor min bagi tahap Persepsi Faedah Penggunaan

Statistics		
TANGGAPAN KEBERGUNAAN		
N	Valid	283
	Missing	0
Mean		4.43

Jadual 12: Analisa Kebolehpercayaan item soalan Persepsi Faedah Penggunaan

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.956	.957	5

Jadual 12 menunjukkan, setelah analisis dilakukan, didapati skor min tertinggi adalah daripada soalan keempat, *Dengan menggunakan modul ECert Latihan saya memperoleh sijil kursus dengan lebih cepat setelah kursus tamat* adalah pada tahap kecenderungan cemerlang dengan

nilai min 4.49. Skor min terendah pula didapati pada soalan 1, *Modul eCERT Latihan meningkatkan kecekapan saya menyimpan sijil kursus yang telah dihadiri* dengan skor min sebanyak 4.39. Walaubagaimanapun, skor min ini masih dalam tahap kecenderungan cemerlang.

Jadual 13: Skor min bagi tahap Persepsi Faedah Penggunaan mengikut item soalan

Statistics						
		1. Modul eCERT Latihan meningkatkan kecekapan saya menyimpan sijil kursus yang telah dihadiri.	2. Modul eCERT Latihan memudahkan saya mengemaskini sijil kursus yang telah dihadiri.	3. Dengan menggunakan eCERT Latihan, saya dapat menjejaki (keep track) kursus yang telah saya hadiri pada bila-bila masa.	4. Dengan menggunakan modul ECert Latihan saya memperoleh sijil kursus dengan lebih cepat setelah kursus tamat.	5. Saya suka menggunakan eCERT Latihan.
N	Valid	283	283	283	283	283
	Missing	0	0	0	0	0
Mean		4.39	4.43	4.44	4.49	4.41

c. Amalan Hijau - Green It Attitude

Bahagian ini membincangkan persepsi pengguna berkaitan amalan teknologi hijau semasa menggunakan ecert latihan. Soalan-soalan pada bahagian ini berpandukan kepada penyataan

Selepas menggunakan eCERT Latihan, saya merasakan ia menyumbang kepada teknologi hijau (mengurangkan penggunaan kertas, mengurangkan penggunaan toner untuk mencetak dan menjimatkan ruangan penyimpanan fizikal (fail dan tempat penyimpanan fail sijil)), oleh itu;

Setelah dianalisis, penilaian tahap persepsi Amalan Hijau adalah pada tahap cemerlang dengan skor min sebanyak 4.47. Analisis kebolehpercayaan bagi item soal selidik tahap kesediaan pensyarah melaksanakan aktiviti kolaborasi adalah 0.956.

Jadual 14: Skor min bagi tahap Amalan Hijau

Statistics

AMALAN HIJAU

N	Valid	283
	Missing	0
Mean		4.47

Jadual 15: Analisa Kebolehpercayaan item soalan Amalan Hijau

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.956	.957	5

Jadual 16 menunjukkan soalan berkenaan persepsi tahap amalan hijau. Didapati soalan ketiga, *eCert Latihan memberi faedah dari segi penjimatan kos kepada Politeknik Ungku Omar* mempunyai tahap kecenderungan cemerlang dengan skor min tertinggi 4.49 manakala skor min terendah adalah pada soalan pertama, *eCERT Latihan adalah modul yang sesuai digunakan di Politeknik Ungku Omar* dan kedua, *eCERT Latihan adalah modul yang sangat praktikal digunakan di Politeknik Ungku Omar* dengan skor min 4.44. walaubagaimanapun tahap kecenderungan bagi soalan ini masih di tahap cemerlang.

Jadual 16: Skor min bagi tahap Amalan Hijau mengikut item soalan

Statistics					
		1. eCERT Latihan adalah modul yang sesuai digunakan di Politeknik Ungku Omar.	2. eCERT Latihan adalah modul yang sangat praktikal digunakan di Politeknik Ungku Omar.	3. eCert Latihan memberi faedah dari segi penjimatan kos kepada Politeknik Ungku Omar.	4. eCERT Latihan sememangnya mengamalkan teknologi hijau.
N	Valid	283	283	283	283
	Missing	0	0	0	0
Mean		4.44	4.44	4.49	4.53

d. Kepuasan Pengguna Terhadap Penggunaan Ecert Latihan (Customer Satisfaction/Attitude Towards Ecert Latihan)

Penilaian pada bahagian ini diukur berdasarkan sikap pengguna samada menerima atau menolak penggunaan sesuatu teknologi dalam melaksanakan kerja. Ia juga berkaitan dengan faktor sikap sebagai salah satu faktor yang mempengaruhi perilaku individu.

Melalui analisis, didapati penilaian tahap penerimaan pengguna terhadap penggunaan ecert latihan adalah pada tahap kecenderungan cemerlang dengan skor min 4.41. Analisis kebolehpercayaan bagi item soalan adalah sebanyak 0.977.

Jadual 17: Skor min bagi tahap Kepuasan Pengguna Terhadap Penggunaan Ecert Latihan

Statistics

TAHAP KEPUASAN

N	Valid	283
	Missing	0
Mean		4.41

Jadual 18: Analisa Kebolehpercayaan item soalan Kepuasan Pengguna Terhadap Penggunaan Ecert Latihan

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.977	.978	7

Jadual 19 menunjukkan, setelah analisis, didapati skor min cemerlang adalah daripada soalan pertama dan ketujuh dengan tahap kecenderungan cemerlang 4.43 terhadap penyataan *Saya berpuas hati semua sijil kursus saya dapat dikemaskini dengan mudah* dan *Secara keseluruhan, saya berpuas hati menggunakan modul eCERT Latihan untuk menjana, mengedar, mengemaskini dan menyimpan sijil-sijil kursus saya.* Skor min terendah pula didapati pada soalan keempat, *Pada pendapat saya, penggunaan eCERT Latihan memenuhi jangkaan saya* dengan skor min sebanyak 4.37. Walaubagaimanapun, skor min tersebut masih berada pada tahap kecenderungan cemerlang.

Jadual 19: Skor min bagi tahap Amalan Hijau mengikut item soalan

Statistics					
		1. Saya berpuas hati semua sijil kursus saya dapat dikemaskini dengan mudah.	2. Pada pendapat saya, penggunaan eCERT Latihan memenuhi jangkaan saya.	3. Saya berpuas hati semua sijil saya dapat diakses pada bila-bila masa mengikut keperluan dan menggunakan peranti yang berbeza.	4. Pada pendapat saya, penggunaan eCERT Latihan adalah sangat berkesan.
N	Valid	283	283	283	283
	Missing	0	0	0	0
Mean		4.43	4.37	4.40	4.41

Statistics				
		5. Pada pendapat saya, eCERT Latihan merupakan modul yang sangat baik.	6. Pada pendapat saya, eCERT Latihan telah membantu pihak Politeknik Ungku Omar dan Unit Latihan dan Pendidikan Lanjutan dalam menyediakan perkhidmatan yang lebih dipercayai dan berkesan.	7. Secara keseluruhan, saya berpuas hati menggunakan modul eCERT Latihan untuk menjana, mengedar, mengemaskini dan menyimpan sijil-sijil kursus saya.
N	Valid	283	283	283
	Missing	0	0	0
Mean		4.40	4.42	4.43

8. Kesimpulan

Kajian ini secara keseluruhannya melaporkan dapatan dari segi tahap kepuasan staf terhadap modul ecert latihan di sistem iPUO. Jadual 20 menunjukkan tahap kecenderungan yang cemerlang bagi semua bahagian bahagian soalan. Didapati;

a. Tahap persepsi kakitangan PUO bahawa modul ecert latihan ini mudah untuk digunakan adalah pada tahap cemerlang dengan skor min 4.38.
b. Tahap persepsi kakitangan PUO bahawa modul ecert latihan ini berfaedah untuk digunakan adalah pada tahap cemerlang dengan skor min 4.43.
c. Tahap persepsi kakitangan PUO bahawa modul ecert latihan ini menggunakan konsep amalan hijau adalah pada tahap cemerlang dengan skor min 4.47.

d. Sikap positif terhadap tahap kepuasan pengguna terhadap modul ecert latihan adalah pada tahap cemerlang dengan skor min 4.40.

Jadual 20: Skor min bagi setiap bahagian soalan

Descriptive Statistics

	N	Mean	Std. Deviation
TANGGAPAN MUDAHGUNA (PEOU)	283	4.3816	.56564
TANGGAPAN KEBERGUNAAN (PU)	283	4.4353	.59396
AMALAN HIJAU	283	4.4744	.56455
TAHAP KEPUASAN	283	4.4094	.59737
Valid N (listwise)	283		

Jadual 21 menunjukkan nilai skor min tertinggi item soalan bagi setiap bahagian soalan. Dapat disimpulkan bahawa kakitangan Politeknik Ungku Omar;

a. Persepsi Mudah Untuk Digunakan
Mempunyai persepsi bahawa apabila menggunakan modul ecert ini, **mereka akan mendapati bahawa**, modul ecert ini boleh digunakan pada bila-bila masa mengikut keperluan. Semua kakitangan PUO mempunyai akses kepada iPUO masing-masing dimana, setiap kali dipanggil untuk berkursus, memo panggilan kursus serta borang keberkesanan kursus boleh diakses dan diisi secara dalam talian. Sebaik sahaja borang penilaian diisi dan dihantar, pengguna hanya perlu *refresh browser* dan ecert akan dijana secara automatik ke dalam iPUO masing-masing. Pengguna mempunya pilihan samada untuk muat turun sijil atau membiarkan sahaja disimpan didalam sistem dan boleh dimuat turun apabila diperlukan.

b. Persepsi Faedah Penggunaan
Mempunyai persepsi bahawa **dengan menggunakan** modul ecert ini, sijil kursus boleh diperolehi dengan lebih cepat. Sebelum menggunakan ecert, sijil kursus disediakan secara manual dimana melibatkan sebanyak 15 langkah proses kerja serta tempoh penyediaan yang mengambil masa selama 7 hari. Tempoh bermula dari proses menyemak, menghasil, menunggu dan mengedarkan sijil kepada peserta. Sijil yang terhad bergantung kepada perolehan semasa politeknik serta proses kerja yang bergantung sepenuhnya kepada peruntukan masa, kemahiran staf, pencetak dan dakwat berwarna. Selepas ecert diperkenalkan, proses penyediaan telah dikurangkan kepada 4 langkah sahaja serta tempoh telah dapat disingkatkan kepada 27 minit.

c. Amalan Hijau - Green It Attitude
Bersetuju bahawa modul eCERT Latihan ini memberi faedah dari segi penjimatan kos kepada Politeknik Ungku Omar. Sebelum ecert diperkenalkan, kos tempahan sijil serta kos dakwat mesin pencetak perlu diambilkira. Ini termasuk pembelian mesin pencetak yang berspesifikasi tinggi agar sijil yang dihasilkan lebih cantik dan berkualiti. Ini mengambilkira juga kos yang perlu dibazirkan apabila sijil tidak boleh diguna disebabkan oleh perubahan logo kementerian atau sijil-sijil yang tersalah ataupun rosak semasa proses cetakan. Selepas ecert digunakan, sijil secara *hardcopy* tidak perlu disediakan, tidak perlu dicetak, tiada pembaziran dan logo kementerian hanya perlu dikemaskini didalam sistem.

d. Kepuasan Pengguna Terhadap Penggunaan Ecert Latihan (Customer Satisfaction/Attitude Towards Ecert Latihan)
Berpuas Hati menggunakan modul ecert latihan dimana semua sijil kursus dapat dikemaskini dengan mudah dan berpuas hati ecert latihan digunakan untuk menjana, mengedar, mengemaskini dan menyimpan sijil-sijil kursus yang telah dihadiri.

Jadual 21 menunjukkan nilai skor min tertinggi item soalan bagi setiap bahagian soalan

No.	Bahagian	Item Soalan	Nilai Min
a.	Persepsi Mudah Untuk Digunakan (PEOU)	Modul eCERT Latihan ini boleh digunakan pada bila-bila masa mengikut keperluan saya.	4.43
b.	Persepsi Faedah Penggunaan (PU)	Dengan menggunakan modul ECert Latihan saya memperoleh sijil kursus dengan lebih cepat setelah kursus tamat.	4.49
c.	Amalan Hijau	eCert Latihan memberi faedah dari segi penjimatan kos kepada Politeknik Ungku Omar.	4.49
d.	Kepuasan Pengguna Terhadap Penggunaan Ecert Latihan	Saya berpuas hati semua sijil kursus saya dapat dikemaskini dengan mudah.	4.43
		Secara keseluruhan, saya berpuas hati menggunakan modul eCERT Latihan untuk menjana, mengedar, mengemaskini dan menyimpan sijil-sijil kursus saya.	4.43

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e-STC FOR SITE REQUISITION MACHINERY SPARE PART ORDER

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ABSTRACT

Procurement Department at Pembinaan Tetap Teguh Jentera (PTTJ) basically manage all machineries at the site and responsible for internal department request, dealing with suppliers, coordinating, and monitoring purchases especially in documentation for purchase spare part machineries and equipment's order. The existing method used for machinery spare parts orders is not systematic and difficult to track between the Workshop Department and The Procurement Department, resulting in overlooking, double order, delay payment to suppliers, and blocked orders by suppliers. Therefore, the aim of the study is to develop the systematic tracking centre (e-STC) for site requisition machinery spare part order using wix.com at PTTJ for more systematic and efficient of purchase Invoices and Delivery Orders (DO) and payments to suppliers. There are three objectives to be studies, first is to identify the need of systematic tracking centre for site requisition machinery spare part orders at PTTJ. Secondly is to develop the e-STC for site requisition machinery spare part orders at PTTJ using wix.com and finally is to test the effectiveness of systematic tracking centre (e-STC) for site requisition machinery spare part orders at PTTJ. Objective 1 and 3, used quantitative method conducted by survey and objective 2 use wix.com. Data Analysis uses SPSS and Excel Solution Online. The results for objective 1 showed that the current method; average mean is very low in every constraint element; <1.5 average mean and was resulted for current method, easy to track order element. Result for objective 2 show that e-STC for site requisition machinery spare part orders at PTTJ using wix.com successful to developed. Meanwhile, result for objective 3 show that > 90% respondents agree the e-STC for site requisition machinery spare part order is systematic. Paired T Test showed the effectiveness element of e-STC for site requisition machinery spare part order for resulted as 2.69 in differences average mean; High in agree interpretation. The conclusion, e-STC is a systematic and efficient medium for purchase Invoices and Delivery Orders (DO) and payments to suppliers and needs to be implemented for site requisition machinery spare part orders at PTTJ.

1. Introduction

Construction industry is one of the industries that play an important role in developing and enhancing economic sector and the development of one's country. The variety of machinery used in the construction industry is critical. The construction industry has a significant impact on the global economy. Construction sites need effective management to optimize productivity and efficiency that stimulates economic growth by creating demand for various goods and services including raw materials, equipment, machinery and transportation service. In this era of technologies, the use of software or systems is essential to the growth of the organization. The Fourth Industrial Revolution (IR 4.0) is now developed on the Digital Revolution, in which technology and people are becoming increasingly integrated, preserve to improve performance of work. Implementing the IR 4.0 is highly suitable in creating a more systematic and centralized tracking centre to assist the process and reduce their common issues. IoT refers to the increasing network of physical objects that feature an IP address for internet connectivity, and the communication that occurs between these objects and other Internet-enabled devices and systems. Pembinaan Tetap Teguh (PTT) is one of the Malaysia's leading construction companies, specialized in Earthworks and Infrastructure works. Basically, all machineries at site under PTT is manage by Pembinaan Tetap Teguh Jentera (PTTJ), which is a subsidiary company under PTT. Primarily, the Procurement Department under PTTJ is responsible for sourcing direct and indirect materials requested by the internal departments, dealing with suppliers to negotiate the best price and payment terms. In existing method, the Procurement Department at PTTJ basically manage all machinery at the site and responsible for internal department request, required to liaise and dealing with supplies for timely delivery, coordinating, and monitoring all purchases especially in documentation for purchase spare part machineries and equipment's order to avoid any shortages, overcharges, and breakage. Procurement Department under PTTJ will also be responsible to manage supply chain related tasks, analyse the cost reduction activities and alternative part replacements. To ensure the financial viability of other industries, a variety of machines are required to handle the required speed, massive quantities of items, precision, and efficiency. These machines are necessary to handle the required speed, massive quantities of items, precision, and efficiency. The first common issue that arises in the process of PTTJ in maintaining and servicing PTT's machinery is the insufficiency to track orders properly made by site and office and followed by the checklist to check is not properly showed and documented to check the condition of the machineries because of poor communication among procurement and workshop department staff because they use WhatsApp's group medium only. There is lack of a systematic Tracking Medium. Other problem is always resulting in overlooking, double order, delay payment to suppliers due to incomplete documentation for purchasing spare part order and insufficiency to track spare part order and the third problem is causing of blocked orders by suppliers due to unsystematic tracking method. Therefore, a more systematic tracking centre for the ordering of machinery spare parts at PTTJ needs to be developed to solve the constrains faced with the existing method. Hence, the aim of the study is to develop the systematic tracking centre (e-STC) for site requisition machinery spare part order using wix.com at PTTJ for more systematic and efficient of purchase Invoices and Delivery Orders (DO) and payments to suppliers. There are three objectives to be studies, first objective is to identify the need of systematic tracking centre for site requisition machinery spare part orders at PTTJ. Next objective is to develop the e-STC for site requisition machinery spare part orders at PTTJ using wix.com and the third objective is to test the effectiveness of systematic tracking centre (e-STC) for site requisition machinery spare part orders at PTTJ. The scope of the project is at the headquarters and two construction site which are Kota Elmina and Bandar Bukit Raja 2. The Site Requisition Order

focusing on the procurement department and the site department at PTTJ.

2. Materials and Methods

The methodology refers to the practical "how" of any given piece of research that specifically it's about how a researcher systematically designs a study to ensure valid and reliable results that address the research aims and objectives that will accomplish a perfect result. It can be termed as plan, structure, and strategy of a research to seek for alternative tools in problem solving and variance mitigation. They are essentially planned, scientific and value neutral (Rajasekar et al., 2006). The research design is the framework of research methods and techniques to focus on research methodologies that are appropriate for the subject matter by set up the method, instruments and the type of analysis used to achieve the result due to the objectives of the study. The research flow of methodology generally, consist of four major steps or phase which is consists of planning, procedure, data collection and data analysis. This development research is a process approach from the beginning to the end of Site Requisition Machinery Spare Part Order at PTTJ. The study's methodology is broken down into multiple parts, each of which will be detailed in depth. Throughout the process of finishing this project, four phases of approach will be used as a Research Flow of Methodology process into mere detail which is show in Figure 1 below; depicts the operational framework. There are four phases of research flow methodology. Phase 1 is the problem discovery and literature reviews, Phase 2 is method of Collection Data (primary sources and secondary source), Phase 3 is production of system (testing of data, analysis, and interpretation of data), recommendation and conclusion. Phase 4 is the Final Outcome (achieve the objectives).

