The 2nd International Conference

of Multidisciplinary Approaches on UN Sustainable Development Goals (UNSDGs)

December 28th - 29th, 2017

at the Hotel Windsor Suites & Convention, Bangkok, Thailand

Organized by

Contact Us

Research and Development Institute, Nakhon Pathom Rajabhat University.
85 Malaiman Rd., Muang, Nakhon Pathom, 73000, Thailand.
Tel. : +66 (0)34 109 300 Ext. 3909, +66 (0)34 261 053
Fax. : +66 (0)34 261 053
E-mail : unsdgs2017@webmail.npru.ac.th
Website : http://dept.npru.ac.th/unsdgs2017

The 2nd International Conference of Multidisciplinary Approaches on UN Sustainable Development Goals (UNSDGs)

The 2nd INTERNATIONAL CONFERENCE

of Multidisciplinary Approaches on UN Sustainable Development Goals (UNSDGs)

December 28th - 29th, 2017

at the Hotel Windsor Suites & Convention, Bangkok, Thailand

PROCEEDINGS

The 2nd International Conference of "Multidisciplinary Approaches on UN Sustainable Development Goals" (UNSDGs)

December 28th – 29th, 2017
at the Hotel Windsor Suites & Convention,
Bangkok, Thailand

Program and Abstracts

The 2nd International Conference of "Multidisciplinary Approaches on UN Sustainable Development Goals" (UNSDGs)

December 28th – 29th, 2017

Hotel Windsor Suites & Convention, Bangkok, Thailand

Co-hosted by: - The Interdisciplinary Network of the Royal Society of Thailand under the Royal Patronage of Her Royal Highness Princess Maha Chakri Sirindhorn
- Loei Rajabhat University
- Department of Medical Services, Ministry of Public Health
- Mahamakut Buddhist University
- National Office of Buddhism
- Faculty of Environment and Resource Studies, Mahidol University
- Faculty of Nursing, Prince of Songkla University
- Center for Research and Development in Community Health System, Faculty of Nursing, Khon Kaen University
- University of Kassel, the Federal Republic of Germany
- Undiknas University, the Republic of Indonesia
- Curtin University, the Commonwealth of Australia

Editors: Asst.Prof.Dr.–Ing.Phatcharasak Arlai
Asst.Prof.Dr.Supoj Hengpraprohm
Dr.Udsanee Pakdeetrakulwong
Miss Suparpitch Chanin
Miss Ladda Khemnark

Published by: Research and Development Institute
Nakhon Pathom Rajabhat University
85 Malaiman Road, Mueang, Nakhon Pathom 73000
Thailand
Tel./Fax: +66 (0) 34 261053
Website: http://dept.npru.ac.th/unsdgs2017
Email: unsdgs2017@webmail.npru.ac.th

Available online at: http://dept.npru.ac.th/unsdgs2017

No.	Nationality	Number of Participants
1	Thai	284
2	German	6
3	Indian	3
4	American	4
5	Chinese	7
6	Filipinos	3
7	Japanese	4
8	Australian	2
9	Burmese	5
10	Pakistanis	2
11	Finns	1
12	Indonesian	4
13	Iraqis	1
14	Korean	1
15	Laotian	1
16	Sri Lankan	1
17	Taiwanese	1
Total	330 Participants	

Summary of participants
Thai participant 86.06 %
Foreign participant 13.94%

No.	Country	Number of Papers
1.	The Kingdom of Thailand	112
2.	The United States of America (USA)	2
3.	The Republic of Finland	1
4.	The Republic of Indonesia	1
5.	The Republic of the Union of Myanmar	1
6.	The Islamic Republic of Pakistan	2
7.	The Commonwealth of Australia	3
8.	The Republic of Iraq	1
9.	The Republic of Korea (South Korea)	3
10.	The Democratic Socialist Republic of Sri Lanka	1
11.	The Republic of China	1
12.	The People's Republic of Bangladesh	2
Total	130 papers	

Summary of Papers
Papers from Thailand % 86.15%
Papers from other countries % 13.84%

Message from
Acting President of Nakhon Pathom Rajabhat University

The 2nd International Conference of "Multidisciplinary Approaches on UN Sustainable Development Goals" (UNSDGs) is the second academic international conference of Nakhon Pathom Rajabhat University. On behalf of Acting President of Nakhon Pathom Rajabhat University, I am delighted to host and co-hosted with 11 organizations including the Interdisciplinary Network of the Royal Society of Thailand under the Royal Patronage of Her Royal Highness Princess Maha Chakri Sirindhorn, Loei Rajabhat University, Department of Medical Services, Ministry of Public Health, Mahamakut Buddhist University, National Office of Buddhism, Faculty of Environment and Resource Studies, Mahidol University, Faculty of Nursing, Prince of Songkla University, Center for Research and Development in Community Health System, Faculty of Nursing, Khon Kaen University, University of Kassel, the Federal Republic of Germany, Curtin University, Commonwealth of Australia, and Universitas Pendidikan Nasional (Undiknas University), the Republic of Indonesia.

The aims of UNSDGs is to provide a forum for academicians and professionals from various educational fields and with cross-disciplinary interests to network, share knowledge and engage in dialogue around the theme of fostering innovation and excellence in multidisciplinary approaches on UN sustainable development goals to produce a set of universally applicable goals that balances the three dimensions of sustainable development: environmental, social, and economic.

I would like to take this opportunity to express my sincere appreciation to Prof.Dr. Phra Brahmapundit, the president of Mahachulalongkornrajavidyalaya University, and Prof. Dr. rer. nat. Manfred Koch – the plenary lecturers, co-hosts, many distinguished international and Thai academicians that have presented their important research works, the conference organizing committees and all supporters who have contributed their resources to the conference with a great determination. Last but not least, I would also like to thank the working team who delicate themselves to achieve the conference.

In conclusion, I am honor to express my heartfelt appreciation to all participants, especially those of you coming from abroad, for joining us and sharing your valuable experience and ideas and wish our visitors will enjoy the conference and have a very pleasant stay in Thailand.

Somdej

(Assistant Professor Somdej Ninlapan)
Acting President of Nakhon Pathom Rajabhat University

Message from
Chairman of the Interdisciplinary Committee for Research and Development of the Royal Society of Thailand

On behalf of the Chairman of the Interdisciplinary Committee for Research and Development of the Royal Society of Thailand, we have co-worked with Nakhon Pathom Rajabhat University since 2011. Herewith the President of Nakhon Pathom Rajabhat University performs as a Chairman of Western Network of the Royal Society of Thailand.

Since then, we have cooperated for publishing Journal of Thai Interdisciplinary Research until now. And I am the Editor of Journal of Thai Interdisciplinary Research.

In the present, Journal of Thai Interdisciplinary Research is indexed in the tier 1 (Science and Technology) of TCI, ASEAN Citation Index (ACI) and Google Scholar.

Moreover, the conference is mainly hosted by Nakhon Pathom Rajabhat University and the Interdisciplinary Committee for Research and Development of the Royal Society of Thailand. The selected articles will be published on the Journal of Thai Interdisciplinary Research.

Finally, I would like to express the deep appreciation to plenary lectures, keynote speakers, all participants and working staffs whom devote themselves to this conference.

I further wish the 2nd International Conference of Multidisciplinary Approaches on UN Sustainable Development Goals (UNSDGs) to be a great success and wish all participants a pleasant stay in Thailand, to have extensive and successful academic exchanges on the importance of interdisciplinary research from the conference, and safe trip back home.

(Professor Dr. med. Yongyudh Vajaradul, FRST)
Chairman of the Royal Society of Thailand

Report Speech

by Dr.Wirat Pinkaew,
Vice president, Nakhon Pathom Rajabhat University, Thailand
at the opening of the 2nd International Conference
of Multidisciplinary Approaches on UN Sustainable Development Goals (UNSDGs)
December 28th, 2017
at the Hotel Windsor Suites & Convention, Bangkok, Thailand

Good morning, Prof.Dr.Phra Brahmapundit, the president of Mahachulalongkornrajavidyalaya University, Prof.Dr.med.Yongyudh Vajaradul, Chairman of the Interdisciplinary Committee for Research and Development of the Royal Society of Thailand, Prof. Dr. rer. nat. Manfred Koch, Faculty of Civil and Environmental Engineering, University of Kassel, Germany, fellow academicians, distinguished guests, ladies and gentlemen.

On behalf of the organizing committee of the 2nd International Conference on Multidisciplinary Approaches to Sustainable Development Goals (UNSDGs), we would like to express our gratitude to Mr.Prasit Pathummarak, Chairman of the University Council of Nakhon Pathom Rajabhat University to preside over the opening ceremony of this international conference.

With Thailand 4.0 being the Thai government's strategic vision and globally, United Nations Sustainable Development Goals being the path, the direction and destination that every country on earth are set to go. These are the themes reflected in this conference. Therefore, we would like to invite all of our partners to become part of the solution by rising up to the challenge of future shifts. The purpose of this international academic conference is to serve as an interdisciplinary exchange forum for faculties, students, researchers and academicians both here and abroad. Those who attend our event can expect to be enriched by the many interesting and relevant research topics of our time. All of the research topics both in the form of oral presentation and poster presentation have carefully been selected by experts in the fields.

Abstracts of selected research papers are published in the abstract proceedings book while the full paper can be accessed online via the conference website All information therein will be sent to university libraries nationwide and related agencies. In addition, the full content of selected high-quality research papers will be published in the academic journal of Thai Interdisciplinary Research which are in the Thai Journal Citation Index (TCI) and ASEAN Citation Index (ACI).

This international conference covers 12 academic disciplines: (1) Sustainable Development Goals; (2) Pure and Applied Science; (3) Electrical Engineering and Technology; (4) Computer and Information Technology; (5) Medical Health Sciences and Laws; (6) Nursing; (7) Humanities and Social Sciences; (8) ASEAN Studies; (9) Water Engineering, Groundwater Hydrology and Environmental Science; (10) Hospitality and Tourism Management; (11) Interdisciplinary Research; and (12) Buddhism for Thailand 4.0.