In general, phase 1 is the preliminary study to identify the problem statement, aims, objectives, scope of study and significance of study. Issues related to the selected topic were identified during this phase. Further, the objectives of the study to solve the problem have also been set. Inn phase 2, data collection for objectives 1 and 3, using quantitative method by survey through distribute the questionnaire to the respondents via google form. Next, for objective 2 is to develop the e-STC for site requisition machinery spare part orders using wix.com. Phase 3 is the stage of the data analysis to achieve the objectives 1 and 3 by using SPSS Software Phase 4 is to get the Final outcome to achieve the objectives.

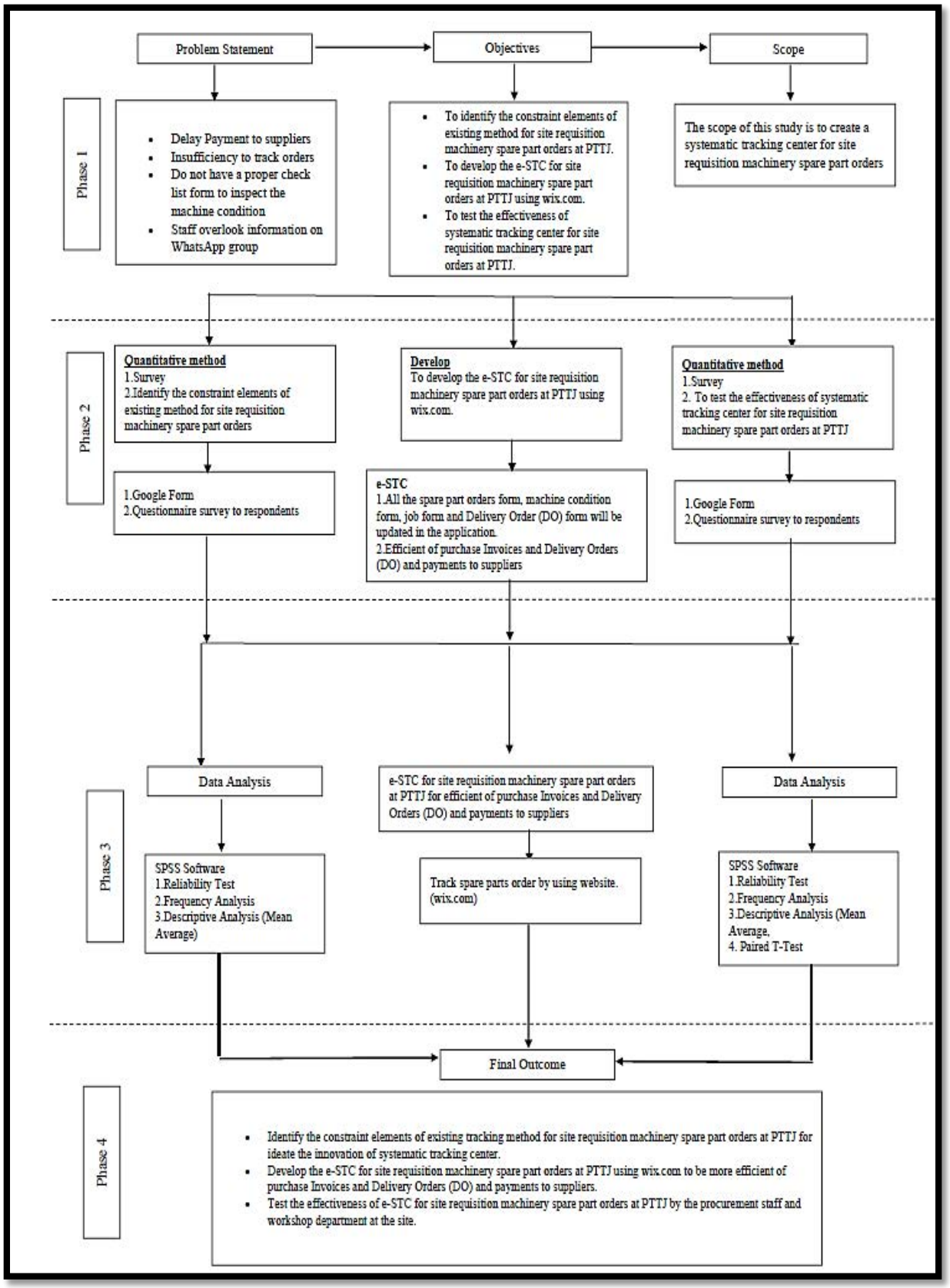


Figure 1: Research flow of Methodology

2.1 Data Collection

Data for objective 1 and 3 is collect through the questionnaire survey by respondents using a Google form. In this study, the quantitative method was chosen. The location of the study is conduct at PTT HQ under procurement department PTTJ and site because the analyst believes procurement department know the circumstance and situations facing related to machinery. Respondents are related person who are responsible for documentation order spare parts. A survey was given to 30 respondents consists of procurement department staff, site, and foreman to answer questions from the survey. In general, a larger sample size allows for more accurate and precise analysis of data and reduces the risk of sampling error. However, in some cases, a sample size of 30 respondents can provide enough data for meaningful analysis, particularly if the study aims to identify basic patterns or relationships in the data. According to Uma Sakaran (2003) sampling is a process of selecting an adequate number of populations to be reviewed so that the study and understanding of the nature or characteristics of the sample can represent the population. One of the most used methods is the Krejcie and Morgan Sampling Method. To simplify the process of determining the sample size for a finite population, Krejcie & Morgan (1970), came up with a table using sample size formula for finite population as in Figure 2 below.

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size. *S* is sample size.
Source: Krejcie & Morgan, 1970

Figure 2: The sample size by Krejcie & Morgan 1970 (Sources from Google search**)**

2.2 Technology Acceptance Model (TAM)

The current global era, information systems are important in helping organizations run their activities. Without a good information system, it will be very difficult, given that the current global flow has become one of the main needs of the activities in an organization. An information system becomes indispensable as it can assist in carrying out the activities undertaken within the organization. Information systems today have become a major requirement in the running of the organization. In accepting a new technology system, not everyone will be well understood. Therefore, it is important to assess or measure the level of

acceptance and understanding recipients and users of information technology by measurement behaviour of the user. The Technology Acceptance Model (TAM) is a framework developed by Fred D. Davis in 1986. Davis's model in the adaptation of Theory Reasoned Action which assumes that one adopts a technology is generally determined by the cognitive process and aims to satisfy the wearer or maximize the usefulness of the technology. TAM is used to examine and measure factors that influence decisions whether one accepts or rejects the information technology. The TAM model is developed from psychological theory that explains that computer user behaviour is based on belief, attitude, intention, and user behaviour relationship. The purpose of this model is to explain the main factors of user behaviour toward acceptance technology users. In more detail explain the acceptance of IT with certain dimensions that can affect the acceptance of IT by the user.

2.3 Data Analysis

The analysis is using SPSS Software version 26 to analysis the Reliability Test, Frequency Analysis and Descriptive Analysis. The systematic use of statistical and logical methods to analyse data as credible evidence.

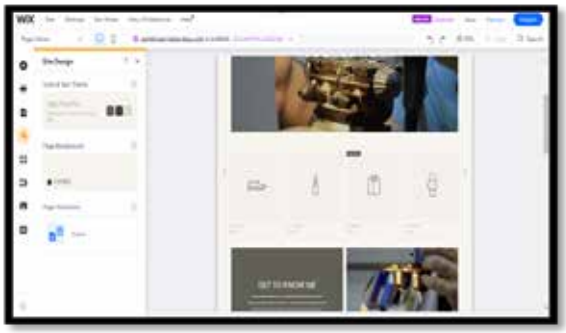
2.4 System Process and Development of e-STC for Site Requisition Machinery Spare Part Orders.

System processes are the result of gathering and quantifying a product's inputs and outputs across the course of its life cycle (ISO 14040:2006). System development refers to the process of creating or modifying systems, as well as the procedures, techniques, models, and methodologies required to do so. As a result, the system process and development mobile application tracking system are crucial to ensure that the process is properly developed and operated. To lead all labour activities while designing a mobile application, a systematic method is essential. However, to manage a successful product, analyse procedures to ensure product efficiency. e-STC for Site Requisition Machinery Spare Part Orders was built using wix.com website. Wix.com is a cloud-based website builder that is easy to use for user because of beginner-friendly to website builder. Wix.com also has hundreds of templates available for user to choose according to their needs. wix.com helps user editing website by adding variety element such as text, images, buttons, and so much more to the page, as shown in Figure 3 and Figure 4 below.

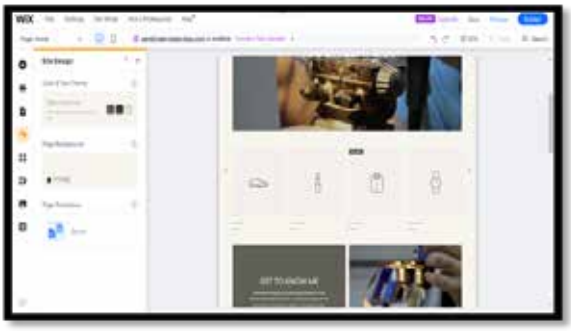
Figure 3: Design of e-STC for Site Requisition Machinery Spare Party Orders

Design of e-STC

Step 3: Design website using wix.com template.



Step 4: Home Page



Step 5: Order Form to order spare parts.

Step 6: Job Form for foreman update during inspection

Step 7: Machine Condition Form for foreman update after inspection

Step 8: Delivery Order for user upload documents

Figure 4: Design of e-STC for Site Requisition Machinery Spare Party Orders

2.4.1 Material Used

The material to be used as tools and the functional of material development for e-STC as shown in Figure 5 below.

Materials Used to develop e-STC	
Computers / Laptops  To create application, store data and test the functionality of the website.	Smartphone  To test the functionality of the website.
Internet/ Wifi  To link the computer and internet connect to upload the data.	wix.com  To develop the e-STC for Site Requisition Machinery Spare Parts Order.
Microsoft Teams  To upload the documents in the application.	Excel spreadsheets  To edit Microsoft Excel spreadsheets online without converting.

Figure 5: Material Used

2.5 Testing of Product

The completed product was tested with a questionnaire distributed via Google form links. This product was tested on 30 members of the site team and headquarters employees. Pembinaan Tetap Teguh Sdn Bhd's 30 personnels include the Procurement Department, the Purchasing Department, and the Workshop Department. Davis' Technology Acceptance Model was used to create the questionnaire (1989). The Technology Acceptance Model (TAM; Davis, 1989) is one of the most influential models of technology adoption, stating that two fundamental factors impact an individual's willingness to utilize new technology and perceived ease of use and perceived value (Neil Charness, 2016). TAM most familiar variables being measured in this study which is Perceived Ease of Use, Perceived Usefulness, Attitude Towards Using Technology and Behavioral Intention to Use. The sample size was determined using Krejcie

and Morgan Table (1970) whereby for population of 30 respondents, 28 samples were adequate. However, all 30 population were involved in this study.

3. Results

There are various methods for determining the user's needs. In this project, the purpose of this questionnaire is to identify the need of systematic tracking centre for site requisition machinery spare part orders at PTTJ using data analysis and a questionnaire. The sample size was determined using Krejcie and Morgan Table (1970) whereby for population of 30 respondents, 28 samples were adequate. There are 30 respondents answered the questionnaire with the Likert scale will be used to determine the respondent's level of agreement on each item. The Likert scale items are description;1 is Strongly Disagree, 2 is Disagree, 3 is Slightly Agree,4 is Agree and 5 is Strongly Agree.

3.1 Reliability Test for Pre-Test

Reliability analysis allows us to study the properties of measurement scales and the items that compose the scales. The Reliability Analysis procedure calculates several commonly used measures of scale reliability and provides information about the relationships between individual items in the scale. For this study, Reliability test Alpha (Cronbach) used. This model is a model of internal consistency, based on the average inter-item correlation as Table 1 below.

Table 1: Reliability Test for Pre-Test

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.888	0.901	16

Cronbach's Alpha is one of the methods to measure reliability. The score below 0.6 is poor, between 0.6 and 0.7 is acceptable, between 0.8 and 0.9 is good, meanwhile, score above 0.9 is excellent. The result show that Cronbach's Alpha Based on Standardized Items is 0.901 and it is excellent in reliability test from questionnaire answered by respondents.

3.2 To identify the need of systematic tracking centre for site requisition machinery spare part orders at PTTJ.

3.2.1 Data Collection for Pre-Test

The techniques of collection from 30 respondents include detailed instructions on how to gather data from a questionnaire using Google Form. In this investigation, the quantitative technique was adopted. This strategy allows for the acquisition of dependable and accurate data, as well as rapid data collection and a broader area of data collection. Table 2 show the result of respondents related to Mean of constraint elements for existing method at PTTJ. There are 4 constraint elements of existing method in machinery sparepart order at PTTJ. The data was generated by using SPSS Software, version 26. The result as show in Table 2 below.

Table 2: Mean and average mean of the categories for existing method

Constraint elements of existing tracking method	Mean	Average Mean	Average Mean (%)
Minimize delay payment	2.03 1.93 2.03 1.93	1.98	25.10
Easy to track order	1.93 1.93 2.00 1.93	1.95	24.68
Systematic Tracking Medium	2.00 1.97 1.97 1.97	1.98	25.06
Effective communication	1.97 1.97 1.97 2.03	1.99	25.16
Total Average:	**1.97**	**7.89**	**100**

3.2.2 Frequency Analysis

Frequency analysis is a general method of analysis that is used in a wide range of scientific disciplines, not just social measurement research. Furthermore, it is a statistical branch that investigates the frequency of occurrences and evaluates metrics such as central tendency, dispersion, percentiles, and so on. Using SPSS to obtain the analysis frequency date. The Frequency show in Figure 6 below.

The result shows that more than 80% of respondents is disagree for all four (4) elements in existing method. The result show that the highest in percentage is the effective communication element; it is 99.17% of respondents is disagreed in existing method. Second highest is in Systematic Tracking Medium elements, it is about 98.33% of respondent disagreed because they only use WhatsApp group medium, next is the Minimize Delay Payment element which is about 98.34% respondents disagreed and lastly is the Easy to Track Order element, results by 93.34% respondents disagreed while using existing method for site requisition machinery spare part orders at PTTJ.

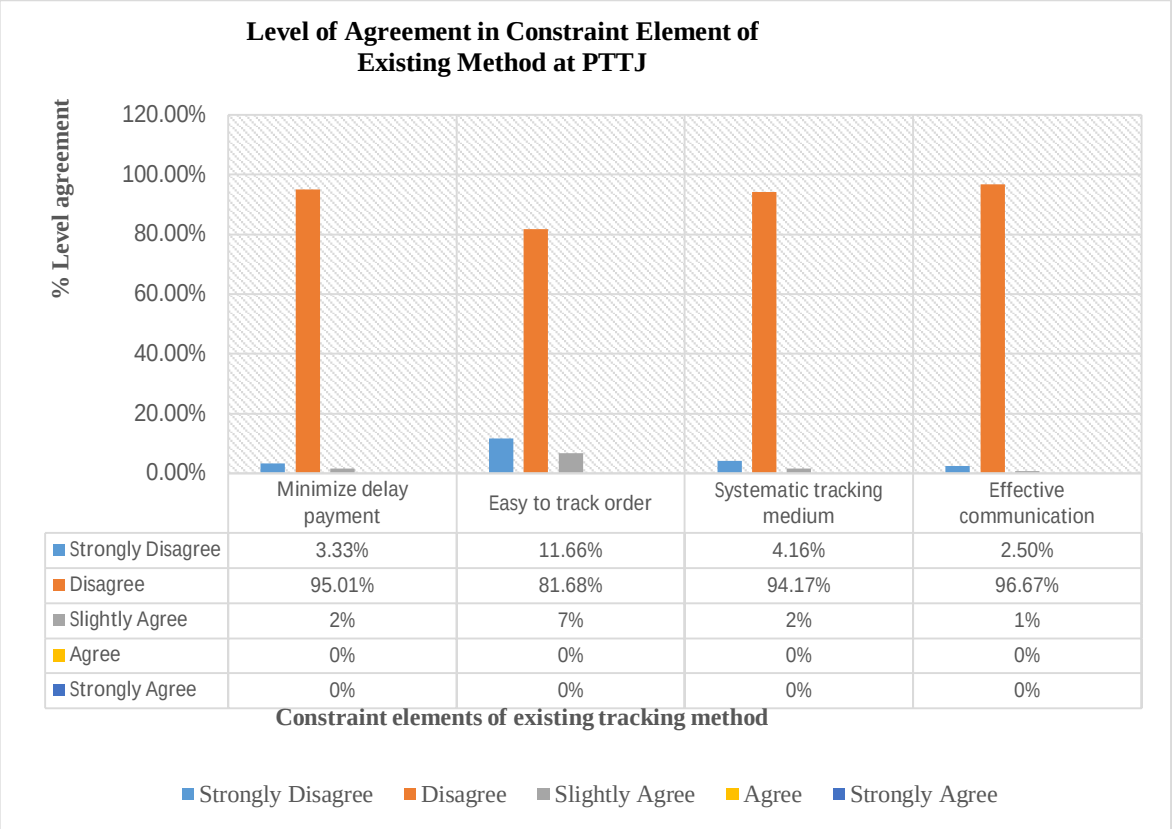


Figure 6: Frequency Analysis in Existing Method by percentage

3.3 Descriptive Analysis.

3.3.1 Average Mean

The constraint elements of existing tracking method had been identified. The result in mean and average means are referred in Table 3 below, interpretation is low in all elements of constraints with analysis revealing that the mean score for all variables examined was less than 2.50, indicating that the usability level of existing methods was poor. The result show that the Effective Communication element is the highest average mean score which is representative as 1.99 in average mean (25.16%) compared to another three (3) elements. Mostly, the average mean is less than 2.50 in all four (4) elements of constraints in using of the existing method for the site requisition spare part orders at PTTJ. It is showing the Mean Interpretation as Low category. Therefore, e-STC for Site Requisition Machinery Spare Part Orders needs to be develop.