There have been 160 articles submitted for review out of which 130 articles were selected for presentation in this conference: 107 in the form of oral presentations and 23 in the form of poster presentations.

In addition, there are as many as 65 agencies and organizations showing interests to present their ideas and articles so with amazing array of presentations during this festive seasons. The Organizing Committee invite all our academic partners and audience to please regard the timing of this international conference as a celebration of knowledge and our New Year Gifts for you.

I will now return the microphone back to the MC to announce the next step of formality.

Thank you for your attention.

Dr.Wirat Pinkaew, Vice president, Nakhon Pathom Rajabhat University, Thailand

Organizing Committee

Chairman of UNSDGs

Asst.Prof.Somdej Ninlapan

Advisory Committees

Prof.Dr.med.Yongyudh Vajaradul

Dr.Wirat Pinkaew

International and national Academic Committees

Prof.Dr.Archie A. Alexander

Prof.Dr.Grant A. Ramm

Prof.Dr.Adrian C. Sleigh

Prof.Dr.Ken Kurasaki

Prof. Dr. HongJoo Kim

Prof.Dr.Leslie Barratt

Prof.Dr.Masami MATSUDA

Prof.Dr.Wasantha Rathnayake

Prof.Viorel Sandu

Prof.Dr rer.nat.Manfred Koch

Prof.Dr.Shoichiro Hara

Prof.Dr.Thomas A.C Weiser

Prof.Dr.Warren Y. Brockelman

Assoc.Prof.Dr.Indrit Troshani

Assoc.Prof.Dr.Luh Putu Mahyuni

Asst.Prof.Dr.Bowie, Po-Yi Hsu

Dr.Amber Bajpai

Dr. Lin Min Min Myint

Dr.Meena Laiphrakpam

Dr.Benjamin C. Schulte

Dr.Dedy Syamsuar

Dr.Gordon Yan

Dr.Juniastel Rajagukguk

Dr.Nicola Palmer

Dr.Omid Ameri Sianaki

Dr.Ponnie Clark

Dr.Imran Haider

Dr.Rui Su

Dr.Samantha Chaperon

Dr.Will Barratt

Dr. Christie Yu –Ling Chang

Mrs.Ruffel Joy C. Manalo

H.E.Ambassador Kamthorn Sithtichoti

Prof.Dr.Budsaba Kanoksilapatham

Assoc.Prof.Dr.Boonyang plangklang

Assoc.Prof.Dr.Sunuttra Taboonpong

Assoc.Prof.Dr.Piya Kovintavewet

Assoc.Prof.Dr.Jakrapong Kaewkhao

Assoc.Prof.Dr.Sayam Aroonsrimorakot

Assoc Prof.Dr.Singhanat Nomnian

Assoc.Prof.Dr.Sita Yiemkuntithavorn

Assoc.Prof.Dr.Tuantun Kitpaisalsakul

Asst.Prof.Dr.–Ing.Phatcharasak Arlai

Asst.Prof.Dr.Supoj Hengpraprohm

Asst.Prof.Dr.Aumaporn Arlai

Asst.Prof.Dr.Hatchaichanok Buajaroen

Asst.Prof.Dr.Kamonpan Boonkit

Asst.Prof.Dr.Patarawagee Yasaka

Asst.Prof.Dr.Pitchayapa Yuenyaw

Asst.Prof.Dr.Piyaporn Tunneekul

Asst.Prof.Dr.Pragasit Sitthikul

Asst.Prof.Dr.Santi KoonKarnKhai

Asst.Prof.Dr.Suvimol Mukviboonchai

Asst.Prof.Dr.Theranun Wannasiri

Asst.Prof.Dr.Usa Noytim

Asst.Prof.Dr.Warakorn Poonsawat

Col.Artcha Boongrapu

Acting 2, Lt.Pornchai Eiamsadthakul

Dr.Adisak Jaturapiree

Dr.Kairung Hengpraprohm

Dr.Kitipun Boon-in

Dr.Maslin Buaban

Dr.Nipon Chuamuangphan

Dr.Nuttawan Pumdeeying

Dr.Orapun Metadilogkul

Dr.Pitiphol Pholpabu

Dr.Prapon Leksuma

Dr.Prasutr Thavornchaisit

Dr.Puvanart Keoplang

Dr.Supote Prasertsri

Dr.Thada Siththada

Dr.Thanathorn Vajirachorn

Dr.Udsanee Pakdeetrakulwong

Dr.Worachet Uttha

Mr.Nupong Phusri

Mr.Surachai Yusuk

Mr.Yanapat Yodkaew

Ms.Duangjit Sukhapabsuk

Ms.Lalana Pathomchaiwat

Ms.Nareema Sangwiman

Ms.Nilubon Kongprem

Ms.Ruja Sukpat

Ms.Thiranum Phrathum

Assistant Secretary

Ms.Ladda Khemnark

Ms.Suparpitch Chanin

Thai committees 56 persons

Foreign committees 32 persons

Total 88 persons

List of Peer Reviews

H.E.Ambassador Kamthorn Sithtichoti	Ministry of Foreign Affairs, Thailand
Col.Artcha Boongrapu	Ministry of Defence, Thailand
Assoc.Prof.Dr.Jakrapong Kaewkhao	Nakhon Pathom Rajabhat University, Thailand
Assoc.Prof.Dr.Smit Insiripong	Muban ChomBueng Rajabhat, Thailand
Dr. Juniastel Rajagukguk	Medan State University, Indonesia
Prof.Dr.Wasantha Rathnayake	Sabaragamuwa University of Sri Lanka Sri Lanka
Prof.Viorel Sandu	National Institute of Materials Physics, Romania
Dr. Lin Min Min Myint	School of Information Technology, Shinawatra University, Thailand
Dr. Ambar Bajpai	School of Engineering, Avantika University, Ujjain, India
Assoc.Prof.Dr.Piya Kovintavewat	Nakhon Pathom Rajabhat University, Thailand
Assoc.Prof.Dr.Phayung Meesad	King Mongkut's University of Technology North Bangkok, Thailand
Assoc.Prof.Dr.Prachyanun Nilsook	King Mongkut's University of Technology North Bangkok, Thailand
Assoc.Prof.Dr.Nuanwan Soonthornphisaj	Kasetsart University, Thailand
Associate Professor Dr. Indrit Troshani	The University of Adelaide, Australia
Dr. Dedy Syamsuar	Computer Science Faculty, Bina Darma University, Indonesia
Dr. Omid Ameri Sianaki	College of Engineering and Science, Victoria University Sydney Australia, Australia
Dr. Imran Haider	Curtin University, Australia
Dr. Orapan Methadilokul	The Medical Council of Thailand
Dr. Prasutr Thawornchaisit	Department of Medicine, Thailand
Prof.Dr.Archie A. Alexandder	Louisiana State University, United States of America
Assoc.Prof.Dr.Khanitta Nuntaboot	Khon Kaen University, Thailand
Prof. Dr.Shoichiro Hara	Kyoto University, Japan
Prof. Dr. Masami Matsuda	Tokyo Kasei-gakuin University, Japan

Assoc.Prof.Dr.Singhanat Nomnian	Mahidol University, Thailand
Assoc.Prof.Dr.Sita Yiemkuntitavorn	Sukhothai Thammathirat Open University, Thailand
Prof. Dr. Will Barratt	Roi Et Rajabhat University, Thailand
Asst.Prof.Dr.Pitchayapa Yuenyaw	Nakhon Pathom Rajabhat University, Thailand
Dr.Thada Siththada	Nakhon Pathom Rajabhat University, Thailand
Assoc.Prof.Dr.Tuantan Kitpaisalsakul	Chulalongkorn University, Thailand
Asst.Prof.Dr.Phatcharasak Arlai	Nakhon Pathom Rajabhat University, Thailand
Prof. Dr. rer. nat. Manfred Koch	University, University of Kassel, Germany
Assoc.Prof.Dr.Narin Sungrugsa	Silpakorn University, Thailand
Dr.Nipon Chuamuangphan	Nakhon Pathom Rajabhat University, Thailand
Dr. Rui Su	Middlesex University, London, United Kingdom
Dr. Nicola Palmer	Sheffield Hallam University, United Kingdom
Asst. Prof. Dr. Bowie, Po-Yi Hsu	National Kaohsiung University of Hospitality and Tourism, Taiwan
Dr. Samantha Chaperon	University of Greenwich, United Kingdom
Dr. Gordon Yan	Coventry University, United Kingdom
Assoc.Prof.Dr.Sayam Aroonsrimorakot	Mahidol University, Thailand
Dr.Meena Laiphrakpam	Mahidol University, Thailand
Asst.Prof. Warakorn Poolsawat	Nakhon Pathom Rajabhat University, Thailand
Dr. Christie Yu –Ling Chang	National Taiwan University, Taiwan

Thai reviewers 24 persons

Foreign reviewers 18 persons

Total 42 persons

The Conference Program

The 2nd International Conference
of "Multidisciplinary Approaches on UN Sustainable Development Goals" (UNSDGs)
December 28th – 29th, 2017
at the Hotel Windsor Suites & Convention, Bangkok, Thailand