3.3.2 Mean Range Interpretation

Table of mean score interpretation is referred in Table 4 below to interpret the pre - test result by respondents in using the existing method for Site Requisition Machinery Spare Part Orders at PTTJ by 30 respondents. The respondent level of usability toward existing method shows for all variables tested the average mean score were less than 2.50 meaning that the mean range level of existing method was Low. By referring to the interpretation of 5- point mean rating from Srisaard (2002).

Table 3: Average Mean in Existing Method

Constraint elements of existing tracking method	Mean	Average Mean	Average Mean (%)	Interpretation
Minimize delay payment	2.03 1.93 2.03 1.93	1.98	25.10	Low
Easy to track order	1.93 1.93 2.00 1.93	1.95	24.68	Low
Systematic Tracking Medium	2.00 1.97 1.97 1.97	1.98	25.06	Low
Effective communication	1.97 1.97 1.97 2.03	1.99	25.16	Low
Total Average:	**1.97**	**7.89**	**100**	

Table 4: Mean Range Interpretation (Source from Srisaard, 2002)

No	Mean Range	Interpretation
1	4.51 – 5.00	Very High
2	3.51 – 4.50	High
3	2.51 – 3.50	Medium
4	1.51 – 2.50	Low
5	1.00 – 1.50	Very Low

3.4 Develop e-STC for Site Requisition Machinery Spare Part Orders

The e-STC for Site Requisition Machinery Spare Part Orders is develop by using wix.com. The e-STC can track Invoices and Delivery Order (DO), update machine condition on site after inspection and order spare parts for machinery. All these works can be seen and done using e-STC for Site Requisition Machinery Spare Part Orders in the Design of e-STC for Site Requisition Machinery Spare Party Orders as show in Figure 3 and Figure 4 as explain in paragraph 2.5 before.

3.4.1 The Process to develop e-STC for Site requisition machinery spare parts order.

The process to develop of e-STC for site requisition machinery spare part order at PTTJ a s show in Figure7, Figure 8, Figure 9, and Figure 10 below. There are several steps to create, design and develop the website of the tracking system.

<table>
<tr><th colspan="2">Process to develop of e-STC</th></tr>
<tr><td>Step 1: Create an account on Wix.com.

Create an account using an email.</td><td>Step 2: Set up the website with Wix ADI

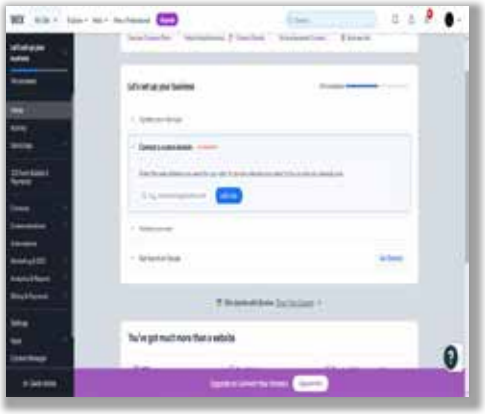
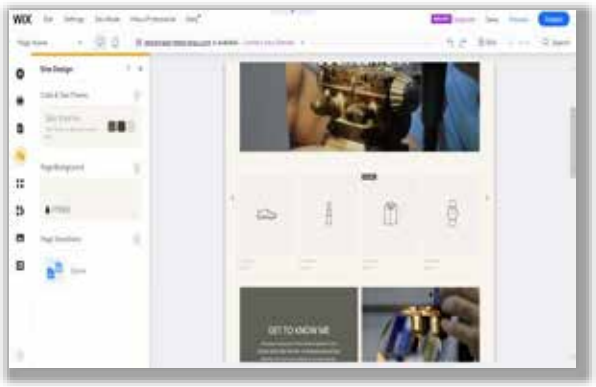
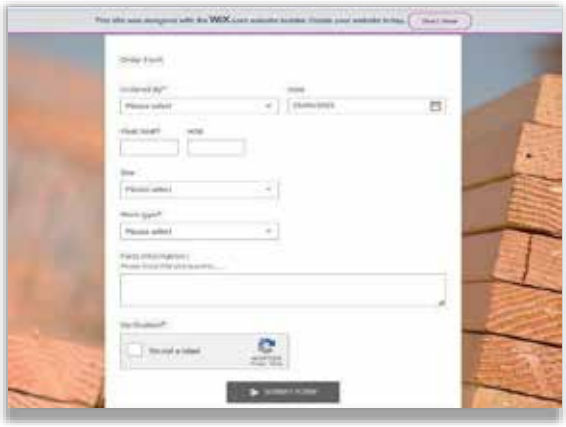
Set up the website based on the type of site are building.</td></tr>
<tr><td> 
</td><td>  </td></tr>
<tr><td>Step 3: Choose template from Wix.com.</td><td>Step 3: Design the website.</td></tr>
<tr><td>Choose templates from the relevant sub-category that been choose from.</td><td>Design the website based on the preference.</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>  </td><td>Step 3: Build the website by adding formsCreate a form for each section using templates in Wix.com. There are four (4)sections on this website:
i. Order form section for spare part orders.
ii. Next is Job form for foreman update during inspection.
iii. Machine condition form for foreman update after inspectionand.
iv. Delivery Order form for user upload documents related.</td></tr>
</table>

Figure 7: The process to develop e-STC at PTTJ

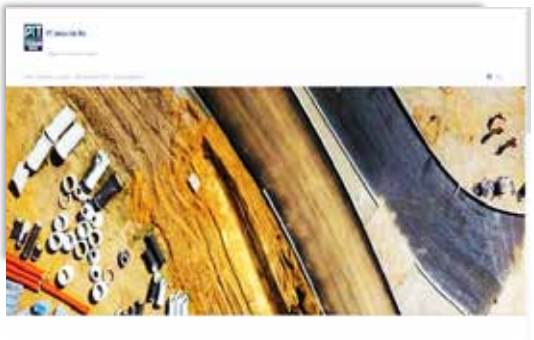
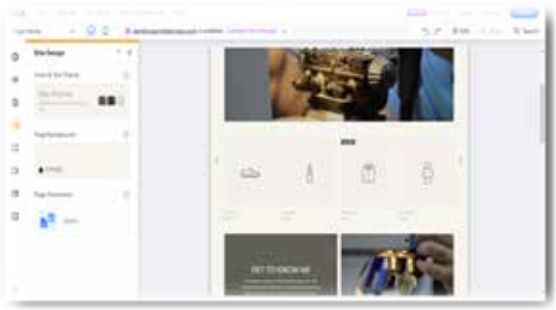
Process to develop of e-STC (continued)	
Step 4: Final product website development.	Final Product: Homepage of e-STC website Create details for Home Page.
	

Figure 8: The process to develop e-STC at PTTJ

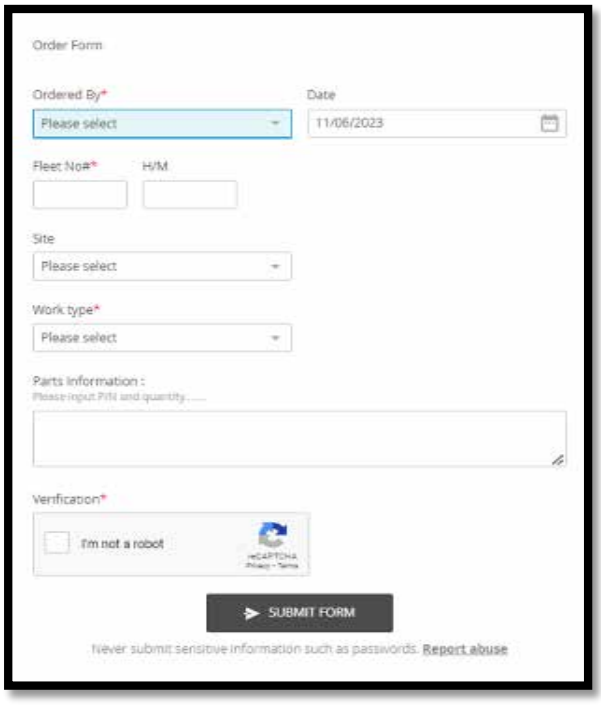
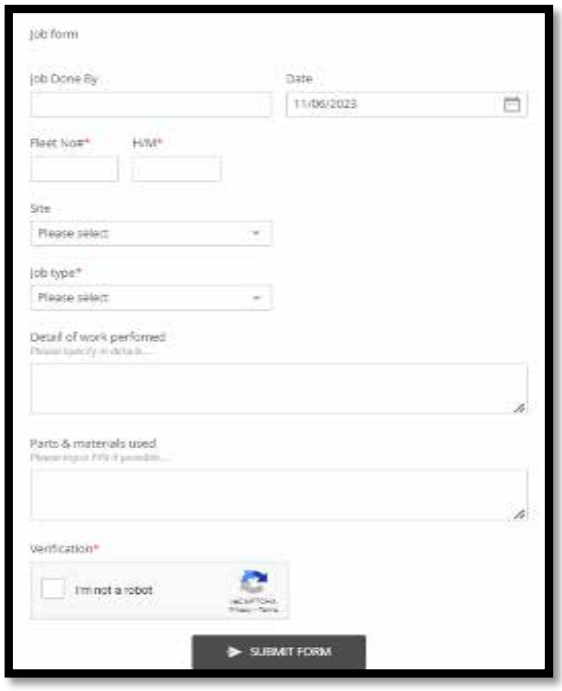
Final product of e-STC	
Order Form to order spare parts.	Job Form for foreman update during inspection
	

Figure 9: The process to develop e-STC at PTTJ

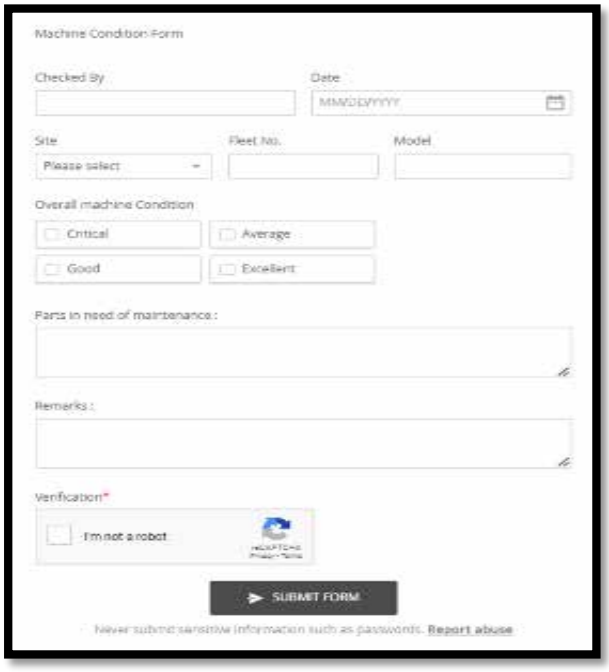
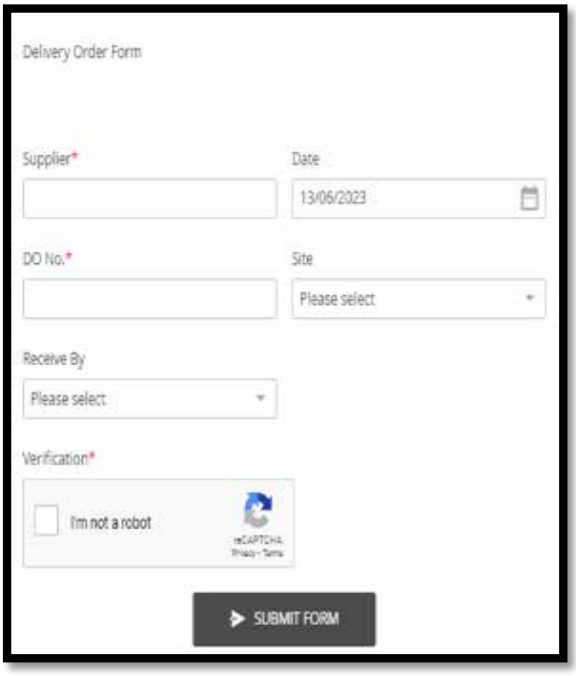
Final product of e-STC (continued)	
Machine Condition Form forforeman update after inspection.	Delivery Order for user uploaddocuments
	

Figure 10: The process to develop e-STC at PTTJ

3.5 Test the effectiveness of e-STC for Site Requisition Machinery Spare Part Orders

There are 30 respondents answered the questionnaire and data collected from a questionnaire using Google Form. The analysis using SPSS Software version 26.

3.5.1 Reliability Test for post-test

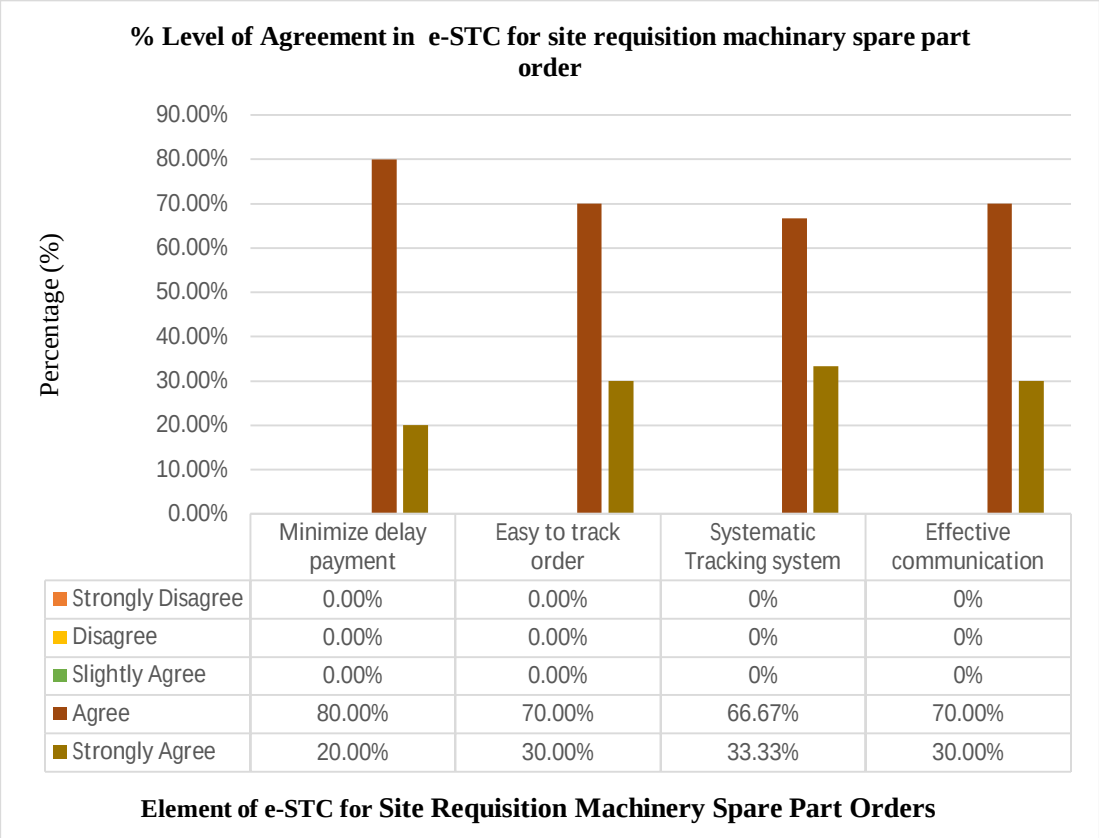
There are four (4) elements that need to scale by respondents in questionnaire, to test the effective usage of e-STC. In addition, the questions were on the 5-point Scale with respondents in level of agreement from “Strongly agree” to “Strongly disagree”. To determine the questionnaire could “reliably” measure the latent variable like the effectiveness of e-STC, Cronbach Alpha test was conducted. The acceptable reliability value is 0.6. Therefore, the questionnaire’s reliability result 0.60-0.70 score is acceptable, and the questionnaire is considered “reliable”. The result as shown in Table 5 below. The average inter-item correlation according to Cronbach's Alpha Based on Standardized Items resulted as 0.731. The reliability result for the questionnaire is more than 0.6, is "reliable".

Table 5: Reliability Test

Cronbach’s Alpha	**Cronbach’s Alpha Based on Standardized Items**	**N of Items**
0.743	0.731	16

3.5.2 Frequency Analysis

Figure 11 show the percentage of respondents who agree with the use of e-STC for ordering spare parts at PTTJ. It is show that the respondents need e-STC for Site Requisition Machinery Spare Part Orders for more efficient to purchase Invoices and Delivery Orders (DO) spare parts machinery and efficient to release payment to suppliers. There are 100% agrees in all four (4) elements that the e-STC can minimize delay Payment, easy to track order, systematic Tracking System and Effective Communication. It shows that >80% respondents agreed in all four (4) elements of use the e-STC for Site Requisition Machinery Spare Part Orders at PTTJ.



	Minimize delay payment	Easy to track order	Systematic Tracking system	Effective communication
Strongly Disagree	0.00%	0.00%	0%	0%
Disagree	0.00%	0.00%	0%	0%
Slightly Agree	0.00%	0.00%	0%	0%
Agree	80.00%	70.00%	66.67%	70.00%
Strongly Agree	20.00%	30.00%	33.33%	30.00%

Figure 11: Frequency Analysis in e-STC as new medium

3.5.3 Descriptive Analysis

3.5.3.1 Average Mean

Table 6 is demonstrating respondent usability toward using e-STC, analysis shows that for all factors, examined, the mean score was greater than 3.51 -4.50 is High interpretation and score in average mean >4.5; interpretation Very High as referred in Table 4, Mean Range Interpretation (Source from Srisaard, 2002) as detailed in paragraph 3.3.2 Mean Range Interpretation above; indicating that using e-STC is significantly simpler than the present approach.

Table 6: Average Mean in e-STC

No	e-STC for Site Requisition Machinery Spare Part Orders	Mean	Average Mean	Average Mean (%)	Interpretation
1	Minimize Delay Payment	4.6 4.73 4.60 4.73	4.67	25.79	**Very High**
2	Easy To Track Order	4.53 4.57 4.63 4.40	4.53	25.06	**Very High**
3	Systematic Tracking System	4.70 4.67 4.43 4.33	4.53	25.06	**Very High**
4	Effective Communication	4.17 4.67 4.43 4.17	4.36	24.10	**High**
	Total Average:	**4.50**	**18.09**	**100**	

3.6 Paired Samples Statistics

Paired samples statistics is the tests to compare the effectiveness of e-STC for Site Requisition Machinery Spare Part Orders as Figure 12 below, bar chart shows the respondent is more preferred to using e-STC which is average mean show the element in Systematic Tracking system, meanwhile is highest score, is 4.33. Next, second highest score in average mean is in Easy Track order element and Effective Communication, where each of the element score is 4.30 average mean. Lastly, the Minimize delay payment element is resulted as 4.20 in average mean. The result to be compare between existing method and e-STC is show in Figure 10 below. There are High in different mean between existing method and e-STC as a website. Figure 11 show average mean in differences of Paired

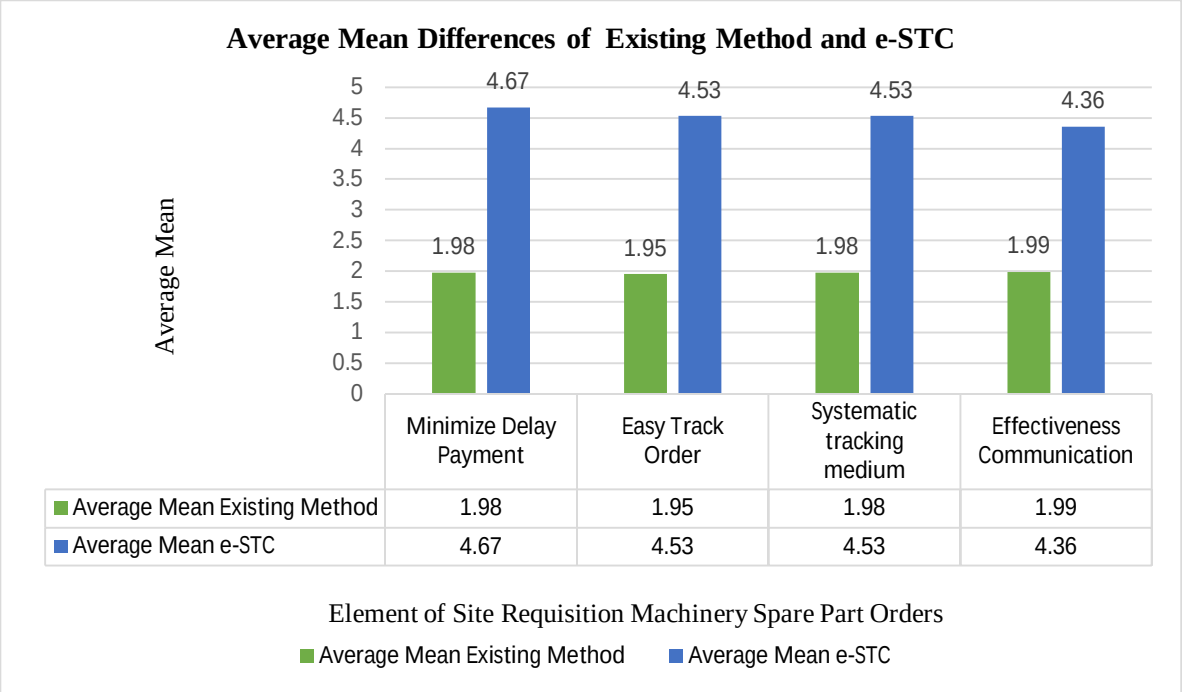


Figure 12: The differences in average mean of existing method and e-STC

From the result of difference average mean between existing method and e-STC as a Website as shown in Figure 13 below. The highest difference is in Minimize delay payment element, is 2.69, second highest is Easy Track Order element, is 2.58, third highest is Systematic Tracking System element, is 2.55 and lastly is Effective Communication element, is 2.37. Therefore, respondents agrees that e-STC Site Requisition Machinery Spare Part Orders at PTTJ is effectiveness in all four elements.

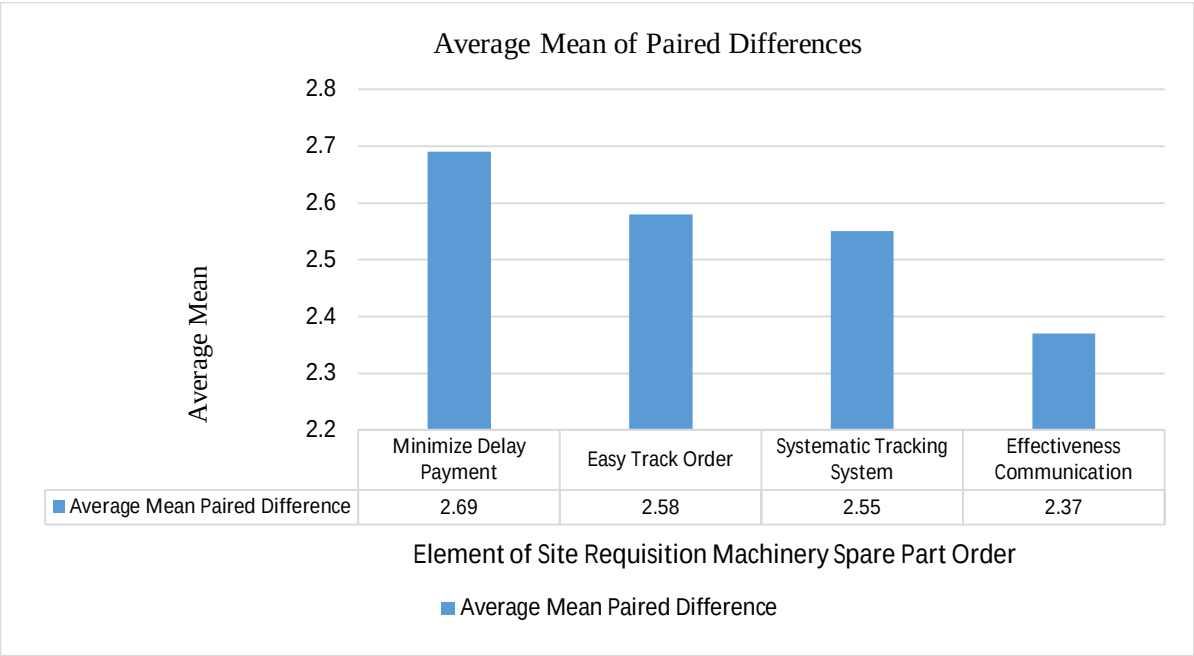


Figure 13: Paired Differences in Average mean between Existing method and e-STC

3.6.1 Paired Sample T-Test

Overall, as the result shows all the four (4) elements have the differences value. A paired found this difference to be significant, t (4) =…, p =, p<0.05. Hence, e-STC is most efficient compared to existing method. A paired sample t-test found this difference to be significant for all variables as show in Table 7 below, the value of **t** of Minimize Delay Payment is 24.74 and the value of p is < .00001. The result is significant at p < .05. Next, the value of **t** of Easy to Track Spare Part Order is 28.83 and the value of p is < .00001. The result is significant at p < .05. The value of t of Systematic Tracking System is 34.07 and the value of p is < .00001. The result is significant at p < .05. The value of **t** of Effective Communication is 29.19 and the value of p is < .00001. The result is significant at p < .05. Therefore, the Website of e-STC for Site Requisition Machinery Spare Part Orders are more effective compared to the existing method.

Table 7: Result of Paired Differences

Pair	Paired Different	t	Significant (two tailed)
	Mean		
Minimize Delay Payment	2.69	24.74	.000
Easy to Track SparePart Order	2.58	28.83	.000
Systematic Tracking Medium	2.55	34.07	.000
Effective Communication	2.37	29.19	.000

4. Discussion

According to oral interview and observations, most of respondents had issues with the delay payment to suppliers, insufficiency to track orders properly made by site and office, site does not have a proper check list form to inspect the machine condition and staff overlook information in WhatsApp group because lack of systematic tracking medium. The main aim of this study is to develop the systematic tracking centre (e-STC) for site requisition machinery spare part order using wix.com at PTTJ for more systematic and efficient of purchase Invoices and Delivery Orders (DO) and payments to suppliers. First objective is to identify the need of systematic tracking centre for site requisition machinery spare part orders at PTTJ. From survey to the respondents, resulted in mean and average mean interpretation is Low in all four (4) elements of constraints in using of the existing method for the site requisition spare part orders at PTTJ with analysis revealing that the mean score for all variables examined was less than 2.50, indicating that the usability level of existing methods was poor in all four (4) elements using existing method. Therefore, e-STC for Site Requisition Machinery Spare Part Orders needs to be develop. The second objective is to develop e-STC for Site Requisition Machinery Spare Part Orders using wix.com. The approach utilized throughout the study was addressed in method, including the creation of an application for the establishment of e-STC for Site Requisition Machinery Spare Part Orders using wix.com. The result show that the e-STC for Site Requisition Machinery Spare Part Orders successful developed. Third objective is to test the effectiveness of the e-STC for Site Requisition Machinery Spare Part Orders. From survey to the respondent to assess input from construction site team members, respondents highly

agree, according to the result are demonstrating respondents' usability toward using e-STC Website. Analysis shows that three (3) elements, examined, the mean score was greater than 4.50. It is resulted as Very High Interpretation and score in average mean is >4.5. The elements are Minimize Delay Payment, Easy to Track Spare Part Order, and in Systematic Tracking System. For Effective Communication element, the score in average mean is 4.36; it is in mean range 3.51-4.50; interpretation High in agreed by respondents in using of the e-STC for Site Requisition Machinery Spare Part Orders for efficient of purchase Invoices and Delivery Orders (DO) and payments to suppliers.

5. Conclusion

In conclusion, based on the results of the disseminated questionnaire survey, it is feasible to deduce that they have roughly difficulties that occur throughout the document management process. All the respondents agreed that e-STC more efficient of purchase Invoices and Delivery Orders (DO) and payments to suppliers. The e-STC for Site Requisition Machinery Spare Part Orders was tested at the workshop and headquarters and was found to be successful. According to most respondents, the e-STC for Site Requisition Machinery Spare Part Orders helps to minimize delay payment, able to track spare part orders, enhance communication of team member and it is also user pleasant in construction sites and headquarters. Descriptive Analysis by Paired T Test, show that the systematic Tracking System is the highest among the four (4) elements in differences mean; is 2.55 with value of **t** is 34.07 and the value of p is $< .00001$. From the result, show that objective 1 and 3 was achieved. Hence, e-STC is of purchase Invoices and Delivery Orders (DO) and payments to suppliers at the same time save lot of time. Moreover, using e-STC for Site Requisition Machinery Spare Part Orders also helps Procurement staff to update machine condition on site and Workshop staff can order spare parts without any doubleorder. Next, the data on e-STC for Site Requisition Machinery Spare Part Orders is property and casual that only admin can register the user so that not simply user can access the website. e-STC for Site Requisition Machinery Spare Part Orders is online website storage and can be used with gadgets. This system is user-friendly where the system can be accessed anywhere and anytime, and the machine condition report can be shared with Microsoft Teams application. Only authorized people or webmasters can enter the website by have the link.

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SMART AQUARIUM MONITORING SYSTEM (SAMS)

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ABSTRACT

A Smart Aquarium with Self-Monitoring System utilizes smart technology to intelligently monitor water conditions and provide feedback to users. It encompasses water level, pH, and turbidity using TDS sensors, along with a Blynk user interface displayed on a smartphone screen for the care of aquatic pets. The integration of sensors with the Arduino UNO microcontroller and Blynk platform allows for real-time monitoring and control. Research results demonstrate the successful integration of SAMS, showcasing its ability to provide real-time monitoring and promote responsible pet ownership. Furthermore, improvement suggestions are provided to enhance the system's performance for ease of use and assist in optimizing its capabilities. Overall, this paper contributes to the advancement of smart aquarium technology and offers valuable insights for future development and implementation.

1. Introduction

This article explores the advancements in smart aquarium technology and monitoring systems. It aims to provide an understanding of the current state of these technologies and guide the creative vision of this project. The context for the design, development, and implementation of this project is established here, with a focus on monitoring pH levels, water level, water temperature, and turbidity, all integrated with smartphone technology.

This project aims to motivate more people to own aquatic pets by offering a convenient and efficient solution for managing aquarium environments. Through the integration of the Blynk App, users can effectively monitor their aquarium's inventory and receive timely notifications about environmental conditions, even when they are at home. This not only enhances the user experience but also promotes responsible pet ownership by ensuring optimal conditions for aquatic life. With accurate pH level management and maintenance of water levels and cleanliness, our Smart Aquarium system minimizes the risk of fish diseases and untimely deaths. Additionally, user-friendly interfaces, such as the Blynk app, make it easy for users to manage and monitor their aquariums, increasing convenience and ensuring the effectiveness of our product.

The literature review for smart aquariums and monitoring systems focuses on innovative

developments in the maintenance of pH levels, water level regulation, and turbidity monitoring within aquariums. Research shows that accuracy in pH control is improving with current technology, such as servo mechanisms that promote precise pH maintenance [1]. Integration with smartphones helps in real-time monitoring and control, although reliability issues are being studied by researchers [2]. The primary factor behind the emphasis on technology in this field is the requirement for pH level monitoring. For sustainability, time-saving features are also essential. Communication and remote monitoring are made possible by IoT technologies [3]. Regulations and requirements about water parameter safety should be known. HCI principles that incorporate interface intuition have a significant impact on effective user engagement. [4]. Determination through testing is crucial for reliable pH control and stable levels. Evaluation due to remote monitoring ability via smartphones is essential [2]. Complexity in tracking precision and practicality comes with LCD screens [5].

2. Materials and Methods

The development of the (SAMS) followed a structured engineering methodology to ensure systematic design, integration, testing, and risk management [6]. Beginning with a thorough requirement analysis, key functionalities such as pH level monitoring, water level management, and remote connectivity were identified. Careful component selection and integration, coupled with circuit design and prototyping, ensured the system's robustness and longevity.

Software development focused on creating reliable control logic for the Arduino UNO microcontroller, which was extensively tested to verify its performance. Prototype testing validated the system's accuracy and responsiveness across various parameters, while environmental and compliance testing ensured its suitability for real-world deployment.

A proactive strategy was employed to identify and mitigate any operational and technological risks that might arise throughout the SAMS development process. Close oversight was maintained throughout the entire component integration and assembly process to ensure that SAMS operated as intended.

The system architecture begins with identifying input sources, including pH sensors, water level sensors, and TDS (Total Dissolved Solids) sensors, with a smartphone serving as the output device. The control center is the meticulously configured Arduino UNO microcontroller, overseeing the Blynk platform, smartphone, and sensor inputs.

The circuit architecture is crucial in the SAMS project as it facilitates the integration of various electrical components necessary for the system's proper functioning. This includes control circuitry, pH sensors, TDS sensors, and water level sensors. The layout design controls the routing of electrical connections and the physical arrangement of these components on a printed circuit board (PCB), ensuring smooth communication between various system parts.

Figure 1 shows the block diagram of SAMS. The SAMS consists of a water level sensor that measures the water level in the aquarium, a pH sensor that monitors the water's pH level (an essential parameter for maintaining a suitable environment for aquatic life), and a TDS sensor that measures the concentration of dissolved solids in the water, which can affect water quality and clarity. The system is powered by a 5V power supply, providing the necessary electrical power for the operation of the components. The Arduino UNO, a microcontroller board, acts as the central processing unit, receiving data from the sensors, processing it, and communicating with the output devices. The Blynk application, a software or mobile app, is

used for remote monitoring and control of the system, receiving data from the Arduino UNO, and providing a user interface for displaying and analyzing the water parameters. A smartphone serves as a display device, allowing for convenient visualization of the water parameters measured by the system. The arrows in the diagram represent the flow of data or communication between the different components, with the sensors sending data to the Arduino UNO, which processes the information and transmits it to the Blynk application and the smartphone for display and monitoring purposes.

Figure 2 below illustrates the flow chart of the SAMS, depicting its operation through a clearly defined logic flow. Key sensors such as pH, water level, and TDS (total dissolved solids) sensors are initialized at the beginning of the program, with a smartphone serving as the output device. The Arduino UNO microcontroller board serves as the central control unit for the system's functioning. The program begins by initializing both the Blynk application for remote smartphone monitoring and the connected sensors. This setup ensures smooth communication and data flow among the system's components. In the main program loop, which runs continuously during system operation, the program checks the status of the Blynk application. If the application is not running, the loop continues to check until connectivity is established. Once connected, the program proceeds to read input values from the pH sensor, water level sensor, and TDS sensor.

The raw sensor data is then converted into suitable units and formatted for display. This formatted data is transmitted to the Blynk application for remote monitoring and display. Additionally, the program constantly monitors for any changes or updates in sensor data compared to previous readings. Upon detecting changes, the updated data is sent to the smartphone for local monitoring, ensuring synchronization between remote and local displays with the latest aquarium conditions. After executing these steps, the program returns to the beginning of the main loop, repeating the process to maintain real-time monitoring and alerting for optimal aquarium conditions.