Conference Program on December 28th, 2017 (Day 1)	
Date/Time	**Description**
08.30 - 09.00	Registration
09.00 - 09.30	**Conference Opening** Report: Dr.Wirat Pinkaew, Vice president, Nakhon Pathom Rajabhat University, Thailand Welcome Speech: Prof.Dr.med.Yongyudh Vajaradul, Chairman of the Interdisciplinary Committee for Research and Development of the Royal Society of Thailand Opening Speech: Mr.Prasit Pathummarak President of Nakhon Pathom Rajabhat University Council, Thailand
09.30 - 10.30	Plenary Lecture Prof.Dr.Phra Brahmapundit, the president of Mahachulalongkornrajavidyalaya University Topic: "Spiritual Transformation"
10.30 - 11.00	Presenting a Token of Appreciation: Mr.Prasit Pathummarak, President of Nakhon Pathom Rajabhat University Council for Plenary Lecture and Conference Co-organizers, (1) Dr.PhraBrahmapundit (2) Prof. Dr. rer. nat. Manfred Koch (3) The Interdisciplinary Network of the Royal Society of Thailand under the Royal Patronage of Her Royal Highness Princess Maha Chakri Sirindhorn (4) Loei Rajabhat University (5) Department of Medical Services, Ministry of Public Health (6) Mahamakut Buddhist University (7) National Office of Buddhism (8) Faculty of Environment and Resource Studies, Mahidol University (9) Faculty of Nursing, Prince of Songkla University (10) Center for Research and Development in Community Health System, Faculty of Nursing, Khon Kaen University (11) University of Kassel, the Federal Republic of Germany (12) Curtin University, Commonwealth of Australia and (13) Universitas Pendidikan Nasional (Undiknas University), the Republic of Indonesia. Commemorative Group Photo
11.00 - 12.00	Plenary Lecture: Prof. Dr. rer. nat. Manfred Koch, Faculty of Civil and Environmental Engineering, University of Kassel, Germany Topic: "Flood Disasters and their Mitigation in the Wake of Climate Change with a Focus on Thailand Case Studies"
12.00 - 13.00	Lunch (Fl. G)
13.00 - 14.00	Keynote Address /Oral Presentations
14.00 - 15.00	Keynote Address /Oral Presentations
15.00 - 15.15	Poster Presentations & Coffee Break
15.15 - 17.00	Oral Presentations (continued)
18.00 - 20.00	Reception

Conference Program on December 29th, 2017 (Day 2)	
Date/Time	**Description**
08.30 - 09.00	Registration
09.00 - 10.00	Keynote Address / Presentations
10.00 - 10.30	Oral Presentations
10.30 - 10.45	Coffee Break
10.45 - 12.00	Oral Presentations (continued)
12.00 - 13.00	Lunch (Fl.G)

Oral Presentation Program

BOARDROOM 1 (FI. G) **Session: ASEAN Studies**		
Session Chair: Asst.Prof.Dr.Pitchayapa Yuenyaw, Dr.Thada Siththada, Ms.Lalana Pathomchaiwat and Dr.Nuttawan Pumdeeying		
Dec 28th, 2017		
Time	**Code**	**Title**
13.00 - 14.00	**Keynote Speaker**	**Assist. Prof. Dr. Rugphong Vongsaroj** **Topic: "Influence of Mainland China on Tourism Industry in ASEAN"**
14.00 - 14.15	AEC 1	**The Impact of ASEAN Coalition on English Teaching in Thailand** by Lalana Pathomchaiwat
14.15 - 14.30	AEC 3	**Implementation Guidelines for Electronic Waste Disposal Management in Thailand to be Sustainable Developing Country in ASEAN** by Phongchayont Srisuwan
14.30 - 14.45	AEC 5	**Weaving Southeast Asian Identities: Strengthening ASEAN Socio-Cultural Community** by Aryasatyani Dhyani

BOARDROOM 2 (FI.G) **Session: Hospitality and Tourism Management**		
Session Chair: Dr.Thanathorn Vajirakachorn, Dr.Nipon Chuamuangphan, Dr.Maslin Buaban, Dr.Prapon Leksuma and Ms.Nilubon Kongprem		
Dec 28th, 2017		
Time	**Code**	**Title**
13.00 - 14.00	**Keynote Speaker**	**Dr.Thanathorn Vajirakhachor** **Topic: "Tourism and Sustainability Development"**
14.00 - 14.15	TOUR 1	**Importance of Hotel Brand Equity in Hospitality Industry** by Rachata Wangchan and Kreetha Simavara
14.15 - 14.30	TOUR 2	**Guidelines for Management of Kew Mae Pan and Pha Mon Nature Trail, Doi Inthanon National Park, Chiang Mai Province, Northern Thailand** by Nareerat Thanakasem, Panjarat Samanasena, Chonticha Pansawang, Jakkrit Charoensit and Pitoon Amornwitthawat
14.30 - 14.45	TOUR 3	**Comparing Performance of Centralized and Non-Centralized Safety Stock Case Study: Retail Clothing Business** by Supreechaya Bunmak, Nathawan Samakachan and Arisara Thaneerananon
14.45 - 15.00	TOUR 4	**Demand Fluctuation in The Fine Dining Restaurant Industry; Patterns, Impacts, and Management Strategies (A case study in Phuket)** by Wiphaporn Jobrich and Pornpisanu Promsivapallop
15.00 - 15.15	TOUR 5	**Can 'Tourism Product Development' Compensate the Social Cost of Carbon Pollution? : A Case Study in Sri Lanka** by Wasantha Rathnayake and Rajapaksha
15.15 - 15.30	TOUR 6	**The Potential of Agriculture based Destinations for Developing Creative Tourism: A Case Study of Ko Lad E-Tan, Nakhon Pathom Province, Thailand** by Maslin Buaban and Khaunyupa Srisawang

BOARDROOM 2 (Fl.G) **Session: Hospitality and Tourism Management**		
Session Chair: Dr.Thanathorn Vajirakachorn, Dr.Nipon Chuamuangphan, Dr.Maslin Buaban, Dr.Prapon Leksuma and Ms.Nilubon Kongprem		
Dec 28th, 2017		
Time	**Code**	**Title**
15.30 - 15.45	TOUR 7	**Guidelines for Community Participation in the Woven Fabric Conservation for Cultural Tourism in Phai Hu Change Community in Banglane District, Nakhon Pathom Province** by Pimchanok Mulmit, Jitsupa Rungraung, Bootsarakorn Khunnarong, Suttipong Aiemnoo and Supansa Paethong
15.45 - 16.00	TOUR 8	**The Participatory Approach to Environmental Management for Tourism in Wat Klang Khu Wiang Floating Market, Sampathuan Subdistrict, Nakhon Chai Si District, Nakhon Pathom Province** by Tiranan Pratum
16.00 - 16.15	TOUR 9	**The Guidelines for Public Relations and Tourism Promotion of the Wat Tha Phut Folk Museum, Rai Khing Subdistrict, Sam Phran District, Nakhon Pathom Province** by Nilubon Kongprem and Prapon Leksuma
16.15 - 16.30	TOUR 10	**The Potential on Tourism Activities at Hot Springs in Thai-Lanna Tourism Cluster** by Dr.Nipon Chuamuangphan

AMPAWA 1 (Fl.10) **Session: Sustainable Development Goals**		
Session Chair: H.E. Ambassador Kamthorn Sithtichoti and Col. Artcha Boongrapu		
Dec 28th, 2017		
Time	**Code**	**Title**
13.00 - 13.15	SDGs 1	**Sustainable Development Goals (SDGs): 1 and 5 –Complementary towards Fulfilment of Goals through BNF grant: An Analysis among the Beneficiaries** by Muhammad Mahboob Ali, Kamrul Hossain and Alauddin Chowdhury
13.15 - 13.30	SDGs 2	**Theory on Community Banking for Empowerment of People Bangladesh: A Conceptual View** by Muhammad Mahboob Ali
13.30 - 13.45	SDGs 5	**Peaceful and Nonviolent Societies as a Sustainable Development Goal 16** by Ingrida Grigaitytė and Hasan Habes
13.45 - 14.00	SDGs 6	**UNESCO Global Geoparks: A new set of management tools for sustainable development and Satun Aspiring UNESCO Global Geopark** by Pakkaporn Singhwachiraworakul, Pratueng Jintasakul, Paul Grote and Narongrit Thungprue
14.00 - 14.15	SDGs 8	**Managing Sustainable Development** by Pradip Peter Dey, Ronald P. Uhlig, Laith Al Any and Mohammad Amin
14.15 - 14.30	SDGs 9	**Comparison Data Inventory of Two Limestone Quarries with Environmental Footprint Technique** by Thanapat Atikij and Sayam Aroonsrimorakot
14.30 - 14.45	SDGs 10	**Promoting Sustainable Development Goals through Corporate Social Responsibility (CSR) Practices: Cases of Rural Hotels in Bali, Indonesia** by Luh Putu Mahyuni and Teddy Prianthara