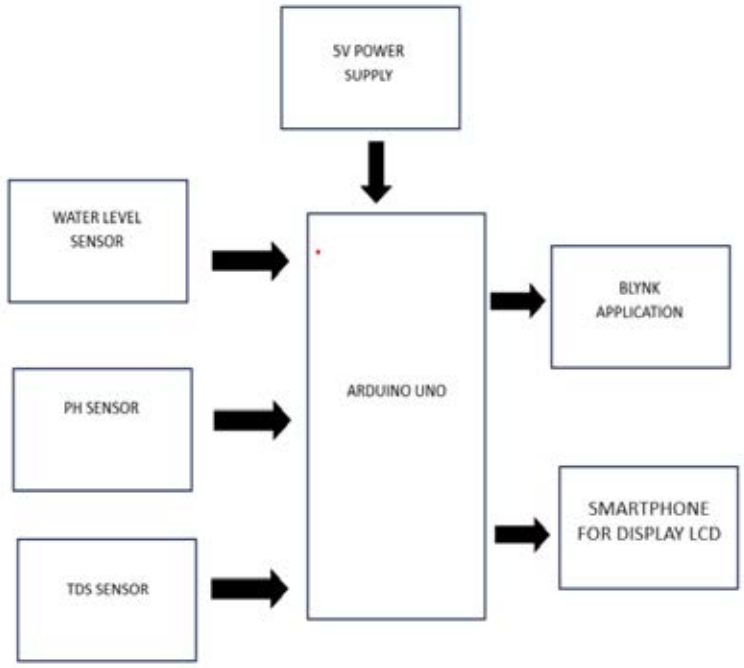

Figure 1: Block Diagram of SAMS

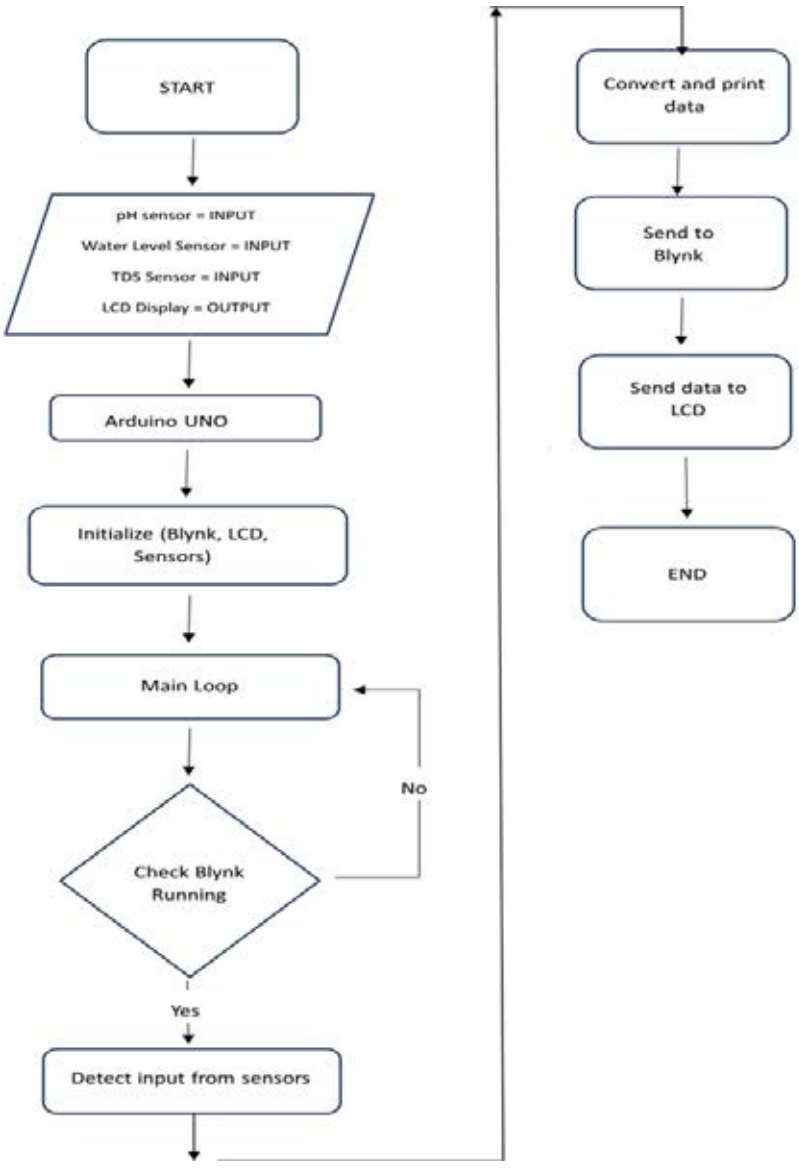

Figure 2 Flow Chart of SAMS

3. Results

Based on Figure 3 and Figure 4, the Smart Aquarium Management System (SAMS) demonstrates robust performance in maintaining critical water parameters, such as temperature, pH, water level, and turbidity, within desirable ranges. This consistent control is essential for establishing a healthy and stable environment for aquatic life.

Upon observation:

Temperature: Maintained within 23°C to 26°C, ensuring a stable thermal environment, albeit at the lower end of the optimal range (24°C to 28°C).
pH: Kept within 7.4 to 7.7, providing a balanced and stress-free environment for fish, well within the optimal range of 6.5 to 7.8.

Water Level: Fluctuated minimally between 48 cm and 51 cm, indicating effective water management.

Turbidity: Remained low between 4.7 NTU and 5.2 NTU, ensuring clear and clean water, well below the threshold of 10 NTU for optimal fish health.

The integration of sensors with the Arduino UNO microcontroller and Blynk platform allows for real-time monitoring and control, enhancing the system's reliability and user-friendliness. This project effectively demonstrates how smart technology can improve aquarium management, offering a dependable, efficient, and user-friendly solution for aquarium enthusiasts.

The result analysis showcased impressive outcomes regarding the capabilities of the SAMS. Integration with the Blynk app facilitated seamless real-time monitoring of the aquarium environment. Temperature sensors accurately tracked internal conditions, with changes promptly reflected on the app interface. Crucially, sensors such as pH sensors, water level sensors, and TDS sensors demonstrated high accuracy and responsiveness in maintaining optimal aquarium conditions.

Figure 3: Result From App Blynk over 7 Days of observation.

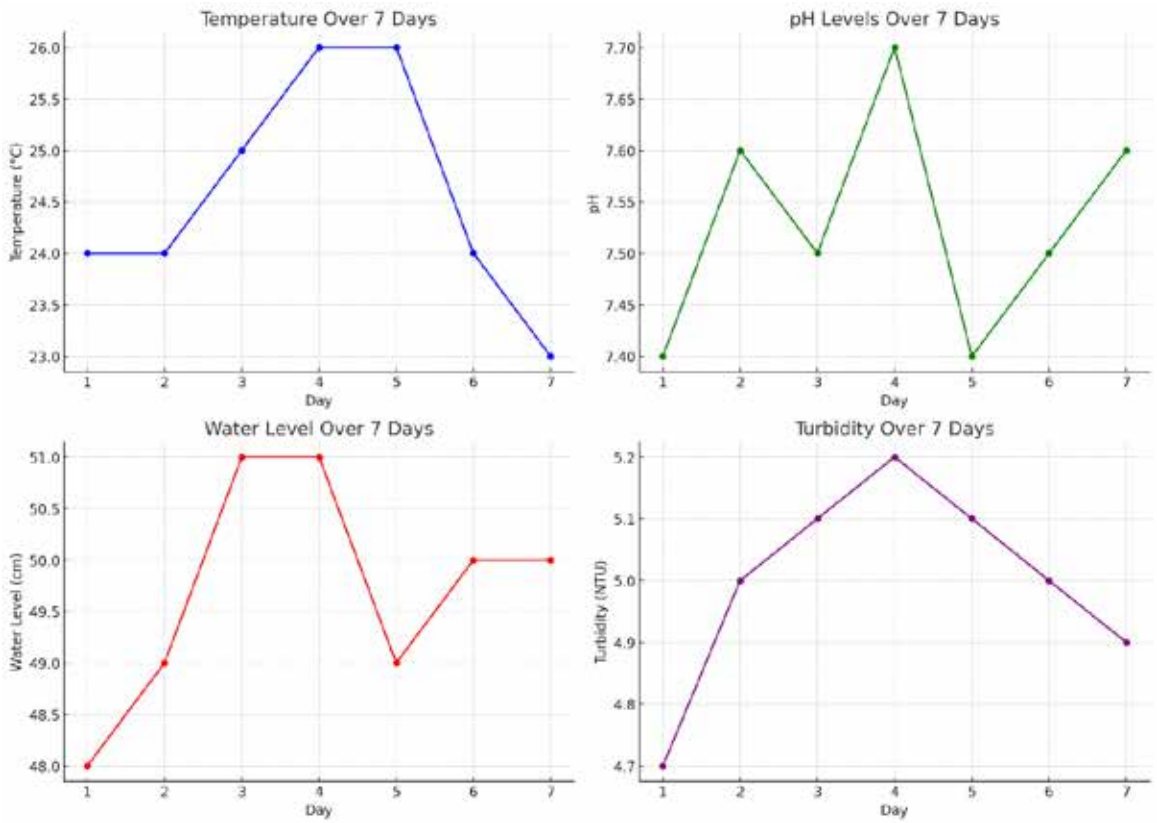

Figure 4: Results From Blynk Apps in Graphical Form

4. Discussion

The Smart Aquarium Management System (SAMS) effectively maintains critical water parameters within optimal ranges. The temperature remains stable between 23°C to 26°C, pH levels fluctuate within the optimal range of 6.5 to 7.8, water levels show minor variations and turbidity levels stay consistently low [7]. SAMS contributes to a healthy aquatic environment by ensuring stable conditions and efficient parameter control. Its integration with sensors and control systems enhances reliability and user-friendliness, offering aquarium enthusiasts a convenient solution for maintaining optimal conditions in their aquatic ecosystems. Table 1 below demonstrates the system's consistent maintenance of critical water parameters within desired ranges, providing a healthy and stable environment for the aquarium.

Table 1: Demonstration of Consistent Maintenance of Critical Water Parameters within Desired Ranges

Parameter	Range / Value
Temperature	23°C - 26°C (Optimal: 24°C - 28°C)
pH	7.4 - 7.7 (Optimal: 6.5 - 7.8)
Water Level	48 cm - 51 cm
Turbidity	4.7 NTU - 5.2 NTU (Optimal: < 10 NTU)

.

5. Conclusions

The SAMS effectively maintains optimal water parameters for tropical freshwater fish, ensuring a healthy environment. Its precise control of temperature, pH, water levels, and turbidity fosters stress-free conditions for aquatic life. Integrated with smartphone technology, especially the Blynk app, it enables real-time monitoring and intervention, promoting responsible pet care and minimizing risks like fish diseases and untimely deaths.

6. Recommendations

To further enhance the performance and reliability of the SAMS, a series of strategic recommendations are proposed. The initial step involves optimizing data transfer speed and reliability. By implementing modern communication protocols such as Bluetooth Low Energy or Wi-Fi, the connection between the smart aquarium and the user interface will be significantly improved. This enhancement will ensure that data is transmitted quickly and accurately, providing users with real-time updates on their aquarium's status.

Incorporating machine learning algorithms for predictive maintenance is another crucial recommendation. By analyzing historical data, these algorithms can anticipate potential issues before they arise, allowing for timely interventions. This proactive approach will help in maintaining optimal conditions within the aquarium, ultimately promoting the health and well-being of aquatic life.

Enhancing the user experience within the Blynk app is also vital. Developing personalized user profiles will allow users to tailor the app to their specific needs. Additionally, customizable notifications can alert users to critical changes in aquarium conditions, ensuring that they can respond promptly. Implementing historical data analysis features will enable users to track trends over time, providing valuable insights into the health of their aquarium.

Integration with cloud services is another important step. Utilizing energy-efficient components for cloud integration will promote sustainability. Remote data storage will facilitate the management of multiple aquariums, and advanced analytics will offer deeper insights into aquarium health and performance. This comprehensive approach will enhance the functionality and efficiency of SAMS.

Incorporating a robust user feedback mechanism within the app is essential for continuous improvement. By gathering user experiences and suggestions, developers can make informed decisions about future enhancements. This user-driven approach will ensure that the system evolves in a way that meets the needs and expectations of its users.

Expanding the system's environmental sensing capabilities will further improve its effectiveness. Adding sensors to monitor additional parameters, such as ammonia levels and nitrate concentrations, will provide a more comprehensive picture of the aquarium's environment. Supporting APIs for seamless interaction with other smart home systems will also enhance the system's versatility and integration capabilities.

Enhancing display and monitoring capabilities is another key recommendation. Enabling simultaneous data display on the I2C LCD Display will provide real-time monitoring without

relying solely on the app. This feature will offer users immediate access to critical information, enhancing their ability to manage their aquarium effectively.

Finally, implementing a reliable backup power supply system is essential. This precautionary measure will ensure that the SAMS can continue to operate during power outages or main system trips. By maintaining stable environmental conditions, this backup system will protect the health and safety of aquatic life. Adopting these recommendations will enable future iterations of SAMS to achieve greater efficiency, reliability, and user satisfaction, paving the way for the development of a comprehensive smart environmental monitoring system ready for future challenges and advancements.

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The ‘SAMS’ project holds deep personal significance for me, and I extend my heartfelt gratitude to everyone who assisted in its completion. A special thank you to my family and friends for their unwavering support throughout. I also appreciate the diligent efforts of the researchers and the assistance from various individuals and institutions. Without each of you, this achievement would not have been possible. Thank you sincerely for your invaluable contributions.

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FAKTOR YANG MEMPENGARUHI PEMBANGUNAN BAKAT PENGKOMERSIALAN DALAM KALANGAN PENSYARAH POLITEKNIK MALAYSIA

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ABSTRAK

Membangunkan bakat adalah cara terbaik untuk memastikan kejayaan sesebuah organisasi. Pembangunan bakat pengkomersialan adalah cara yang paling penting dan terbaik untuk membangunkan bakat pensyarah-pensyarah Politeknik dalam melahirkan pensyarah Pendidikan dan Latihan Teknikal dan Vokasional yang berkualiti bagi masa hadapan. Aktiviti pengkomersialan di Politeknik perlu diperkasakan sejajar dengan Pelan Transformasi Politeknik, namun begitu kajian memfokuskan kepada pembangunan bakat pengkomersialan dalam kalangan pensyarah di politeknik masih lagi belum diterokai. Kajian ini mengenalpasti faktor yang mempengaruhi pembangunan bakat pengkomersialan dalam kalangan pensyarah Politeknik Malaysia. Pendekatan kajian ini menggunakan kaedah kuantitatif yang bersesuaian dengan objektif kajian. Analisis data menunjukkan semua konstruk, nilai min adalah 4.0 keatas. Ini menunjukkan pendekatan dan inisisatif yang telah dilaksanakan oleh pihak Pusat Penyelidikan dan Inovasi, Jabatan Pendidikan Politeknik dan Kolej Komuniti adalah selaras dengan Pelan Transformasi Politeknik Malaysia. Walau bagaimanapun, inisisatif ini perlu diteruskan dan ditingkatkan bagi memastikan kelestarian pengkomersialan Politeknik Malaysia.

1. Pengenalan

Menurut Yusof dan Alias (2020) cara terbaik untuk memastikan kejayaan sesebuah organisasi adalah melalui pembangunan bakat. Pembangunan bakat ialah pendekatan strategik dan menyeluruh untuk jabatan sumber manusia dan perancangan perniagaan syarikat. Ia juga merupakan langkah baharu yang diambil oleh syarikat untuk meningkatkan prestasi (Hasan & Mohtadin, 2023). Selain itu, ini akan meningkatkan potensi dan prestasi pekerja atau bakat mereka, yang boleh mempunyai kesan besar pada organisasi pada masa kini dan masa hadapan. Organisasi yang berjaya adalah yang dapat memberikan pekerjanya pengetahuan baharu. Ia adalah penting untuk menekankan bahawa organisasi yang menyediakan ilmu pengetahuan

adalah organisasi yang akan menghasilkan pekerja yang berbakat yang menggunakan kebijaksanaan mereka untuk mengembangkan pengetahuan, kemahiran, dan kebolehan mereka.

Pembangunan bakat terutamanya dalam bidang pengkomersialan merupakan salah satu inisiatif penting bagi Politeknik Malaysia. Md Sagir, Mohd Nor, dan Muharam (2019) menegaskan bahawa institusi pendidikan tinggi seperti politeknik dan kolej komuniti melihat pengkomersilan merupakan elemen penting, yang memerlukan perkhidmatan konsultasi dan pembangunan inovasi teknologi baru bagi pembangunan institusi Pendidikan dan Latihan Teknikal dan Vokasional Malaysia.

Politeknik Malaysia merupakan satu institusi Pendidikan dan Latihan Teknikal dan Vokasional di Malaysia yang melahirkan graduan yang holistik. Pengkomersialan adalah satu aktiviti yang boleh menjana pendapatan Politeknik hasil daripada pembangunan produk warga Politeknik Berdasarkan kepada statistik 97% graduan politeknik mendapat pekerjaan selepas 9 bulan graduasi. Ini membuktikan graduan yang dilahirkan mendapat pendidikan secara holistik. Pembudayaan penyelidikan, inovasi dan pengkomersialan di Politeknik sentiasa mendapat perhatian pihak industri. Dalam konteks institusi Pendidikan dan Latihan Teknikal dan Vokasional di Malaysia, pengkomersialan merupakan hasil penyelidikan yang biasanya diteruskan melalui paten, pelesenan dan pembentukan syarikat hiliran (spin-off) (Muhammad Razaki, Ismail, & Mohamad Anuar, 2023). Petunjuk yang paling umum seperti aktiviti paten, pelesenan dan pembentukan perniagaan adalah cenderung kepada fokus yang agak kecil dalam aktiviti pengkomersialan.

Aktiviti pengkomersialan di Politeknik perlu diperkasakan sejajar dengan pelan transformasi Politeknik, namun begitu kajian memfokuskan kepada pembangunan bakat dalam pengkomersialan dikalangan pensyarah di politeknik masih lagi belum diterokai. Walaupun, kajian yang memfokuskan kepada faktor yang mempengaruhi pembangunan bakat pengkomersialan di Institusi Pendidikan dan Latihan Teknikal dan Vokasional tidak banyak dilaksanakan oleh para sarjana, namun ianya penting bagi pengurusan pengkomersialan Politeknik Malaysia pada masa hadapan. Oleh itu, objektif utama kajian ini adalah untuk mengenalpasti faktor yang mempengaruhi pembangunan bakat pengkomersialan dalam kalangan pensyarah Politeknik Malaysia.

2. Tinjauan Literatur

2.1 Latihan Pengkomersialan

Menurut Razaki (2023) latihan komersial ialah satu proses atau aktiviti yang dijalankan untuk mengembangkan kemahiran dan pengetahuan dalam bidang pemasaran, jualan dan perniagaan secara amnya. Latihan jenis ini bertujuan untuk meningkatkan keupayaan individu untuk mencipta strategi pemasaran yang berkesan, meningkatkan jualan dan mengoptimumkan prestasi perniagaan secara keseluruhan. Beberapa jenis latihan yang boleh dilakukan dalam pengkomersialan termasuklah pemasaran digital, pemasaran, penjualan, pengurusan produk dan sebagainya. Bagi latihan pemasaran digital, pelatih akan mempelajari teknik pemasaran digital seperti penggunaan media sosial, konten online, SEO, dan iklan digital untuk menarik pelanggan dan meningkatkan penjualan (Aris, 2019).

Manakala latihan penjualan akan dapat meningkatkan kemahiran komunikasi persuasif, menangani perselisihan pendapat, memahami keperluan pelanggan, dan teknik penjualan (Aris, 2019). Latihan pengurusan produk pula membantu pelatih dalam memahami kitaran hayat produk, pengembangan produk, analisis pesaing, dan strategi penetapan harga untuk mengoptimumkan portofolio produk syarikat.

2.2 Pelan Pelaksana

Pelan pelaksanaan komersial mempunyai banyak kepentingan penting dalam memastikan kejayaan dan keberkesanan aktiviti perniagaan (Suffarruddin, Jaafar, & Jamaludin, 2023). Antara faedah dalam pelan pelaksanaan komersial adalah menetapkan keutamaan, pengurusan sumber, penyelarasan dan Kerjasama dan pemantauan kemajuan. Menetapkan keutamaan adalah merupakan pelan pelaksanaan komersial membantu dalam menetapkan keutamaan dalam operasi perniagaan. Ini membantu dalam mengenal pasti aktiviti yang paling penting dan mereka bentuk strategi untuk melaksanakannya dengan cekap. Manakala pengurusan sumber amat penting dalam merancang pelaksanaan aktiviti perniagaan, syarikat boleh mengurus sumber dengan cekap, termasuk tenaga kerja, masa dan belanjawan. Ini membantu dalam mengelakkan pembaziran sumber yang berharga (Suffarruddin et al., 2023).