AMPAWA 1 (Fl.10) **Session: Pure and Applied Science**		
Session Chair: Assoc.Prof.Dr.Jakrapong Kaewkhao, Dr.Patarawagee Yasaka and Dr.Kitipun Boon-in		
Dec 29th, 2017		
Time	**Time**	**Time**
9.00 - 10.00	**Keynote Speaker**	**Prof. Dr. Ken Kurosaki** **Topic: "Thermoelectric Materials"**
10.00 - 10.15	SCI 1	**Effect of Cr_2O_3 Concentrations on Physical and Optical Properties of Sodium Barium Bismuth Silicate Glasses** by Piyachat Meejitpaisan, Nattapon Srisittipokakun and Jakrapong Kaewkhao
10.15 - 10.30	SCI 2	**Study Structural, Physical and Optical Properties of Commercial Glass and Sunergy Clear Glass** by Pornnapha Mangthong, Nattapon Srisittipokakun, Jakrapong Kaewkhao
10.30 -10.45	SCI 3	**The Physical and Optical Parameters of $Li_2O – MO – B_2O_3$ Glasses Doped with Eu3+(MO = MgO, CaO, SrO, BaO)** by Benchaphorn Damdee, Jakrapong Kaewkhao and Keerati Kirdsiri
10.45 - 11.00	SCI 4	**Investigations on Spectroscopic Properties of Dy^{3+} Ion in Zinc Barium Borotellurite Glasses** by Patarawagee Yasaka, Chananya Wongdeeying, Nisakorn Sangwaranatee, Pruittipol Limkitjaroenporn and Jakrapong Kaewkhao
11.00 - 11.15	SCI 5	**Fabrication and Study on Optical and Photoluminescence Properties of Europium Doped in Borate Glasses** by Kitipun Boonin, Patarawagee Yasaka and Jakrapong Kaewkhao
11.15 - 11.30	SCI 6	**Photon Interaction of WO_3-Doped Soda Lime Borosilicate Glasses in Energy Range 1 keV to 105 keV:Theoretical Calculation** by Pruittipol Limkitjaroenporn, Wiraporn Hongtong and Jakrapong Kaewkhao
11.30 - 11.45	SCI 7	**The Photoluminescence Properties of Barium Gadolinium Borate Glasses doped with Dy^{3+} Ions** by Keerati Kirdsiri, Kanthamanee Kamsila and Narong Sangwaranatee
11.45 - 12.00	SCI 8	**PTR, PCR and Energy Resolution Study of BGO, CsI(Tl), and LYSO Scintillation Crystals** by Wasu Cheewasukhanont, Wuttichai Chaiphaksa, Pruittipol Limkitjaroenporn, and Jakrapong Kaewkhao
AMPAWA 2 (Fl.10) **Session: Pure and Applied Science**		
10.00 - 10.15	SCI 9	**Determination of Effective Atomic Number and Effective Electron Density of Some Local Building Materials in Nakhon Pathom Province** by Donlaporn Onta, Sirapong Klinhom, Wichita na Ayudhya and Keerati Kirdsiri
10.15 - 10.30	SCI 10	**Diversity of birds in Hlawga Park, Republic of the Union of Myanmar** by Aye Thant Zin, San San Myint, Myitzu Thinn Aung, Khun Aung Naing Oo, Kajornsak Jaiyawat, Chanatip Vongpraramat and Pongsarun Junshum
10.30 -10.45	SCI 11	**High Antibacterial Activity under Visible Light of WO_3-Doped TiO_2 Thin Films** by Weerachai Sangchay and Phatcharee Phoempoon
10.45 - 11.00	SCI 12	**Effects of CuO on Glass Prepared from Local Sand in Nakhon Pathom Province** by Watcharin Rachniyom, Narong Sangwaranatee and Jakrapong Kaewkhao

AMPAWA 2 (Fl.10) **Session: Pure and Applied Science**		
11.00 - 11.15	SCI 13	**A Negative Binomial-new Weighted Lindley Distribution for Count Data and Its Application to hospitalized Patients with Diabetes at Ratchaburi Hospital, Thailand** by Siriporn Samutwachirawong
11.15 - 11.30	SCI 14	**Luminescence Properties of Sm^{3+} Ions doped Aluminium, Barium and Phosphate Glasses** by N. Kiwsakunkarn, Jintana Poosanapong, Yaowaluk Tariwong, Jakrapong Kaewkhao and Natthakridta Chanthima
11.30 - 11.45	SCI 15	**Physical and Optical Study of Alkali and Alkaline Earth Metals Based Phosphate Glasses** by M. Shoaib, N. Chanthima, G. Rooh and J. Kaewkhao
11.45 - 12.00	SCI 16	**High Performance Properties of Multi-Walled Carbon Nanotubes and Carbon Black in NR/SBR** by Phatcharee Phoempoon, Weerachai Sangchay, Lek Sikong, Kalyanee Kooptanond and Orasa Patarapaiboolchai

AMPAWA 2 (Fl.10) **Session: Medical Health Sciences and Laws**		
Session Chair: Dr.Orapun Medilogkul, Dr.Prasutr Thavornchaisit, Acting2, Lt.Pornchai Eiamsadthakul		
Dec 28th, 2017		
Time	**Code**	**Title**
13.00 – 14.00	**Keynote Speaker**	**Dr.med.univ.Dr.rer.nat.Manfred Hartard and Mr. Dennis Bruns** **Topic: "Vibration Therapy Machines"**
14.00 – 15.00	**Keynote Speaker**	**Professor Dr.Grant A. Ramm** **Topic: "The Liver Stem Cell Niche: Role in Inflammation, Fibrogenesis and Regeneration in Chronic Liver Disease"**
15.00 - 15.15	MED 1	**Health Information Exposure, Health literacy and Health Promotion Behavior of Undergraduate Students of Kasetsart University** by Chalermkwan Singhwee
15.15 - 15.30	MED 2	**Influence of Astaxanthin on the Elicitation of Allergic Contact Dermatitis to P-Phenylenediamine: A Pilot Study** by Suphattra Trakanwittayarak, Jitlada Meephansan, Supitchaya Thaiwat and Suwimon Pootongkam
15.30 - 15.45	MED 3	**Transitional health-risk factors and associated 8-year nationwide incidence of hypertension in a Thai Cohort Study of 40,548 open university students** by Prasutr Thawornchaisit
15.45 - 16.00	MED 4	**Health-risk factors and 8-year incidence of kidney disease in Thailand: prospective findings from a large national cohort study** by Prasutr Thawornchaisit
16.00 - 16.15	MED 5	**Efficacy of combining fractional Carbon Dioxide laser and Silicone Gel in the treatment of hypertrophic scars and keloids** by Thanakom Sukcharoen and Suparuj Lueangarun
16.15 - 16.30	MED 6	**Effect of Calcipotriol on Uvb-Induced Mmp-9 In Human Skin: A Pilot Study** by Sasipa Limpikirati, Jitlada Meephansan and Saranyoo Ponnikorn
16.30 - 16.45	MED 7	**Clinical Status of Cerebral Palsy Patients Who used Cannabis Extract in Daily Life: A Survey** by Orapun Metadilogkul

AMPAWA 2 (Fl.10) **Session: Medical Health Sciences and Laws**		
Session Chair: Dr.Orapun Medilogkul, Dr.Prasutr Thavornchaisit, Acting2, Lt.Pornchai Eiamsadthakul		
Dec 28th, 2017		
Time	**Code**	**Title**
16.45 - 17.00	MED 8	**Pain Reduction among Patients used Cannabis extract as Self-Medication among Advanced Cancer Cases with Metastasis: A Survey** by Orapun Metadilogkul
17.00 - 17.15	MED 9	**Fasting Blood Glucose of Diabetes Mellitus Patients Who used Cannabis extract as Self-Medication: A Survey** by Orapun Metadilogkul

AMPAWA 3 (FI. 10) **Session: The Interdisciplinary Research**		
Session Chair: Prof.Dr.med.Yongyudh Vajaradul, Dr.Waret Veerasai, Assoc.Prof.Dr.Wongchan Wongkaew and Asst.Prof.Dr.Lertsiri Bovornkitti		
Dec 28th, 2017		
Time	**Code**	**Title**
13.00 - 14.00	**Keynote Speaker**	**Prof. Dr. med. Yongyudh Vajaradul** **Topic: "The Interdisciplinary Research Methodology and Its Necessity for Thailand 4.0 Strategy"**
14.00 - 15.00	**Keynote Speaker**	**Prof.Dr.Warren Y. Brockelman** **Topic: "Gibbons, forests, and climate change"**
15.00 - 16.00	**Keynote Speaker**	**Dr. Supote Prasertsri** **Topic: "Higher Education for Thailand 4.0"**
16.00 - 16.15	ITR 1	**Review of Indicators on Active Ageing towards Sustainable Development in Thailand** by Meena Laiphrakpam and Sayam Aroonsrimorakot
16.15 - 16.30	ITR 4	**Evaluation of Business Simulation Laboratory Project Business Education Faculty of Management Science Nakhon Pathom Rajabhat University** by Pattaraporn Puisuwan, Arisara Thaneerananon and Kanchanutch Nualnisachol
16.30 - 16.45	ITR 5	**The Strategic Planning Development for a Quality Active Ageing** by Rudchanok Sittivas
16.45 - 17.00	ITR 6	**Buddhist Institute with Creation for the Elderly Well-being Sustainable** by Sutthi Kabpila
17.00 - 17.15	ITR 7	**Local Herbs for Health Promotion: Grass Root Innovation C** by Poratip Chanchamsri
17.15 - 17.30	ITR 8	**Legal Measures to Support Coastal Communities for Sustainable Self-Governance in Global Climate Change** by Thitirat Itthimechai
17.30 - 17.45	ITR 9	**Property Management for Sustainable Livelihood of the Elderly** by Teerayuth Namkanisorn
17.45 - 18.00	ITR 10	**Grassroots Innovations with Local Foods** by Suthangrat Saisuwan
18.00 - 18.15	ITR 11	**Conflict Management between People and Forest Elephants according to the King Bhumibol's Science** by Somjate Ploychan

18.15 - 18.30	ITR 12	**Community Welfare System for the Elderly** by Natthawut upatham
AMPAWA 3 (FI. 10) **Session: The Interdisciplinary Research**		
Session Chair: Prof.Dr.med.Yongyudh Vajaradul, Dr.Waret Veerasai, Assoc.Prof.Dr.Wongchan Wongkaew and Asst.Prof.Dr.Lertsiri Bovornkitti		
Dec 28th, 2017		
Time	**Code**	**Title**
18.30 - 18.45	ITR 13	**Strategies for Adolescent Sexual Health Promotion based on Feminism** by Sumitra Niamkan
18.45 - 19.00	ITR 14	**Management of Coastal Fishing in the Thai-Cambodian Border for Sustainable Development** by Piyavut Prasitthiwed
19.00 - 19.15	ITR 15	**Environmental Education and Awareness among Students in India, Japan and Thailand for Sustainable Development** by Meena Laiphrakpam, Sayam Aroonsrimorakot and Aribam Rama Shanker