Mahbob, Megat Ali, Wan Sulaiman, & Wan Mahmud (2019) menegaskan bahawa pelan pelaksanaan membantu dalam penyelarasan antara pelbagai jabatan atau pasukan dalam syarikat. Ini membolehkan kerjasama yang lebih baik dan memastikan setiap bahagian perniagaan bergerak ke arah yang sama ke arah matlamat yang sama. Dengan mempunyai pelan pelaksanaan yang jelas, syarikat boleh memantau kemajuan dengan mudah terhadap matlamat dan sasaran yang telah ditetapkan. Ini membolehkan pengecaman awal masalah atau halangan yang mungkin muncul semasa pelaksanaan. Dengan mempunyai pemahaman yang jelas tentang pelan pelaksanaan, pengurusan boleh membuat keputusan yang lebih baik dan lebih termaklum. Mereka boleh menilai pilihan dengan mempertimbangkan kesannya terhadap pelaksanaan keseluruhan.

2.3 Kolaborasi Latihan

Kolaborasi dalam latihan adalah strategi yang sangat berkesan untuk meningkatkan kualiti dan impak program latihan. Pendekatan Pelbagai merupakan salah satu kebaikan dalam kolaborasi Latihan. Dimana, kolaborasi membolehkan penyedia latihan menggabungkan pendekatan dan metodologi yang berbeza daripada pakar dan institusi yang berbeza (Syed Chear & Md Yunus, 2019). Ini dapat menghasilkan pengalaman pembelajaran yang lebih pelbagai dan menarik kepada peserta.

Kerjasama membolehkan pertukaran pengetahuan antara pelbagai pihak yang terlibat dalam latihan, termasuk pengajar, peserta dan organisasi rakan kongsi (Ariffin et al., 2016). Ini boleh memperkayakan kandungan latihan dan meluaskan wawasan peserta. Kerjasama juga membuka peluang untuk mengembangkan rangkaian profesional melalui penglibatan dengan pelbagai pihak berkepentingan dalam latihan. Ini boleh membantu peserta dalam membangunkan hubungan yang berharga untuk pembangunan kerjaya mereka.

2.4 Pembangunan Bakat

Menurut Yusof dan Alias (2020) pembangunan bakat merujuk kepada proses mengembangkan potensi atau kemahiran individu dalam bidang tertentu. Ini boleh merangkumi pelbagai jenis aktiviti dan pendekatan yang bertujuan untuk mengoptimumkan kebolehan seseorang dalam bidang tertentu, seperti keusahawanan, seni, sukan, muzik, sains atau bidang lain-lain.

Pembangunan bakat mempunyai banyak kepentingan kepada individu mahupun masyarakat secara keseluruhan. Antara kepentingan pembangunan bakat ialah pembangunan potensi, peningkatan kemahiran, peningkatan motivasi, peningkatan kreativiti, kepuasan diri dan peningkatan kerjaya dan Pendidikan (Hasan & Mohtadin, 2023).

3. Metodologi

Kaedah kajian ini, menggunakan kaedah kuantitatif yang sesuai dengan fenomena dan objektif kajian. Pendekatan kuantitatif ini adalah untuk mencari atau menganalisis data yang sesuai dengan responden. Instrumen kajian ini menggunakan borang soal selidik yang berskala 1 hingga 5 (Likert Scale), 1 mewakil sangat tidak setuju dan 5 mewakili sangat setuju. Instrumen ini mengandungi 2 bahagian. Bahagian pertama adalah maklumat responden dan bahagian kedua adalah konstruk kajian. Responden bagi kajian ini terdiri daripada pensyarah di Politeknik Negeri Selangor. Jumlah saiz sampel adalah berdasarkan jadual Krejie dan Morgan (1970) dan juga G power.

Borang soal selidik telah diedarkan melalui Unit Penyelidikan, Inovasi dan Pengkomersilan bagi setiap Politeknik di Negeri Selangor secara online melalui google form. Oleh yang demikian, sejumlah 105 responden yang terdiri daripada pensyarah Politeknik telah diperolehi. Data yang diperolehi telah di Analisa menggunakan perisian Statistical Package for Social Sciences (SPSS) versi 22. Penggunaan perisian SPSS adalah sesuai digunakan untuk menganalisis data seperti profil responden, nilai min dan juga sisishan piawai serta nilai kolerasi.

4. Analisis data

Data telah di analisis menggunakan perisian SPSS versi 22. Analisis deskripsi seperti min dan sisihan piawai telah digunakan untuk menterjemah data yang telah dikumpulkan. Interpretasi skor min yang digunakan adalah berdasarkan interpretasi skor min oleh oleh Nunally dan Bernstein (1994) seperti yang ditunjukkan dalam jadual 1 dibawah:

Jadual1: Interpretasi Skor Min

Skor Min	Interpretasi Skor Min
1-00-2.00	Rendah
2.01-3.00	Sederhana Rendah
3.01-4.00	Sederhana Tinggi
4.01-5.00	Tinggi

Sumber: Nunally & Bernstein (1994)

Jadual 2: Maklumat responden

	Jumlah responden (n=105)	**Peratusan (%)**
Jantina:		
Lelaki	46	44%
Perempuan	59	56%

Jadual 2 menunjukkan latarbelakang responden bagi kajian ini. Berasarkan jadual 2, sebanyak 105 responden yang terdiri daripada pensyarah Politeknik negeri Selangor telah menjawab soal selidik bagi kajian ini. Majoriti responden merupakan dikalangan pensyarah perempuan iaitu sebanyak 56% (59 orang). Manakala sebanyak 44% terdiri daripada pensyarah lelaki iaitu 46 orang sahaja.

Jadual 3: Nilai Min dan Sisihan Piawai

	Item	**Min**	**S.P**
Latihan Pengkomersialan (LP)	Saya berpandangan, latihan yang disediakan hasil input daripada Traning Need Analysis (TNA) boleh meningkat kemahiran pengkomersialan dalam kalangan pensyarah	4.43	.509
Pembangunan Pensyarah (PP)	Saya berpendapat, pembangunan bakat pensyarah mengikut bidang dapat menghasilkan produk dan perkhidmatan berkonsep solution provider	4.38	.610
Pelan Pelaksana (PPE)	Saya berpendapat, Politeknik perlu mempunyai pelan pelaksanaan latihan pengkomersialan bagi kelestarian pembangunan bakat	4.55	.634
Kolaborasi Latihan (KL)	Saya berpendapat, pelaksanaan latihan perlu mempunyai kolaborasi untuk perkongsian ilmu	4.28	.408

Jadual 3 menunjukkan nilai min faktor yang mempengaruhi pembangunan bakat dalam kalangan pensyarah Politeknik Malaysia. Berdasarkan rajah diatas, semua item menunjukkan nilai skor min tinggi. Dimana nilai skor min kesemua item adalah melebihi 4.01 (interpretasi skor min tinggi). Menurut dapatan kajian, semua faktor iaitu Latihan pengkomersialan, pelan pelaksana, kolaborasi Latihan dan pembangunan bakat merupakan faktor utama dalam mempengaruhi pembangunan bakat pengkomersialan dalam kalangan pensyarah Politeknik Malaysia.

Berdasar dapatan juga, didapati bahawa konstruk kolaborasi latihan mempunyai nilai skor min yang terendah, iaitu 4.28. Walau bagaimanapun ianya masih berada dalam kedudukan tertinggi dalam interpretasi skor min tertinggi.

5. Perbincangan

Berdasarkan dapatan kajian menunjukkan bahawa latihan pengkomersialan, pelan pelaksana, kolaborasi Latihan dan pembangunan bakat merupakan faktor utama yang mempengaruhi pembangunan bakat pengkomersialan dalam kalangan pensyarah Politeknik Malaysia. Ini menunjukkan semua aktiviti yang telah dilaksanakan di peringkat Jabatan Pengajian Politeknik terutamanya Pusat Penyelidikan dan Inovasi teah bejaya membangunkan bakat pensyarah-pensyarah Politeknik dalam pengkomersialan. Banyak aktiviti telah dilaksanakan oleh Pusat Penyelidikan dan Inovasi, Jabatan Pengajian Politeknik dan Kolej Komuniti sepanjang 5 tahun ini.

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REFURBISHMENT SSD TESTERS BUILDING 1 ON PRODUCTION LINE AT NEW SITE

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ABSTRACT

This paper presents the result of a comprehensive refurbishment SSD Testers on production line at new site of Micron Memory Malaysia. The inadequate space in Solid State Drive (SSD) manufacturing line at first site to support new testers for additional New Incoming Product (NPI) is the core issue for this research. The best alternative is to loan temporary space to the other product assembly line to run new testers activities at second site which is the new Building 1. The findings depict an overall version of specific layout, testers' implementation lead time analysis and the impact latest testers quantity construct the balancing of capacity planning in operation. Based on this study able to capture on how the space has been utilized for allocated the SSD testers to support flourishing of upcoming demands.

1. Introduction

In the past few many years, a fourth business revolution has emerged and called Industry 4.0. Industry 4.0 takes the emphasis on virtual era from current many years to an entire new stage with the assist of interconnectivity through the Internet of Things (loT), get entry to real-time facts, and the creation of cyber-bodily systems. This gives an extra comprehensive, interlinked, and holistic method to manufacturing. It connects bodily with virtual and lets in for higher collaboration and get entry to throughout departments, partners, vendors, product, and people. The revolution of industry 4.0 empowers commercial enterprise proprietors to manage and apprehend each issue in their operation and lets in them to leverage immediate facts to enhance productivity, enhance processes, and power growth. Many worldwide semiconductor industries compete to be the best in supplying cyber physical systems and one of them is company M [1][2].

Company M is a semiconductor company that offers the best industries broadest portfolio by developing and producing memory and storage technologies. It has steadily grown its presence in Malaysia to establish the Centre of Excellence for Solid State Drive (SSD) Assembly and Test. SSD or solid-state hard drive is a type of storage device used by computers. This non-volatile storage medium stores persistent data in solid-state flash

memory. SSD replaces the computer's traditional hard disk drives (HDDs) and perform the same basic functions as hard drives. However, SSDs are significantly faster than SSDs. With SSDs, the device's operating system boots faster, programs load faster, and files save faster. Solid State Drive technologies is developed successfully and contribute to be one of main profits for company M. Company M really concerns about the quality of the products are producing every day until has ability to create the ideal machines to ensure defects on finished products are close to zero. The company understands the importance of providing quality and excellent demand to manage workloads to avoid any profits losses [1] [3]. On middle of 2021, this company setup a new goal for having SSDs mass production by accepting high customers' demand. The aim is to add new incoming products (NPI) and bring a bulk of new testers to support the demand. However, the space to run new testers in SSD manufacturing line already maximize and inadequate in first site. After going through a lot of engineering discussion and analysis, the engineering team has unanimously agreed to find a temporary space at the new site of company M which is Building 1. Eventually, level 3 was selected to allocate all new testers. Level 3 in Building 1 technically belongs to another product manufacturing area which is Component Assembly and Test (CAT) yet there is still a cold shell space that can perfectly fix all new SSD testers to support upcoming products.

1.1 Problem Statement

The inadequate space for running new testers in SSD manufacturing line at first site has made the engineering team decided to move this tester to new site which is Building 1 in level 3. However, refurbishment activity is needed in level 3 since the space for new testers is shared with Component Assembly and Test (CAT) production line.

1.2 The objective of this project:

i. To optimize the specific layout for the tester's activities for SSD manufacturing line.

1.3 The scope of this project:

i. To oversee the installation of testers A and testers B that can be installed in Building 1 Level 3 according to schedule plan.

ii. To balance out quantity of both testers for capacity planning in production by comparing previous capacity plan and the capacity new plan.

2. Materials and Methods

In this parts discussed overview of data collection process and method of SSD refurbishment manufacturing line. This project must be done by steps and follow the process flow to achieve stated objectives. In order to gain the project objectives, it is must to divide duties based on individual skills. This procedure is needed to ensure everything is on track as per scheduled. Also, it can ensure this project team is effective to monitor the appropriate execution in testers' setup.

2.1 Observation on project to gain understanding on SSD manufacturing line.

a. SSD Flow Process

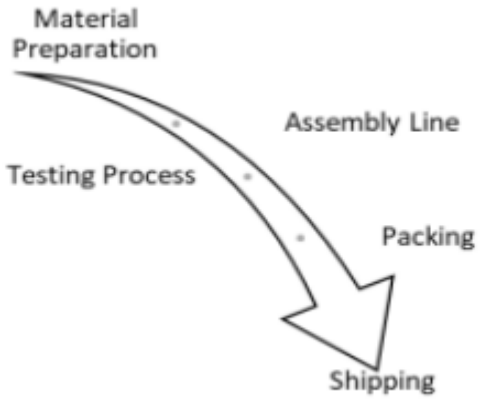

Figure 1 shows SSD Testers flow process in manufacturing line

b. SSD Tester Types

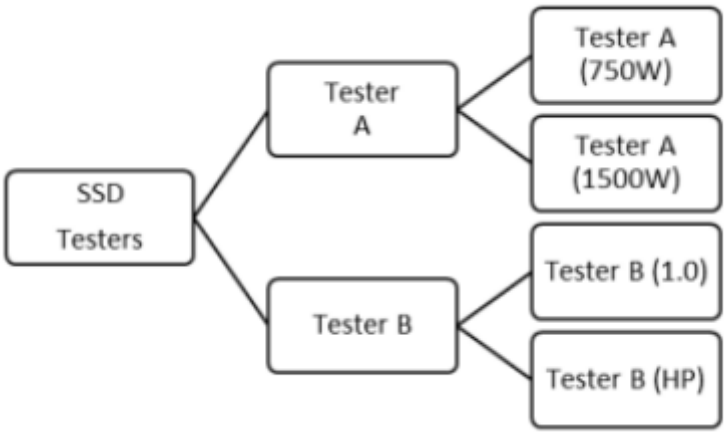

Figure 2 shows SSD tester's types

2.2 Method of data collection about project

a. Weekly project meeting on every Tuesday at 10am

The weekly project meeting on every Tuesday at 10am is held via zoom platform. The goal of this meeting is to update and discuss on testers activities status from each engineering site (Quality, Test and Process) and Finance team. The meeting also helps to keep the project moving forward based on schedule. Moreover, it allows to determine and remind all members which chores should be completed

soon, set new tasks as well as task to be remove and examine the status of current tasks and the amount of time left.

- Tool purchase types and flows in Company M

  In order to get and track the testers, it is a must to understand how the flows in every tools purchase and types of purchase. In micron, there are two types of tool purchases.

  i. New purchase
  - Monthly purchase
  - Weekly purchase

  ii. Hardbook / Urgent purchase

  This purchases have different process and procedure need to fulfil to get approval from local and global procurement site and Vice President. Figure below show flow process of standard new tool purchase in Company M.

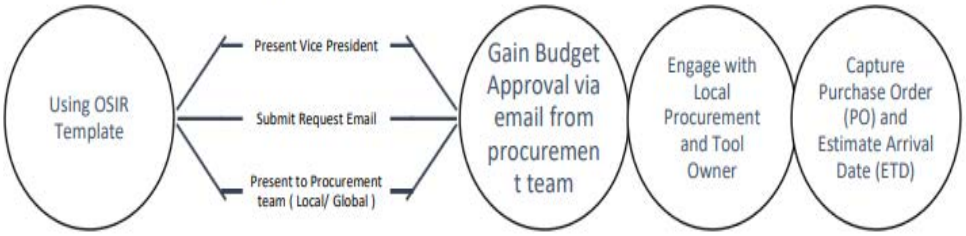

Figure 3 shows the flow of standard tool purchase in SSD testers' types.

- Testers' readiness activities process flow

  After the purchased tools on-board in warehouse, those testers will be track in the readiness file. Below shows general flow of testers activities of testers that need to be capture in every stage.

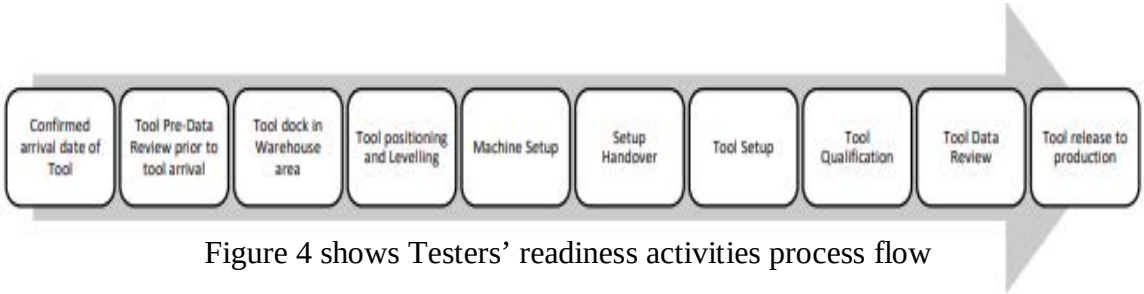

Figure 4 shows Testers' readiness activities process flow

b. Project monitoring software

Project monitoring software includes several useful features that help to manage project effectively from start to completion. This make organizing each project activity, assigning it to team members and following up on it easily.

- Monitoring activities testers activities using excel files.

  There are two file that use to track and capture testers activities as

per planned in scheduled.

i. Testers and parts purchased order tracking file.

This file works as to track the testers and small parts status by tracking arrival dates, receive dates, lead time of shipment, requestor name, tool owner name, vendor shipment location and arrival site. There are a lot of communication and complex discussion needed to gain data from procurement team, tool owners and warehouse site.

ii. Tester's readiness activities file

This file works to track testers' activities in production line. Once the testers docked in Micron warehouse the file will starts to track all activities happen. Tool owners will be the one who report on the testers' activities time to time.

- Project design layout software by using Autodesk software:

AutoCAD AutoCAD is a computer aided program that created by Autodesk business. It enables to create and edit digital 2D and 3D designs fasters and more readily than using hands. The data also can be readily download and keep in the cloud. This allowing the software can access from any location and any time easily. In this project the software is using to frame the level 3 production layouts also capture quantity and utilize space need to the testers.

- Tester forecast planning and capacity analysis by using Capacity Planning Software:

Capacity planning software is a programmable technology that assists manufactures in determining actual production capacity require and support to meet the changing loading demand for every product. In terms of capacity planning, the capacity will be calculating as maximum amount of work can be perform period by considering a lot of possibility and constraints in manufacturing line. The effective capacity is when the maximum quantity of work can do in given time.