PLOY (FI. 11) **Session: Nursing**		
Session Chair: Asst.Prof.Dr.Hathaichanok Buajaroen, Asst.Prof.Dr.Pimsupa Shandanasotthi, Mrs. Natthaya Cherngchalard Chooprom, Asst.Prof.Dr.Theeranan Wannasiri, Ms.Laarnie D.Esteban, Ms. Labmie Lynnette Dematoque, Mrs. Ruffel Joy C. Manalo		
Dec 28th, 2017		
Time	**Code**	**Title**
13.00 - 14.00	**Keynote Speaker**	**Associate Prof. Dr. Khanitta Nuntaboot** **Topic: "Nursing Reform to promote Sustainable Development Goals"**
14.00 - 14.15	NUR 1	**Philippines' Public Health Nursing at a Glance** by Laarnie D. Esteban
14.15 - 14.30	NUR 2	**ASEAN Mutual Recognition Arrangement (MRA) on Nursing Services: Philippine's Challenges, Issues and Possible Way Forward** by Labmie Lynnette L. Dematoque
14.30 - 14.45	NUR 3	**Factors Related to Initiation of Cigarette Smoking Behavior among Secondary School Student in Nakhon Pathom Province** by Wanpen Waelveerakup, Malinee Jumnain and Prasinee Suksatapornlerte

PLOY (FI. 11) **Session: Nursing**		
Session Chair: Asst.Prof.Dr.Hathaichanok Buajaroen, Asst.Prof.Dr.Pimsupa Shandanasotthi, Mrs. Natthaya Cherngchalard Chooprom, Asst.Prof.Dr.Theeranan Wannasiri, Ms.Laarnie D.Esteban, Ms. Labmie Lynnette Dematoque, Mrs. Ruffel Joy C. Manalo		
Dec 29th, 2017		
Time	**Code**	**Title**
9.00 – 10.30	**Keynote Speaker**	**Prof. Dr.Shoichiro Hara** **Topic: "Community Evidences to support Sustainable Development Goals"**
10.30 – 12.00	**Keynote Speaker**	**Prof. Dr. Masami Matsuda** **Topic: "Sustainable Development Goals in Community"**

MORAKOT 1 (FI. 12) **Session: Water Engineering, Groundwater Hydrology and Environmental Science**		
Session Chair: Assoc.Prof.Tuantan Kitpaisalsakul, Asst.Prof.Dr.Phatcharasak Arlai and Assoc.Prof.Dr.Sayam Aroonsrimorakot		
Dec 28th, 2017		
Time	**Code**	**Title**
13.00 – 14.00	**Keynote Speaker**	**Prof. Dr. rer. nat. Manfred Koch** **Topic: "The Impact of Climate Change on Streamflow and Sustainable Water Resources Management"**
14.00 – 14.15	WRE 1	**Factors Affecting Performance of Standard Application and Indicator for Greenhouse Gas Emission in Green Office, Thailand** by Sayam Aroonsrimorakot, Setrawut Phuynongpho and Supapan Athirot
14.15 - 14.30	WRE 2	**The Potential Solutions of Water Resource Problem in Cisarua Sub-District, Bogor, West Java, Indonesia** by M. Faisi Ikhwali and Titiek Ujianti Karunia
14.30 - 14.45	WRE 3	**Multi-Objective Optimization for Flood Control Operation and Electricity Production of Nam Ngum 1 and 2 Hydropower Plants** by Vilandone Keophila, Anucha Promwungkwa and Kanchit Ngamsanroaj
14.45 - 15.00	WRE 4	**Effects of Light Intensity and Wind Velocity on the Evaporation Rate of Saturated Soil Surface** by Tammasak Punsaensri and Watcharapong Tachajapong
15.00 - 15.15	WRE 5	**Impacts of Climate Change on Irrigation Water Management by the Bhumibol Dam in Thailand** by Tuantan Kitpaisalsakul
15.15 - 15.30	WRE 6	**Application of the Tha-Chin River Model to early Flood Warning for Community Areas in the Bang Rakam Municipality, Central Thailand** by Phatcharasak Arlai and Manfred Koch

MORAKOT 1 (Fl.12) **Session: Computer and Information Technology**		
Session Chair: Dr.Supoj Hengpraprohm, Dr.Kairung Hengpraprohm, Dr.Worachet Uttha, Dr.Pitiphol Pholpabu, Dr.Udsanee Pakdeetrakulwong, Suksawat Sae-lim		
Dec 29th, 2017		
Time	**Code**	**Title**
9.00 - 10.00	**Keynote Speaker**	**Assoc. Prof. Dr. Thanachart Numnonda** **Topic: "Big Data Technology to drive Digital Economy"**
10.00 - 10.15	COM 1	**Applying an Extremely Imbalanced Technique on Big Data: Case Study of the Web Intrusion** by Kesinee Boonchuay, Sureerat Kaewkeeree and Youppadee Intasorn
10.15 - 10.30	COM 2	**A Multi-agent Approach for Semantic Annotation of Source Code Artefact** by Pornpit Wongthongtham, Udsanee Pakdeetrakulwong, Suksawat Sae-Lim, Worachet Uttha, Sutarat Chaonafang, Suphitcha chanrueang, Supakit Nakpomchin, Somkiat Chormuan
10.30 -10.45	COM 3	**Ontology-based Multi-agent Systems: An Overview of Existing Approaches** by Pornpit Wongthongtham, Udsanee Pakdeetrakulwong, Suksawat Sae-Lim, Atisak Chatcharoenporn
10.45 - 11.00	COM 4	**Multi-language Communication Protocol Model Based on Conceptual Spaces and Language Games** by Somjin Juntarajessadakorn, Vatinee Nuipian and Phayung Meesad

MORAKOT 1 (Fl.12) **Session: Computer and Information Technology**		
Session Chair: Dr.Supoj Hengpraprohm, Dr.Kairung Hengpraprohm, Dr.Worachet Uttha, Dr.Pitiphol Pholpabu, Dr.Udsanee Pakdeetrakulwong, Suksawat Sae-lim		
Dec 29th, 2017		
Time	**Code**	**Title**
11.00 - 11.15	COM 5	**Evaluation of Linux I/O Schedulers on SSD for HDFS** by Kritwara Rattanaopas, Sureerat Kaewkeeree, Sarapee Chunkaew and Supawadee Mak-on
11.15 - 11.30	COM 6	**Social Media Framework Incorporating Fuzzy Regression for Affective Design: State-of-the-art, Challenges, and Opportunities** by Pratima Jain, Pornpit Wongthongtham, and Kit Yan Chan
11.30 - 11.45	COM 7	**Service Measurement Tool for Internet Service Provider** by Somkiat Chormuan and Worachet Uttha
11.45 - 12.00	COM 8	**Semantic Web-based Approach for Economic Performance Indicators Based on Global Reporting Initiative (GRI) G4** by Ilham S.Y. Yaldo and Udsanee Pakdeetrakulwong

MORAKOT 2 (FI. 12) **Session: Buddhism for Thailand 4.0**		
Session Chair: Assist.Prof.Dr.Warakorn Poonswat, Dr.Puvanart Keoplang, Dr. Nathacha Thamthanapaisan, Mr.Yanapat Yodkaew		
Dec 28th, 2017		
Time	**Code**	**Title**
13.00 – 14.00	**Keynote Speaker**	**Mr. Charles G. Lief** **Topic: "Buddhism: Learning for Transform yourself, Transform the World"**
14.00 – 14.15	BUD 1	**Buddhism 4.0 for the "Spiritual but Not Religious"** by Thomas A.C Weiser
14.15 - 14.30	BUD 2	**Thai Buddhism 4.0: Transforming Buddhist Practices In-Depth, Inward, and Beyond** by Christie Yu-Ling Chang
14.30 – 14.45	BUD 3	**Child Growth and Development** by Chutarat Sathirapanya
14.45 - 15.00	BUD 4	**A Short History of Jin Nikāya in Thailand: Sociopolitical Perspective** by Bbhikṣu Shih Yuande
15.00 - 15.15	BUD 5	**Parents' Hope for their Children with Special Needs** by Sermsap Vorapanya and Apison Parchanavon
15.15 - 15.30	BUD 6	**Buddhist Approaches on Welfare for a Nation** by Ven. Pandava
15.30 - 15.45	BUD 7	**Theravada Buddhism and Tea in Blang Minority Ethnic Identification: A Case Study of Laoman'e Hill Village in Xishuangbanna, Yunnan** by Ven. Wen'en Yan
15.45 - 16.00	BUD 8	**Is the Mind NOT the Brain? What is the Comparison of Mental Processing and the Computer?** by Chaiyen Ratnavijarn
16.00 - 16.15	BUD 9	**The Buddhist Effective Method for Solutions of Kāmarāga in the Modern Societies** by Ven. Dharma Rakshit Bhikkhu
16.15 - 16.30	BUD 10	**Sageliness Within and Kingliness Without: A Three-Dimensional Mandala and an Emperor's Mindfulness Practice** by Jingyu Huang

16.30 – 16.45	BUD 11	**The Relationship between the 12 National Core Values Behaviors and Ethical Behaviors of Students in Nakhon Pathom Rajabhat University** by Praepat Yodkaew
16.45 - 17.00	BUD 12	**Buddhist CITTA Transformative Technology the Solution for the Unsustainble Development** by Chaiyen Ratnavijarn
17.00 - 17.15	BUD 13	**Happiness: Gimmick Buddhism for Thailand 4.0** by Natthacha Thamthanapaisarn