2.3 Refurbishment of SSD Testers Building 1 Level 3 Flow Process

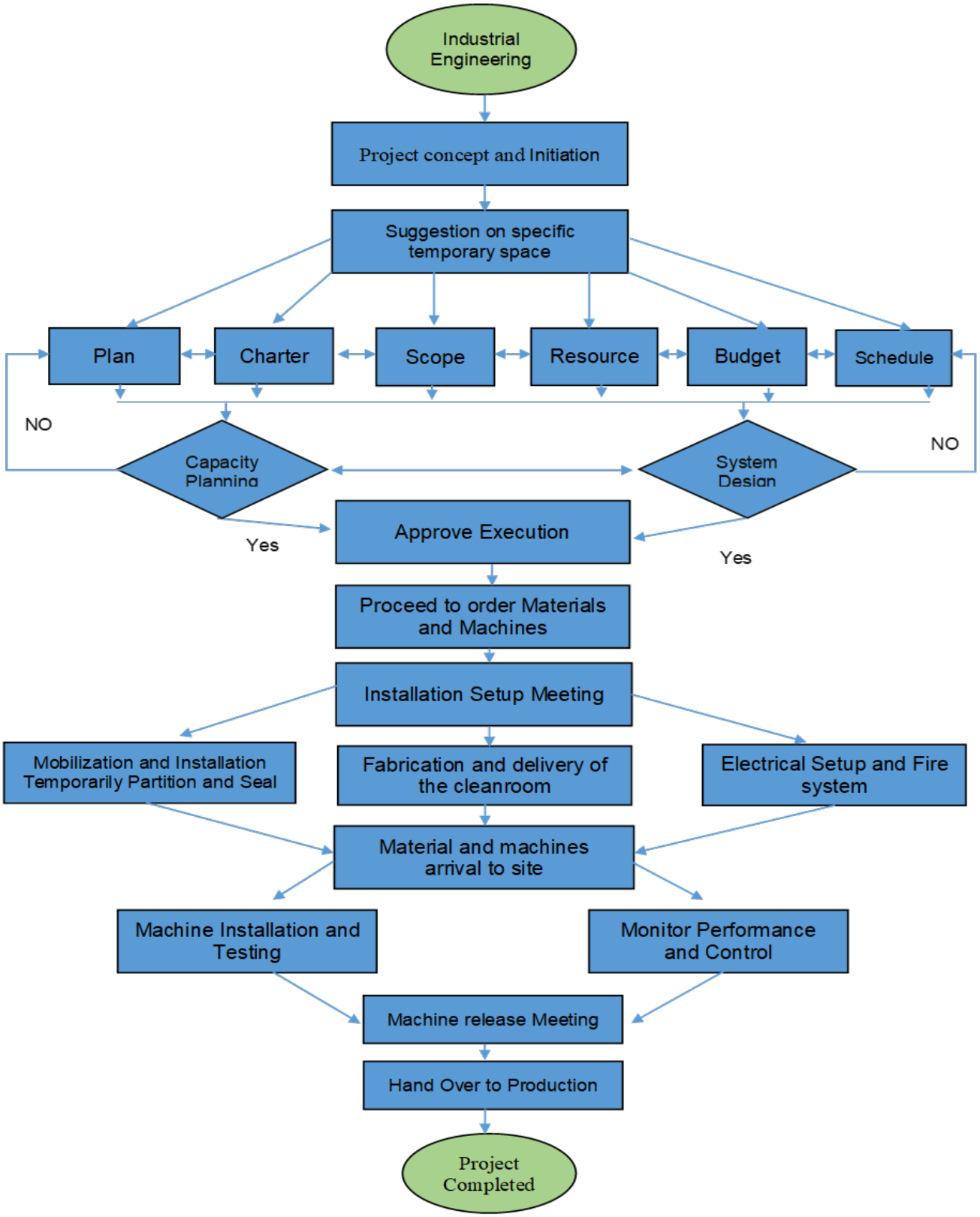

Figure 5 shows refurbishment SSD Testers Building 1 Level 3 flow process

3. Results and Discussion

3.1. Next objective is to reduce lead time these testers activities by 10%a s compared to current activities before release to production. At this phase, the lead time is captured to compare previous testers and latest activities. Based on objective stated the reduction can be captured based on formula below:

Step 1: Average of lead time Testers A and Testers B

$$A = \frac{1}{n}\sum_{i=1}^{n}(ai)$$

$A = Arithematic\ mean\ (Average)$
$n = number\ of\ value\ (week)$
$a = Data\ set\ value$

Step 2: Convert week to days.

$$Days = Total\ of\ Week\ x\ 7\ days$$

Step 3: Convert Days into percentage.

$$Days\ in\ percentages\ (\%) = \frac{Actual\ Days}{Plan\ Days}\ x\ 100\%$$

Step 4: Using different method to get reduction in lead time.

$$Days\ Reduction = Previous\ Day\ (100)\% - Latest\ Day\ (\%)$$

Notes : Plan lead Time = 4.3 Weeks = 31 days =100%

Below is Table 1 that shows the data after using formula stated to capture the reduction:

Table 1: Average Actual Lead Time in Week Testers A and Testers B

TESTER	PREVIOUS	LATEST (NEW)
A	6	4.5
B	8	7.1

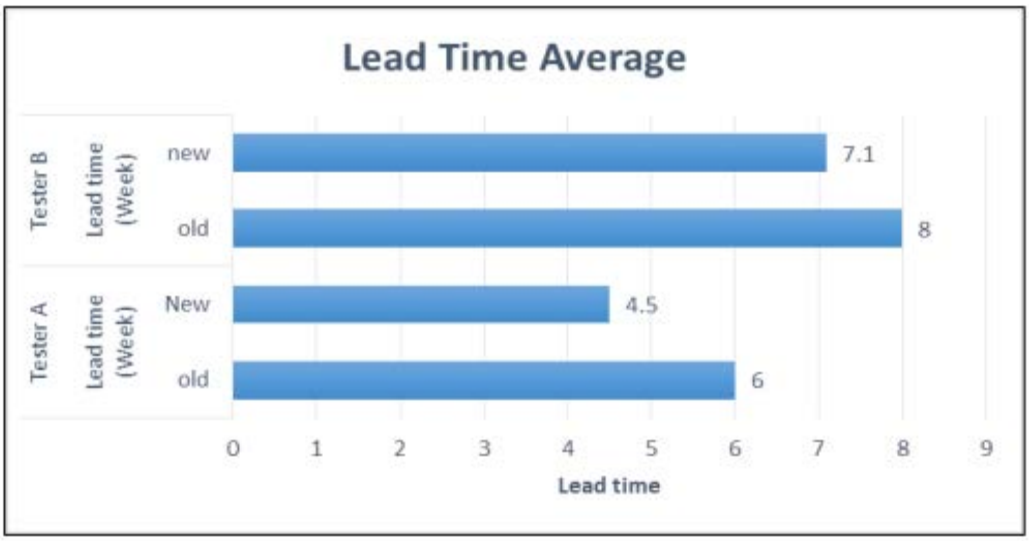

Figure 6 shows Average Actual Lead Time Previous VS Latest Tester A and B

Table 2: Reduction of Lead Time Testers A and Testers B

	PREVIOUS	**LATEST (NEW)**			
Tester	**Total Count**	**Percentage**	**Total Count**	**Percentage**	**Reduction**
A	42	135%	33	106%	29%
B	56	181%	50	161%	19%

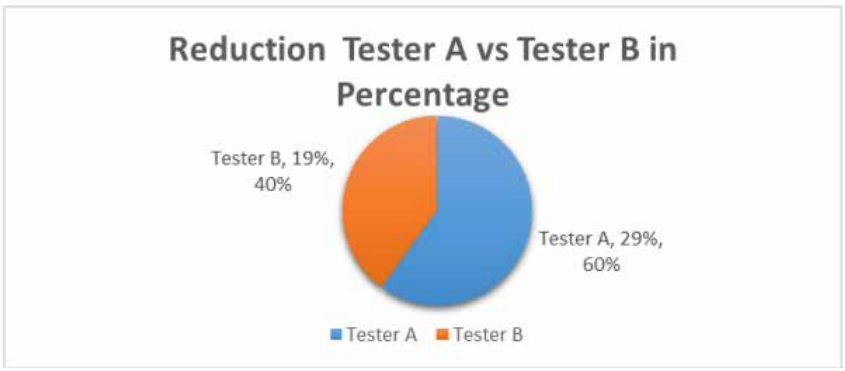

Figure 7 Reduction of Lead Time Testers A and Testers B

Based on this result, both testers are having reduction lead time compared to previous data. Based on Table 2, Tester A is having 29% of reduction meanwhile Tester B is 19%. There a few main factors can be highlighted on this study that effected towards previous and latest lead time.

a. Type of testers
b. Production line setup activities
c. Engineering qualification and discussion

These three factors influence latency between the initiation and completion of SSD Testers process. The shorter period of completion is better for the testers. So, the testers can be release at production line and run the line.

3.2. Capacity planning helps production and planners decide which demand among a portfolio of products are options to prioritize and when. By having a balance capacity in these testers, planners will have best strategies to plan weekly loading demand for production. Previously, the plan is to insert the quantity of Tester A is 42 while Tester B is 99. However, this total created imbalance capacity plan. The best analysis is made to provide balance capacity to the testers' workstation based on space required.

By using capacity plan formula:

$$Output\ per\ week = Capacity\ per\ tool\ (CPT)$$

$$CPT = \frac{Total\ Per\ Week}{Effective\ Process\ Time\ (EPT) + Handling\ Time} x\ Load\ Size\ x\ Tool\ Utillization\ (\%) x\ Yield\ (\%)$$

$$Total\ Time\ Per\ Week = 24\ Hrs\ x\ 7\ Days = 168$$

$$EPT = Test\ tim$$

$$Load\ Size = No.testes\ slots\ x\ Tool\ primitive$$

$$Yield = \frac{(100\ \% - First\ Past\ Yield\ ) + 100\%}{100\%}$$

The result shows as per tabled in Table 3 below:

Table 3: Result of Capacity Plan of Tester A and Tester B

WORKSTATION	PREVIOUS		LATEST	
Tester	**Total Count**	**Capacity**	**Total Count**	**Capacity**
A	42	243278	64	370709
B	56	464707	50	391031

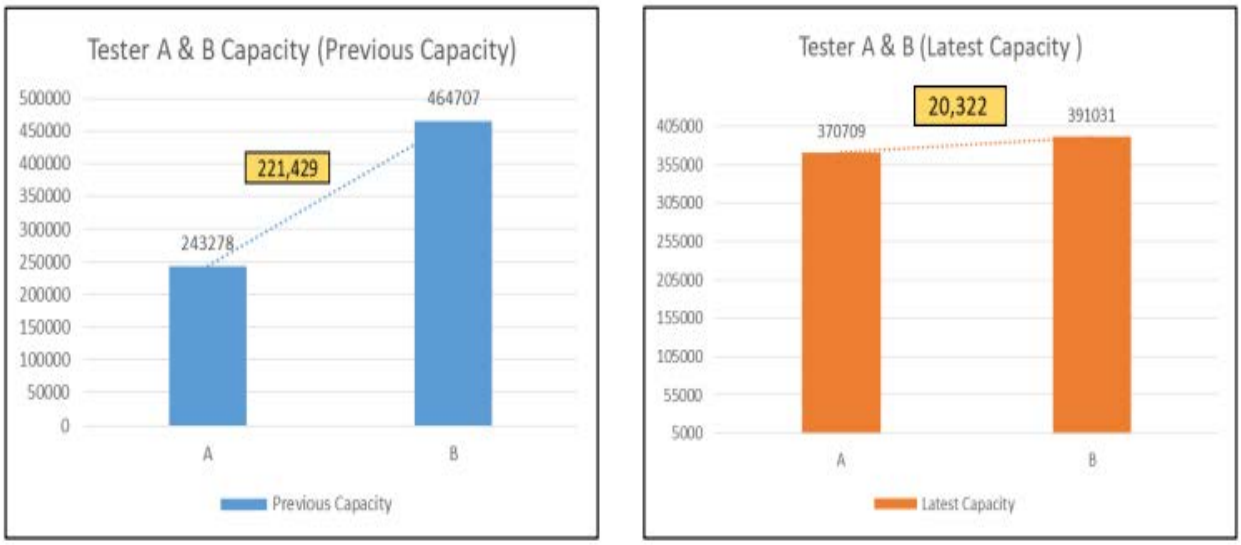

Figure 8 shows two graphs of previous Capacity Latest Capacity Testers A and Tester B

Based on this analysis, the latest capacity of both testers is almost balance. It can be capture by comparing at Figure 8. There are reasons the latest plan is planning to not reach equivalent. One of them due to customer request on specific product that need Testers B more than Testers A and next is the temporary space required to run at SSD Testers can supports around 145 and below quantity of testers. Generally, balance out the capacity for both testers are important to avoid bottleneck in production line. The impact will point a congestion in production system flow if workloads arrive to only one tester instead other. This can have a significant impact on the flow of SSD Testers line and sharply increase the time and expense of production. Line balancing is manufacturing engineering function in which whole collection of production line task are divide into equal portions. Well-balanced production line improve productivity.

4. Conclusion

There are methods to perform engineering layout design linked with lead time of testers' activities and capacity planning calculations under precision is described in this paper. The findings depict an overall version of specific layout, testers' implementation lead time analysis and the impact latest testers' quantity construct the balancing of capacity planning in operation. Manufacturing line balancing study based on capacity check from industrial engineering team also tends to employ thought and ingenuity to change conditions in production long term game plan. Manufacturing flexibility is the key to effective resource management. So, it is important to keep concerns and predict each issue happen in every part of SSD manufacturing activity to avoid worst scenarios. Based on this study researcher able to capture on how the space has been utilized for allocated the SSD testers to support flourishing of upcoming demands with the best plan loading plan for production.

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COMPARISON OF BORON PRESENCE IN THE BLEACHED CIGARETTE STUBS WASTE

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ABSTRACT

The high prevalence of smoking in Malaysia, particularly among men and adolescents, poses environmental concerns due to the toxic residues in cigarette stubs, including hazardous elements like boron or boric acid, which persist in the environment for extended periods. Therefore, this element could affect the water source and soil, eventually affecting human health. In order to reduce the effect of this element, bleaching process is recommended. Sodium hypochlorite (10%) with ratio 1:2 (sodium: water) was used in bleaching process with sample preparation, followed by analysis using Fourier Transform Infrared Spectroscopy (FTIR) and Energy Dispersive X-Ray (EDX). FTIR analysis showed that the peaks are nearly similar for all four types of sample data those taken 1 hours and 30 minutes post-bleaching, 2 hours 30 minutes post-bleaching, as well as those taken 3 hours 30 minutes post-bleaching and from already used or smoked materials, and no significant differences were observed, in contrast to what was seen in the EDX analysis. The provided data from EDX indicated that the percentage of boron decreased from 42.3% to 20.6% for sample 2 hours 30 minutes post-bleaching and 3 hours 30 minutes post-bleaching. The research on the chemical composition of cigarette stub waste, particularly focusing on boron, is of great significance due to its potential impact on the environment and human health. The study investigated the concentration levels of boron in cigarette stub waste, which could help in developing better waste management strategies to protect the environment.

1. Introduction

Cigarette smoking is a prevalent habit globally, leading to the accumulation of large quantities of stub waste. There is a significant problem with littering cigarette filters in Malaysia. According to a study by Mohd Hanafiah et al. (2019), cigarette butts are the most commonly littered item in the urban areas of Malaysia. This highlights the widespread presence of cigarette filter litter, and the need to address this environmental issue. These stubs, when improperly discarded, pose a threat to the environment and human health because of the potential release of harmful chemicals. However, recycling cigarette stubs has gained attention

as a potential solution for reducing waste and mitigating environmental impacts. To implement effective recycling and waste management strategies, it is crucial to gain a comprehensive understanding of the chemical composition of recycled cigarette stubs waste. Cigarette filters have contributed to the growing problem of microplastic pollution. Research conducted by Zulkifli et al. (2020) found that discarded cigarette filters are a significant source of microplastics in Malaysia's urban areas. Microplastics pose risks to marine life and ecosystems, as they can be ingested by organisms and disrupt the food chain. Research conduct by Novotny (2009) found that cigarettes and cigarette filters collected in the International Coastal Cleanup for 1996–2007 shown Figure 1.

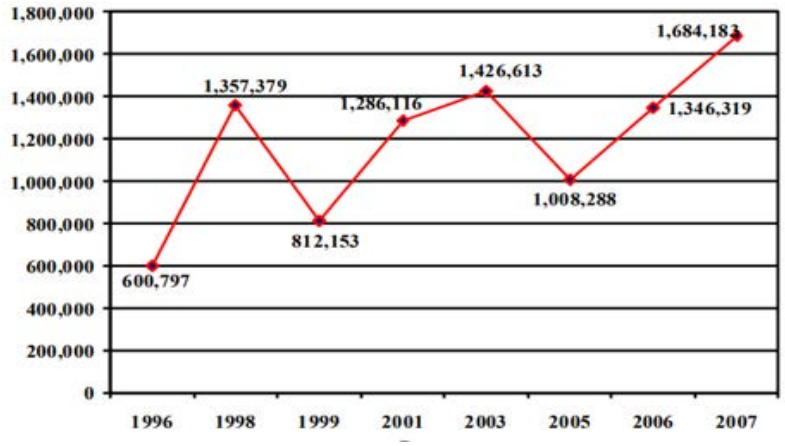

Figure 1: Cigarettes filters collected in the International Coastal Clean-up (Novotny, 2009)

Cigarette filter litter not only harms the environment but also poses health and aesthetic concerns. A study by Ismail et al. (2018) revealed that cigarette butts accounted for a significant portion of the litter found in public spaces, affecting the cleanliness and visual appeal of the surroundings. Furthermore, improper disposal of cigarette filters can lead to the release of toxic chemicals, thereby affecting air and water quality.Malaysia faces a substantial challenge in the littering of cigarette filters. A study conducted by Ismail et al. (2018) in the urban areas of Malaysia revealed that cigarette butts were the most frequently littered item. This demonstrates the widespread issue of cigarette filter litter in the Malaysia.

Several studies have highlighted the environmental impacts of improperly disposed cigarette stubs. For example, Novotny (2009) found that cigarette butts were the most commonly collected type of litter in coastal clean-ups, posing a threat to marine ecosystems. Chemical composition analysis of recycled cigarette stubs waste can provide empirical evidence regarding the presence of hazardous elements and compounds, such as heavy metals and toxic chemicals, which contribute to environmental pollution.