MORAKOT 2 (Fl.12) **Session: Electrical Engineering and Technology**		
Session Chair: Assoc.Prof.Dr.Piya Kovintavewat and Assoc.Prof.Dr.Santi Koonkarnkhai		
Dec 29th, 2017		
Time	**Code**	Title
09.00 - 09.15	EET 1	**Effect of Weather Change on Hydrogen Production via Electrolysis Powered by Photovoltaic System** by Rungchai Kaensako, Nawadee Srisiriwat and Anuchart Srisiriwat
09.15 - 09.30	EET 2	**Power Loss Comparison of Pulse Width Modulation Techniques Based on Space Vector Method by MATLAB/SIMULINK** by Kanitphan Boonsomchuae and Satean Tunyasrirut
09.30 - 09.45	EET 3	**Application of Artificial Neural Networks for the Wind Power Prediction in Nakhon Pathom** by Bopit Chainok
09.45 - 10.00	EET 4	**Design of Decentralized PID Controller with Root Locus Method based on Inverted Decoupling for TITO System** by Chananchai Wutthithanyawat, and Santi Wangnipparnto
10.00 - 10.15	EET 5	**Investigating Electric Vehicle (EV) Charging Station Locations for Agartala, India** by Somudeep Bhattacharjee Saima Batool, hampa Nandi and Udsanee Pakdeetrakulwong

PAITOON (Fl.33) **Session: Humanities and Social Sciences**		
Session Chair: Prof.Dr.Budsaba Kanoksilapatham, Assoc.Prof.Sita Yiemkuntttavorn, Assoc.Prof.Singhanat Nomnian, Asst.Prof.Dr.Pragasit Sitthitikul, Asst.Prof.Dr.Usa Noytim, Asst.Prof.Dr.Kamonpan Boonkit, Asst.Prof.Dr.Piyaporn Tunneekul, Ms.Duangjit Sukhapabsuk, Mr.Surachai Yusuk, Mr.Nupong Phusri		
Dec 28th, 2017		
Time	**Code**	Title
13.00 - 13.15	HUM 1	**The Impact of Perceived Transformational Leadership on Perceived Employee Creativity in Orchid Farming in Nakhon Pathom Province** by Panyindee Janjirapon, Hirannapat Minmantra and Thong-oon Woraya
13.15 - 13.30	HUM 2	**Determinants of Happiness in a Multicultural Setting: A Case of Chana district, Songkhla province, Thailand** by Nurainee Jangoe, Sarawuth Chesoh and Apiradee Lim
13.30 - 13.45	HUM 3	**The Comparative Study of Logistics Cost Structure for Farmers' Siamese Fighting Fish** by Hirannapat Minmantra, Sukcharoenpong Sompon and Ditsathaporncharoen Santi
13.45 - 14.00	HUM 4	**A study on the Psycho-Social Disturbance of Children who are exposed to Domestic Violence in South Korea** by Misook Cho

PAITOON (Fl.33)
Session: Humanities and Social Sciences

Session Chair: Prof.Dr.Budsaba Kanoksilapatham, Assoc.Prof.Sita Yiemkuntttavorn, Assoc.Prof.Singhanat Nomnian, Asst.Prof.Dr.Pragasit Sitthitikul, Asst.Prof.Dr.Usa Noytim, Asst.Prof.Dr.Kamonpan Boonkit, Asst.Prof.Dr.Piyaporn Tunneekul, Ms.Duangjit Sukhapabsuk, Mr.Surachai Yusuk, Mr.Nupong Phusri

Dec 28th, 2017

Time	Code	Title
14.00 - 14.15	HUM 5	**Developing Intrinsic Reward System in Digital Era of Chandrakasem Rajabhat University: Discursive Practice to Social Reproduction** by Chonticha Tippratum
14.15 - 14.30	HUM 6	**Lifestyles of Gen Y Men Consumer that Influenced the Loyalty of Fashion Products in Thailand** by Thatchavong Julsawat, Sutasinee Siripokapiroma
14.30 - 14.45	HUM 7	**The Effectiveness of Public Policy Implementation for the Repayment Management Model to Student Loans Fund** by Opad Meechao

PAITOON (Fl.33)
Session: Humanities and Social Sciences

Session Chair: Prof.Dr.Budsaba Kanoksilapatham, Assoc.Prof.Sita Yiemkuntttavorn, Assoc.Prof.Singhanat Nomnian, Asst.Prof.Dr.Pragasit Sitthitikul, Asst.Prof.Dr.Usa Noytim, Asst.Prof.Dr.Kamonpan Boonkit, Asst.Prof.Dr.Piyaporn Tunneekul, Ms.Duangjit Sukhapabsuk, Mr.Surachai Yusuk, Mr.Nupong Phusri

Dec 29th, 2017

Time	Code	Title
09.00 - 09.15	HUM 8	**Reticent Factors of Thai EFL Students: a Case Study of Undergraduate Students in Faculty of Education, Phuket Rajabhat University** by Thanawan Kongkaw, Salaiya Hankhiew, Pratchaya Chuayjaroen, Sofiya Che-ousen, and Yawahir Dolah
09.15 - 09.30	HUM 9	**Service Areas of Social Studies Program, Faculty of Humanities and Social Sciences, Nakhon Pathom Rajabhat University** by Jittrapon Soontorn
09.30 - 09.45	HUM 10	**Relationships between Accounting Practices and Financial Strengths of SMEs: Reflections from Financial and Accounting Experts** by Supanee Injun
09.45 - 10.00	HUM 11	**The Academic and Vocational Service Model of Institute Vocational Education of Bangkok in Thailand** by Chantana Potikruprasert, Pariyaporn Tungkunanan
10.00 - 10.15	HUM 12	**The Path Analysis of Factors Affecting Decision Making Behavior and Work Behavior of Employees in Large Sub-district Administrative Organization in Udon Thani Province, Thailand** by Khanisara Thanyasunthornsakun, Sawitree Boonmee, Rachata Suansawat and Pariyakron Wunnakeeree
10.15 - 10.30	HUM 13	**Factors Affecting the Organizational Engagement of Employees of the Bank for Agriculture and Agricultural Cooperatives (BAAC), Udon Thani Province** by Rachata Suansawat, KhanisaraThanyasunthornsakun, Sawitree Boonmee and Mathurin Kaewsangon
10.30 -10.45	HUM 14	**The Effects of ZPD Based Scaffolding Techniques on Reading Comprehension of Thai University Students** by Surachai Yusuk

Poster Presentation Program

PETCH PAILIN ROOM (Fl.11) **Session: Pure and Applied Science**		
Session Chair: Assoc. Prof. Dr. Jakrapong Kaewkhao, Dr. Patarawagee Yasaka and Dr. Kitipun Boon-in		
Dec 29th 2017		
Time	**Code**	**Title**
10.00 - 10.15	SCI 1 P	**Diversity of Culinary Herbs and Ethnobotany in Hlawga Wildlife Park, Yangon City, Republic of the Union of Myanmar** by Peangjai Jianwitchayakul, Soe Soe Aung, Thanda Aye, Mya Zarli, Aye Aye Mu and Zin Mar Myint
	SCI 2 P	**Comparison of Radiation Interaction of Clay and Autoclaved Aerated Concrete Bricks for Radiation Shielding Properties** by Kittipong Siengsanoh, Pruittipol Limkitjaroenporn and Jakrapong Kaewkhao

PETCH PAILIN ROOM (Fl.11) **Session: Medical Health Sciences and Laws**		
Session Chair: Dr. Orapun Metadilogkul, Dr. Prasutr Thavornchaisit and Mr. Pornchai Eiamsettakul		
Dec 28th 2017		
Time	**Code**	**Title**
15.00 - 15.15	MED 1 P	**Stress Relieving of Thai Traditional Medicine Students by using Thai Traditional Medicine** by Pitchayapa Attanoruk, Pitchayapha Inphrom, Jatuporn Panusnothai, Nantiya Manhmay and Sittipong Pornprasit.
	MED 2 P	**Factors Related to Mosquito-Borne Diseases in China-Laos Border Areas: Results from Multiple Correspondence Analysis** by Chao Wu, Hongning Zhou Jun Zhao, Xiaofang Guo, Quan Lv, Hongbin Li, Edward B McNeil and Virasakdi Chongsuvivatwong
	MED 3 P	**Formulation an Analgesic Spray Containing *Cleome viscosa* L. crude Extract** by Peerasa Ariyavechakul, Pilanthana Lertsatitthanakorn, Kongtana Trakarnsanga and Thien Thiraworawong4
	MED 5 P	**Antibacterial Activity of Rafflesia kerrii Meijer Extracts against Hospital Isolates of Methicillin-Resistant Staphylococcus Aureus (MRSA)** by Pitsanee Wichantuk, Pornphan Diraphat, Fuangfa Utrarachkij, Marut Tangwattanachuleeporn and Chakrit Hirunpetcharat
	MED 6 P	**Effect of Methotrexate on Interleukin-36γ serum levels in psoriasis: A pilot study** by Attawut Limsaengrat, Jitlada Meephansan and Achara Phumyen
	MED 7 P	**Stability Study of Prasaplai Capsule used for Clinical Efficacy Study in Postpartum Rehabilitation in Bang Pa In Hospital, Phra Nakhon Si Ayutthaya** by Chaisak Thanonkaew1, Lertchai Jitsaeree, Suwanna Pahusachalak, Suthima Sukreeket, Jiraporn Muangpran, Supaporn Pornpinatepong, Bunleu Sungthong and Pilanthana Lertsatitthanakorn

PETCH PAILIN ROOM (FI. 11) **Session: Nursing**		
Session Chair: Assist. Prof. Dr. Hathaichanok Buajaroen, Assist. Prof. Dr.Pimsupa Shandanasotthi, Mrs. Natthaya Cherngchalard Chooprom, Asst.Prof.Dr. Theeranan Wannasiri, Ms.Laarnie D. Esteban, Ms.Labmie Lynnette Dematoque, Mrs. Ruffel Joy C. Manalo		
Dec 28th, 2017		
Time	**Code**	**Title**
15.00 – 15.15	NUR 1 P	**Health Literacy of Cambodian Transnational Workers in Nakhon Ratchasima Province via Social Media Online** by Dussadee Triyawong, Chatthong Jarupisitpaiboon, Nattineeporn Chantaranothai, Narumon Premmasawat and Areerat Pesungnoen
	NUR 2 P	**The Effect of Empowerment Program on Self-Care Behaviour of Elderly People with Hypertension at Nakhon Ratchasima Province, Thailand** by Kornkan Phuengnam RN, M.N.S and Watcharee Sangsai RN, M.N.S
15.00 – 15.15	NUR 3 P	**Effects of Education to prevent Non-Communicable Diseases by using KORAT Song on the Knowledge and Self-Care Behaviors among Adults** by Kanyapat Niyomsat, Chatchai Daengdi ,Kornkanok Kabkhoontod, Kawinna Kaeophimai, Jugkapan Wanpugdee, Jutamas Saichan, Supaporn Chobsa-ard and Supawan Pongpanna
	NUR 4 P	**The Humanized Care Behaviors among Nursing Students Studying at Boromarajonani Nursing College, Thailand** by Thassanee Thipsungnoen, and Praphaphorn Suemram

PETCH PAILIN ROOM (Fl.11) **Session: Humanities and Social Sciences**		
Session Chair: Assist. Prof. Dr. Budsaba Kanoksilapatham, Assoc. Prof Dr. Sita Yiemkuntitavorn, Assoc. Prof. Dr. Singhanat Nomnian, Assist. Prof. Dr. Pragasit Sitthitikul, Assist. Prof. Dr. Usa Noytim, Assist. Prof. Dr. Kamonpan Boonkit, Assist. Prof. Dr. Piyaporn Tunneekul, Ms. Duangjit Sukhapabsuk, Mr. Surachai Yusuk and Mr. Nupong Phusri		
Dec 28th 2017		
Time	**Code**	**Title**
15.00 - 15.15	HUM 1 P	**Work Motivation of Myanmar Workers in the Food Processing Factory: Case Study of Kasemchai Farm Group Co., Ltd.** by Bencharat Buengboran, Assanee Piancharoenwong and Wisit Rittiboonchai.
	HUM 2 P	**Factors Affecting Work Efficiency of Employees of Nong Pho Ratchaburi Dairy Co-operative Limited (Under the Royal Patronage)** by Phuthai Saengchan, Darin Photangtham and Wisit Rittiboonchai.
	HUM 3 P	**The philosophy of sufficiency economy to happiness in the work of the staff in Bangkok** by Wisit Rittiboonchai.
	HUM 4 P	**Factors Affecting Employee good organizational Behavior Thai Sugar Industry Co., Ltd.** by Saowaluk Phetpankan, Wisit Rittiboonchai, Surasaek Phonghanyudh and Kaewta Poopatanapong.

PETCH PAILIN ROOM (Fl.11) **Session: Humanities and Social Sciences**		
Session Chair: Assist. Prof. Dr. Budsaba Kanoksilapatham, Assoc. Prof Dr. Sita Yiemkuntitavorn, Assoc. Prof. Dr. Singhanat Nomnian, Assist. Prof. Dr. Pragasit Sitthitikul, Assist. Prof. Dr. Usa Noytim, Assist. Prof. Dr. Kamonpan Boonkit, Assist. Prof. Dr. Piyaporn Tunneekul, Ms. Duangjit Sukhapabsuk, Mr. Surachai Yusuk and Mr. Nupong Phusri		
Dec 28th 2017		
Time	**Code**	**Title**
15.00 - 15.15	HUM 5 P	**Human Service System of Issues & Tasks with South Korea: Effect on Quality of Human Life** by Misook Cho
	HUM 6 P	**A Study on the Behavior Problem of Poor Grandparenting Children in South Korea** by Misook Cho.
	HUM 7 P	**An Exploration of Science Student Teachers' Understanding of STEM Approach and Teaching Practices During Professional Teaching Practices** by Pinthudit Klinkajorn, Mattanee Siengsanoh and Kittipong Siengsanoh.
	HUM 8 P	**The Marketing Mix Factors affecting Selection Credit of the Government Savings Bank Kui Buri, Prachuap Khiri Khan Province** by Matinee Sudthuam, Hansa Klaychanpong and Wisit Rittiboonchai.
	HUM 9 P	**Community Welfare: Welfare with a Cultural Background** by Jirachaya Jeawkok, Wanchai Dhammasaccakarn, Kasetchai Laeheem and Preedee Shoteshong.

PETCH PAILIN ROOM (Fl.11) **Session: Water Engineering, Groundwater Hydrology and Environmental Science**		
Session Chair: Assoc. Prof. Dr. Tuantan Kitpaisalsakul , Assist. Prof. Dr. Phatcharasak Arlai, Assoc. Prof. Dr. Sayam Aroonsrimorakot		
Dec 28th 2017		
Time	**Code**	**Title**
15.00 – 15.15	WRE 1 P	**Development of Indicators for the Assessment of Social, Economic and Environmental Impacts of Clean Development Mechanism (CDM) Projects in Pakistan with a Case Analysis of Pakistan's First Approved CDM Project** by Butt, Ayesha Aftab

PETCH PAILIN ROOM (Fl.11) **Session: The Interdisciplinary Research**		
Session Chair: Prof. Dr. med. Yongyudh Vajaradul, Dr. Waret Veerasai, Assoc. Prof. Dr. Wongchan Wongkaew, and Assist. Prof. Dr. Lertsiri Bovornkitti		
Dec 28th 2017		
Time	**Code**	**Title**
15.00 – 15.15	ITR 1 P	**Utilization of Pretreated Peanut Hulls for The Optimized Bioproduction of Cellulase by Pycnoporus Sanguineous** by Methus Chuwech, Nuansri Rakariyatham, Kawin Supawittayayothin, Niphorada Yawirat,Nopakarn Chandet , Jidapha Tinoi and Phakhawat Jaisin

Table of Contents

Plenary Abstracts

Flood Disasters and their Mitigation in the Wake of Climate Change with a Focus on Thailand Case Studies

M. Koch[1,*]

[1]Department of Geotechnology and Geohydraulics, University of Kassel, Germany

Abstract

Floods belong to the class of so-called hydrological disasters that include, in addition, landslides and extreme ocean waves. As such they are largely triggered by extreme meteorological/climatic events which includes storms and tropical cyclones, and on the other extreme, droughts and extreme temperatures. Because of these different possible origins of floods, it is of no surprise that recent climate change across the world has - and may have more so in the future - noticeable effects on the occurrence of floods, however, depending much on the locality of the region. Notwithstanding of numerous climate research studies carried out over recent years which unequivocally predict large temperature increase across the globe over the 21th century, the alterations of regional rainfall pattern to a more extreme behavior, which eventually would lead to more and stronger flood events, is less clear and continues to be an ongoing topic of discussion and research. Thus, although increasing temperatures are likely to lead to increasing precipitation, the effects on extreme storms are less clear. The situation is more straightforward for low-lying coastal areas, as rising sea levels in the wake of climate change will irrevocably lead to higher flood stages there.

Specifically, the year 2017, now coming to an end, has seen some huge flood disasters in various regions of the world, i.e. in Texas and Florida, both triggered by hurricanes (Harvey and Irma, respectively), South Asia (India and Bangladesh) and Southeast Asia (Malaysia, Thailand) , triggered here by extended seasonal Monsum precipitation which turned out to be stronger than normal. Indeed, as far as Southeast Asia, i.e. Thailand, is concerned, flood events appear to have been more numerous over the last few years. Again, whether this is a another manifestation of climate change in the region, or just a consequence of some intermittent multi-annual or decadal variability of well-known pacific atmospheric/oceanic indices, i.e. ENSO / El Nino-SST, which are known to strongly affect the seasonal weather pattern in the circum-pacific coastal regions, is still a matter of debate. In fact, studies of the author show indeed strong correlative seasonally delayed tele-connections between ENSO / El Nino indices and Thailand's local weather pattern.

As large flood disasters cause huge economic losses, let alone losses of lives, - and weather extremes are impossible to be stopped or controlled -, flood mitigation or flood control becomes an urgent necessary for all stakeholders involved. In the short term, early warning systems including improved weather- and/or tropical storm track prediction, may be helpful to, at least, save human damages from subsequent flood events. However, for a successful long-term flood mitigation, an integrated flood management or control is necessary, which includes the preparation of flood-prone areal maps through observations or hydraulic modeling, reservation of flood diversion areas, construction of levees, and in central Thailand river basins, appropriate water management in the upstream reservoir/dams. Last, but not to the least, overland runoff processes should be slowed down by environmentally friendly land-use management, such as reforestation of denuded lands, or at least the cease of deforestation activities, as they have been ongoing in many natural scenic landscapes and national parks of Thailand over the last decades.

Keywords: Floods, climate change, extreme events, storms, hemispheric atmospheric/ocean indices, ENSO, flood mitigation, hydraulic modeling

* Corresponding author; e-mail: kochm@uni-kassel.de

Session of Sustainable Development Goals

Peaceful and Nonviolent Societies as a Sustainable Development Goal 16

Ingrida Grigaitytė[1,*] and Hasan Habes[1]

[1]Peace, Mediation & Conflict Research, Faculty of Education and Welfare Studies,
Åbo Akademi University, Strangatan 2, 65100, Vaasa, Finland

Abstract

In the light of the UN Sustainable Development Goals, there is a growing need for approaches, tools, policies and practical solutions for peaceful, just and strong societies in today's multicultural community. This paper describes a model of a peaceful society within the Närpes community in Finland by employing ethnographic participant observations and semi-structured interviews. In 2016, the ethnographic data were gathered during different occasions via the acquaintance networks and seven interviews were conducted with the experts of the areas of interest for the purpose of this research. The Närpes Model comprehends five elements; (1) the ethnic identities of the Närpes inhabitants, (2) the values of the Närpes society, (3) Närpesians' relation to the foreign cultures, (4) socioeconomic equality and stability, and (5) tight interaction among different sectors and institutions. This holistic Närpes approach reveals that promotion of peace and justice along with apprise of peoples' identities and values, positive interaction among different ethnic groups, and creation of effective and accountable institutions can make the world to be a better place. It is possible to have a peaceful and nonviolent society as in the example of Närpes model. Although Närpes is a small-scale community, the approach to achieve peace, justice and strong institution can be applied to broader societies to fulfill the challenges of extremely multicultural communities. Thus, the SDG 16 is one of the global goals, which is possible to reach worldwide by 2030, if the action is taken now.