Analysis of the chemical composition can identify the specific toxic substances present in recycled cigarette stubs waste. For instance, Moerman et al. (2011) detected the presence of harmful compounds such as nicotine, polycyclic aromatic hydrocarbons (PAHs), and heavy metals in cigarette butts. Understanding the chemical composition can help to assess the potential health risks associated with exposure to recycled cigarette stubs waste. Improper disposal of cigarette stubs in soil can lead to contamination and affect soil quality. An empirical analysis of the chemical composition can reveal the presence of contaminants, such as boric acid, heavy metals (e.g., lead, cadmium), and organic compounds, which can adversely impact soil fertility and the surrounding ecosystem. A study by Cruz et al. (2020) found elevated levels

of heavy metals in soil samples contaminated by discarded cigarette butts, indicating the need for effective waste management practices.

Figure 2: Composition of cigarettes. Ismail et al. (2018)

Research conduct by Ismail et al. (2018) found that cigarette stub waste contains various chemicals and composition that can be harmful to human health that shown in Figure 2. The chemical composition analysis of recycled cigarette stubs waste will reveal the presence of hazardous elements, toxic compounds, and contaminants, posing a significant environmental risk and potential health hazards.The analysis of chemical composition can shed light on the potential for water pollution caused by recycled cigarette stub waste. Boric acid, which is present in cigarette stubs, can adversely affect water sources. According to Li et al. (2018), boric acid can contaminate freshwater bodies and can affect aquatic organisms. Understanding chemical composition can help identify the extent of water pollution and guide appropriate measures for water resource protection.

A study from Girotti. (2015), sodium hypochlorite as a disinfectant and bleaching agent, particularly in the context of recycling cigarette stub waste. Analysis of the chemical composition of the waste after bleaching using sodium hypochlorite plays a crucial role in mitigating environmental risks and improving waste management practices. This enables the identification and quantification of chemical constituents, facilitating the development of effective strategies for handling, treating, and disposing of waste. The use of sodium hypochlorite for bleaching has been demonstrated to modify the chemical composition of waste and promote resource conservation within a circular economic framework. These findings also contribute to innovation in waste management, driving further research and development of improved treatment methods, alternative bleaching agents, and more efficient practices.

According to a study by Silverstein et al. (2014) Fourier Transform Infrared Spectroscopy (FTIR) is a powerful analytical technique used to identify the chemical functional groups in recycled cigarette stub waste and provides a detailed spectrum that represents the absorption patterns of different functional groups, allowing researchers to determine the types of chemical compounds and their structural characteristics in waste. FTIR can detect harmful compounds

in recycled cigarette stub waste, such as the polycyclic aromatic hydrocarbons (PAHs) found in cigarette smoke. By analyzing the FTIR, researchers can confirm the presence of PAHs and assess their concentration levels, providing insights into potential health risks. Comparative studies using FTIR of different samples of recycled cigarette stub waste can identify variations in the chemical composition. FTIR can monitor and assess chemical changes during treatment processes to reduce the harmful components in waste. Analyzing FTIR before and after treatment helps to evaluate the effectiveness of treatment methods in modifying the chemical composition and reducing hazardous substances. In a study of Jain et al. (2016) using Fourier Transform Infrared Spectroscopy (FTIR) for the analysis, researchers can gain valuable insights into the chemical composition, identification of harmful compounds, comparative studies, and treatment effectiveness.

Energy Dispersive X-Ray (EDX) analysis enables the identification and quantification of elements present in recycled cigarette stub waste. According to a study by Goldstein et al. (2017) EDX detects characteristic X-ray emissions to determine the types and concentrations of elements present, including heavy metals or trace elements. EDX analysis aids in evaluating contaminants within the waste material. Hossain et al. (2019) EDX analysis helps understand the physical characteristics, potential sources of waste, and behavior of elements. EDX can monitor changes in the chemical composition of recycled cigarette stubs waste during the treatment processes.

Research have use certain consecutive processes and stages of processing in order to achieve the objective, accordingly the steps required to analysis on the chemical composition of the cigarette stubs waste. Boric acid, a toxic substance, has a chemical composition that exhibits a high peak in the analysis. It is commonly found in tobacco, and consumption of boric acid can result in acute or chronic poisoning. For instance, acute poisoning can occur when individuals ingest roach-killing products that contain powdered boric acid. According to the study of Linskens et al. (2014), boric acid is considered a caustic chemical that can harm tissues upon contact. Individuals who are frequently exposed to boric acid may experience chronic toxicity.

2.0 Materials and methods

2.1 Collecting and Cleaning Process

The cigarette stubs waste were gathered randomly around pedestrian areas, sidewalks and everywhere passed by the public. Then, proper segregation from other waste materials was ensured. This helped maintain the purity of the waste material and facilitated the subsequent bleaching process. The waste material needed to be removed and separated from the cigarette filter, which was also known as plug wrap paper and tipping paper located at the end of the waste cigarette butt. The waste material was cleaned by washing it using tap water to remove light dirt, such as small dust.

2.2 Bleaching and Drying Process

Sodium hypochlorite (usually in the form of a bleach) was diluted with water to obtain the desired concentration. Cigarette stubs were placed in a container or vessel and immersed in the prepared sodium hypochlorite solution. The bleaching process was used with sodium hypochlorite (10%) with a ratio of 1:2 (sodium: water) for sample preparation. For efficient

treatment, it is essential to ensure that the waste material is fully submerged. The duration of immersion can vary, but preliminary tests should be conducted to determine the optimal contact time. The waste material should be agitated or mixed in a sodium hypochlorite solution to enhance the contact between the chemical and the waste. This promotes bleaching and aids in the removal of impurities and contaminants. A study of Rayung. (2014) mention that after bleaching, clean the waste material with tap water and allowed to completely dry the waste material in oven for 30 minutes and 110˚C. Ensure that the sample is properly dried and free of contaminants or external particles. Four types of sample have been bleached and dried for testing.

2.3 Analysis using FTIR & EDX

The dried samples were prepared for FTIR analysis. A small amount of the waste material sample was placed onto an FTIR sample holder, such as a potassium bromide (KBr) pellet or an attenuated total reflection (ATR) crystal. FTIR analysis was performed using a spectrometer equipped with an appropriate FTIR accessory, such as a transmission or attenuated total reflection (ATR) module. The FTIR spectra of the samples were collected over a suitable wavelength range such as the mid-infrared region. The FTIR spectra were analyzed to identify the functional groups, chemical bonds, and compounds present in the recycled cigarette stub waste. Next,the sample was prepared for EDX analysis also by mounting it on a suitable cigratte stubs waste.The sample holder was placed in an EDX analyzer.The operating conditions of the EDX system, such as the acceleration voltage and beam current, were adjusted based on the characteristics of the sample and desired analysis.EDX analysis was performed by scanning the sample surface with an electron beam and detecting the characteristic X-rays emitted by the elements present.Acquire EDX spectra and analyze the data to determine the elemental composition and identify specific elements or contaminants in the cigarette stubs waste.Four types of samples have been test for FTIR and EDX :

1) Fiber material has been smoked
2) Fiber material that is bleached using sodium hypochlorite within a period of 1 hour 30 minutes
3) Fiber material that is bleached using sodium hypochlorite within a period of 2 hour 30 minutes
4) Fiber material that is bleached using sodium hypochlorite within a period of 3 hour 30 minutes

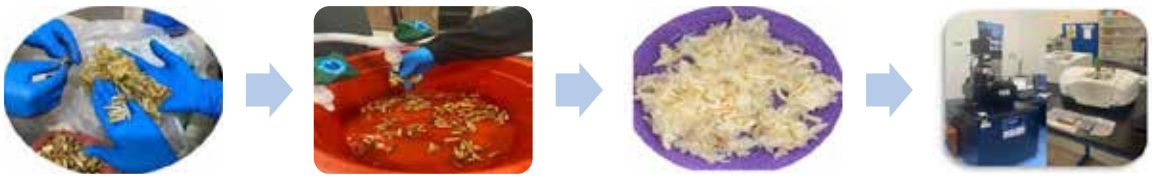

Figure 3: Process of analysing the chemical composition

Process of analysing the chemical composition shown in Figure 3.FTIR and EDX data were to identify the functional groups, compounds, and elements present in the waste material.Quantitatively analyze the EDX data percentage, to determine the relative abundances

of the specific components. The impact of the bleaching process using sodium hypochlorite on the chemical composition of the cigarette stub waste was determined by the FTIR and EDX results before and after the treatment.

3.0 Results & Discussion

Analysis of the chemical composition reveals valuable information about the various compounds, elements, and functional groups present in cigarette stubs waste. By employing techniques such as Fourier Transform Infrared Spectroscopy (FTIR) and Energy Dispersive X-Ray spectroscopy (EDX), the specific components of the waste material can be identified and characterized.

3.1 FTIR Analysis

FTIR analysis can provide valuable insights into the presence of boric acid in bleached cigarette stub waste. By examining the obtained FTIR spectra, the characteristic peaks associated with the boron-oxygen bond or boron-containing functional groups can be identified. These peaks indicated the presence of boric acid in the waste material. This analysis can further reveal the relative intensity or changes in these peaks, providing information on the concentration or effectiveness of the bleaching process in modifying the amount of boric acid in the waste material.

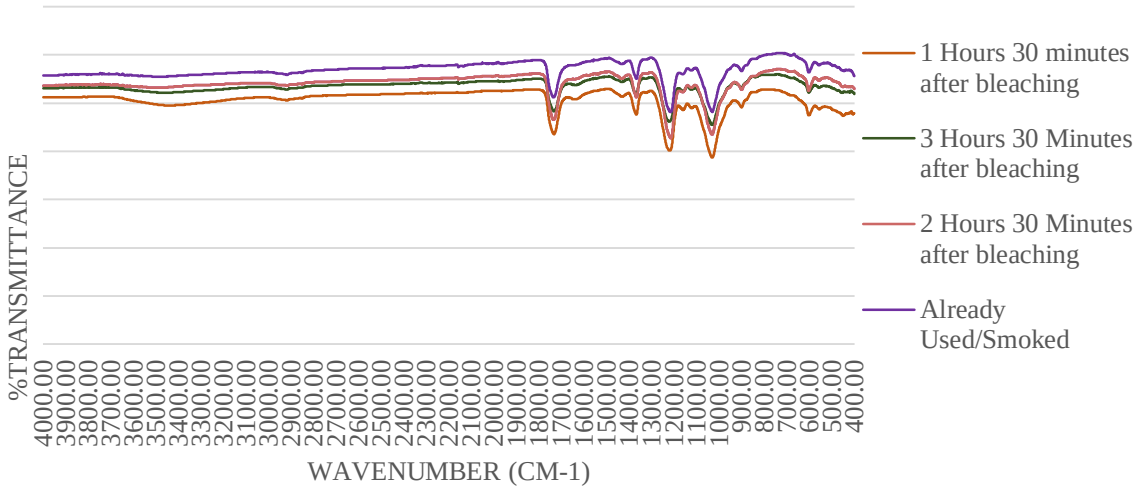

Figure 4: Fourier Transform Infrared Spectroscopy Result

The Figure 4 illustrates four types of sample data analysis using Fourier Transform Infrared Spectroscopy (FTIR). The highest and most intense peaks represent smoked or used cigarettes. Absorption peaks in the fingerprint region (typically 600-1500 cm^-1) correspond to stretching and bending vibrations of CH and CH2 groups, indicating the presence of aliphatic hydrocarbons. Absorption bands around 1700-1750 cm^-1 are characteristic of carbonyl functional groups (C=O), which may indicate the presence of compounds such as ketones, aldehydes, or carboxylic acids. Absorption bands around 1500-1600 cm^-1 suggest the presence of nitro functional groups (-NO2), commonly found in compounds such as nitroaromatics. Following this, we soaked the fiber material in a chemical mixture for 3 h and 30 min using the bleaching method and followed by 2 h and 30 min, with the last data point representing soaking times of 1 h and 30 min. When examining the graph, it was found that FTIR analysis showed that the peaks are nearly similar for all types of sample data, and no

significant differences were observed, in contrast to what was seen in the EDX analysis.There is a peak indicating at each of the data that identify presence of boron-oxide-carbon, a chemical component found in the ether group.

3.2 EDX Analysis

Therefore, EDX analysis complements FTIR analysis by providing quantitative information about the elemental composition, specifically the concentration of boron. By detecting characteristic X-rays emitted by the elements, EDX analysis can identify the presence of boron in bleached cigarette stub waste. The results of the analysis indicate the initial concentration of boron before the bleaching process as well as any changes in concentration following the treatment. A reduction in the percentage of boron detected in the waste material after bleaching suggests the efficacy of the treatment in reducing the presence of boric acid or boron. Table 1 illustrates five different types of data analysis using Energy Dispersive X-Ray (EDX).

By examining the material fiber that has undergone smoking, the data obtained from EDX analysis revealed that boron (B) exhibited the highest percentage among the hazard elements detected. It is important to note that when the concentration of boron reaches its maximum, it can potentially have an impact on human health. After subjecting the fiber materials to bleaching using a mixture of sodium hypochlorite and water for 1 h and 30, 2 h and 30 min, and 3 h and 30 followed by drying in a universal oven, the analyzed data revealed interesting findings. Interestingly, the most abundant chemical element observed in the data was boron, which is also reflected in the corresponding table 1.

Table 1: Energy Dispersive X-Ray Result

Atom (Symbol)	Before Bleaching Wt.%	σ	After Bleaching (1hr 30min) Wt.%	σ	After Bleaching (2hrs 30min) Wt.%	σ	After Bleaching (3hrs 30min) Wt.%	σ
Carbon, C	54.5	3.5	57.6	1.5	61.6	1.8	65.7	1.9
Boron, B	42.3	3.7	33.8	2.8	20.6	2.3	20.6	2.5
Oxygen, O	2.9	0.2	12.4	0.5	17.5	0.5	22.9	0.8
Potassium, P	0.1	0	0	0	0	0	0	0
Calcium, Ca	0.1	0	0	0	0	0	0	0

Upon analyzing the EDX data, it was found that various atoms, including Carbon, Oxygen, Boron, Potassium, and Calcium, were present. The EDX percentage results effectively demonstrated the proportion of atoms remaining in the fiber material. The Boron atom dropping by 8.5% from 42.3% to 33.8% for 1 h and 30. For instance, carbon exhibited a significant increase. Conversely, the Boron atom content experienced a sharp decline, dropping by 21.7% from 42.3% to 20.6% for 2 h and 30 bleaching process. For the 3 h and 30 bleaching process the boron atoms still remain same in for of percentages compare to 2hr and 30 mins. On the other hand, oxygen increased and both calcium and potassium levels experienced a marginal decrease of 0.1%. The results indicate that bleaching resulted in a substantial decrease in the presence of boron atoms. This successfully identify the chemical composition and reducing the boron content in the fiber material. Furthermore, the bleaching agent increased the proportions of oxygen and carbon. This can be attributed to the reaction of the sodium

hypochlorite bleaching chemical, which promotes an increase in the oxygen and carbon content. Figure 5 shown the cigarette stubs waste that before(a) and after(b) bleaching process.

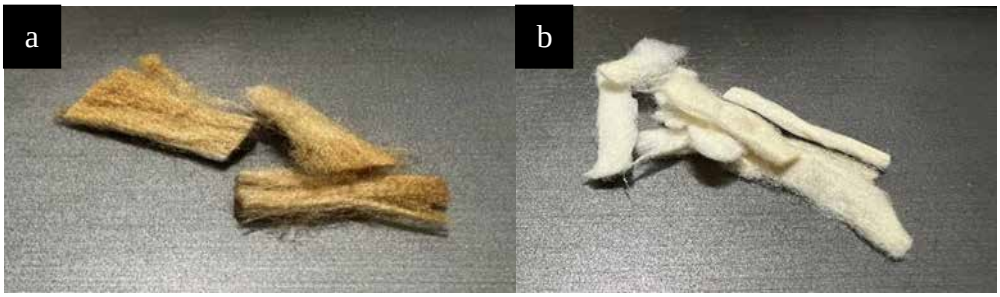

Figure 5: Cigarette stubs waste before(a) and after(b) bleaching process

Overall, these findings highlight the effectiveness of the bleaching process in altering the chemical composition of the fiber material. The reduction in boron atoms, coupled with the increase in oxygen and carbon, signifies the successful modification of the material using the employed bleaching method. The findings from both FTIR and EDX analyses provided insights into the chemical composition of boron in the waste of recycled cigarette stubs. The presence of characteristic peaks in the FTIR spectra and EDX analysis indicated the presence of boron as an element in cigarette stubs. The changes in the concentration of boron before and after the bleaching process can provide valuable information on the effectiveness of the treatment. The results suggest that the bleaching process using sodium hypochlorite has the potential to modify the chemical composition of cigarette stub waste, including the reduction of boron. This reduction is desirable because boric acid can pose environmental risks and affect water sources and soil, ultimately impacting human health. The successful reduction of boric acid through bleaching indicates a positive outcome in terms of waste management and environmental protection.

It is important to note that the specific findings and discussion will depend on the actual results obtained from the FTIR and EDX analyses conducted on bleached cigarette stub waste. The discussion should be tailored to the specific concentrations of boron detected as well as any changes observed before and after the bleaching process. Further interpretation and analysis of the data, along with reference to relevant literature and recommendation, will help provide a more comprehensive understanding of the implications of the presence or reduction of boron in the waste of bleached cigarette stubs.

4.0 Conclusion

In conclusion, the issue of boron in the analysis of the chemical composition of recycled cigarette stub waste is significant due to its potential environmental and health implications. Boric acid is known to be present in cigarette stubs and can pose risks when not properly managed or disposed. The FTIR and EDX analyses confirmed the presence of boron in the recycled cigarette stub waste. This aligns with the expected argument of the study, which aimed to determine the chemical composition of the waste material, specifically focusing on boron compounds aligning with the expected objective of the study. The characteristic peaks observed in both the FTIR spectra and EDX analysis provided clear evidence of the presence of boron. These findings support the expected argument that boron compounds would be present in the waste material. The study evaluated the effectiveness of a bleaching process using sodium hypochlorite in modifying the chemical composition of cigarette stub waste. The changes in boron concentration before and after the bleaching process suggest that the treatment has the

potential to reduce the presence of boron in the waste material. This argument emphasizes the importance of identifying and quantifying the concentration of boric acid to assess its potential impacts on water sources, soil, and human health.The analysis using techniques such as FTIR and EDX confirmed the presence of boric acid within the treated cigarette stub waste. FTIR analysis revealed characteristic peaks associated with boron-oxygen bonds or boron-containing functional groups, indicating the presence of boric acid. EDX analysis provided quantitative information on the concentration of boron, confirming its presence as an element in the waste material.The research findings revealed the concentration levels of boron in the waste of bleached cigarette stubs.

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