Keywords: Peaceful Societies, Nonviolent Societies, Närpes model, The UN Sustainable Development Goals.

1. Introduction

The official end of the Millennium Development Goals in 2015 brings the world to the new era of the Sustainable Development Goals (SDGs) [1]. With the SDGs, the implementation of the goals become universal since the goals focus not only on the developing countries, but also on the developed countries to take action to provide a sustainable planet for the future generations. In order to end poverty, protect the planet, and assure people living in peace and prosperity, these 17 goals are adopted by the countries having priorities on climate change, economic inequality, sustainable consumptions, innovations, and peace and justice [2].

Although all 17 goals have different aims and targets, they are all interconnected. In order to reach the targets set out in the SDGs, the fundamental issue is to work on the goals collectively and interdependently. In this respect, not only governments but also private sectors, civil societies and citizens need to work together in order to achieve the SDGs.

Turning plans into actions and promises into reality as foreseen in the SDGs is not something that impossible to achieve, if all nations work together collaboratively. Authors of this paper focus on the SDG 16, which is promoting peace and justice with building effective and transparent institutions. This aims to create peaceful, nonviolent and sustainable societies. In this regard, the unique case of Närpes, an exceptionally peaceful community on the west coast of Finland, can be seen as an example of how to implement these goals in practice. For that reason, Närpes as a model of peaceful society that is achieving Goal 16 in the SDGs will be discussed in this paper

Närpes is a small Swedish-speaking town in South Ostrobothnia region that became well-known for its peacefulness, multiculturalism, successful integration and cohesion among the inhabitants, and very low levels of violence and crime. In 2016, approximately thirty-five different nationalities (11% of all population), with over fifteen spoken languages, reside within a community of 9387 inhabitants [3]. However, foreign population is not exactly presented in the statistical database. First, only those persons that have an A-status for staying in the country are officially registered. Second, people that acquired Finnish passports are totaled as Finnish nationals [4].

* Corresponding author; e-mail: igrigait@abo.fi

Table 1: Närpes Population Based on the Language Background

	Total	Finnish speakers	Swedish speakers	Other languages
	9387	**523**	**7 747**	**1 117**
Men	**4 750**	**210**	**3 951**	**589**
Women	**4 637**	**313**	**3 796**	**528**

Beside the metropolitan cities, Närpes was the first community that received refugees in Finland [5]. In 1988, the first Vietnamese came; in 1992, the first Bosnians arrived, in 2004 followed by labor immigration from the other Balkan countries, Eastern Europe, Central America, and in 2014 refugees from Sudan [6]. During the past year, fluctuating number of the asylum seekers and refugees from mainly Middle East reside in Närpes [7],[8].

Based on the collected statistics from the year 2010 to 2013, out of the 304 municipalities, Närpes was ranked the 11th safest place to live in Finland [9]. In 1995, the only case of homicide since 1980 took place. It was an incident caused due to the jealousy and drinking problems when a husband murdered his wife. Between the year 2000 and 2015 July, only 23 aggravated assaults were recorded [10]. Närpesians themselves feel safe in this community and are not afraid to walk in the streets in the dark. Local people say that it is quite and safe in Närpes; "our children can go to and from school unaccompanied and play safely in the parks and close by the forests". At the moment, Närpes municipality does not have any police station. For couple of years, a police establishment in Närpes was operating twice a week as a service station, which was totally closed in the beginning of 2016 [11],[12]. In addition, recent research that looked at a drug use for the depression, need for child protection, allowances given due to the sickness, and crimes influenced by alcohol or drugs found out that out of 317 municipalities, Närpes is the 5th happiest municipality in Finland [13].

2. Materials and Method

In order to get the insights on the social relations between the locals and immigrants of Närpes as well as to understand the work of institutions, two complementary methodologies were employed: ethnographic participant observations and semi-structured interviews.

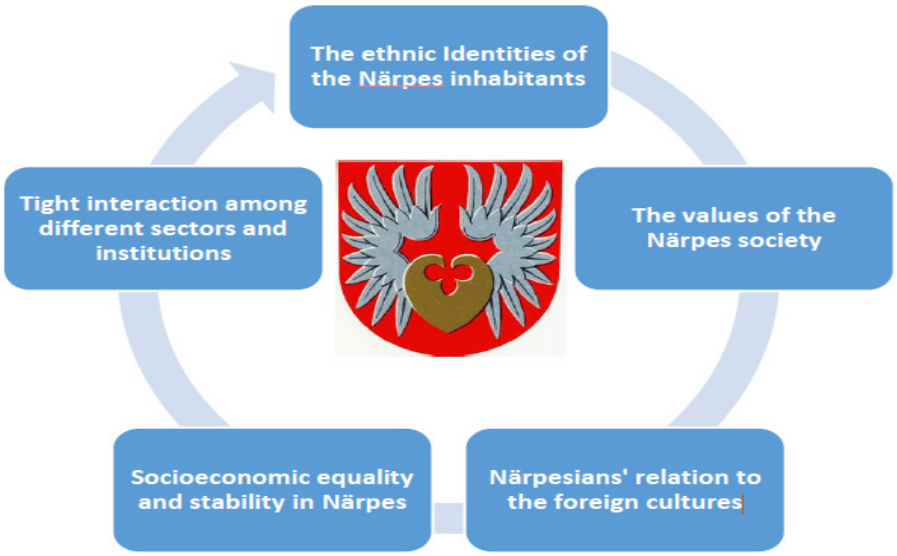
Ethnographic participant observations have been conducted since 2016. The data related to Närpes culture, its peacefulness, and Närpesians' nonviolent behavior have been gathered andrecorded, by talking with people on daily basis, and by going on the visits and attending social gatherings. Thus, it has been a possibility to conduct ethnographic observations on different occasions via the acquaintance networks. These observations were recorded on a paper in a notebook providing a commentary on the happening, interactions, and behavior of the observed people.

In 2016, semi-structured interviews were carried out with seven participants. These participants were selected via acquaintance networks based on their knowledge and familiarity of interest areas of a researcher; a 56-year-old lady that works as an integration coordinator of a Welcome office, a 74-year-old chairwoman of Närpesnejdens fredsförening [Närpes Peace Civil Society], a 37-year-old chairwoman of Ljusets kvinnor [Women of Light CSO], a 77-year-old man that worked as a primary school teacher with the first Vietnamese and Bosnian refugee kids, a 33-year-old service lady at the local employment office, a 46-year-old language and culture teacher at the local Adult Education Center, and a 27-year-old lady working as a Islam religion teacher at the local high school. Emerging themes for the interviews focused on the social cohesion, daily lives, integration processes within the community, people's behavior, and culture of a Närpes society. Prior to the interview session, interviewees were informed about the topics of the interview, rights of an interviewee, usage of the material, practical issues related to the interview session and so forth. One interview took place at the respondent's workplace and the remaining five at the respondents' homes. Interviews were conducted in Swedish and approximately took one hour. The interviews were audio recorded, indexed by general topic, and transcribed into electronic form using a word processor.

3. Results and Discussion

The Närpes model comprehends the five following components: (1) the ethnic identities of the Närpes inhabitants, (2) the values of the Närpes society, (3) Närpesians' relation to the foreign cultures, (4) socioeconomic equality and stability, and (5) tight interaction among different sectors and institutions.

Figure 1: Närpes Model



The ethnic identities of the Närpes inhabitants

In Finland, Swedish community faces culture survival challenges but yet people of Närpes are proud of their strong unique culture deriving from the local traditions and traditions brought up by the immigrants. Närpesians themselves are not true Finns or Swedes and they cannot either be purely classified under the Swedish-speaking Finn culture either due to their strong Swedish dialect or due to a great mix of cultures residing with the community.

Närpesians are a minority within the minority Swedish population among the major Finnish population. They know how it feels to be an ethnic minority within the major culture and so it is relatively easy to sympathise with the town foreigners. Especially, the younger Närpesian generation are more open to the diversity and has more willingness to create cross-cutting ties among the locals and foreigners. They tend to be less religious than their parents, they have received degrees of higher education, they have experienced working or studying abroad, and their background is a rich blend of various cultures. It is a growing phenomenon that while growing up, a child speaks three or four languages as well as encounters traditions and behavior patterns of several ethnic groups. For instance, a mother speaks Swedish to a child, a father speaks Dutch, between each other parents speak English, and a child is attending Finnish speaking school. This creation of multicultural identities have been present in Närpes for several decades, and it is one of the factors contributing to Närpesians' pragmatic openness towards the other ethnic groups.

The values of the Närpes society

The old Närpesian values owe to both, Swedish and Finnish cultures. The main characteristic of the Finns is their sameness; they do not like to stand out from the crowd and they mode of dress is very similar to everyone else's. Finns do not celebrate their achievements since it would be seen as bragging. They are naturally reserved, especially towards the chatty foreigners, and are likely to seem very formal and aloof. Meanwhile Swedes, are open-minded, social, and chatty in contrast to the Finns. Swedes value personal equality, they are liberal even though they are moderate and do live their cultural lives based on traditions, stability, and customs. In both cultures, there is a relative absence of social barriers – no class distinctions in education and everyday social life that minimize the gaps between the racial, social, or class superiority. Little town of Närpes, when compared to Scandinavia, has long and extensive experience of immigration, which brought up an equal society based on diversity. One of the local teachers says that "we all can be equal even though we all cannot be the same". Närpesians value people and the strongest values noticed within their community are honesty, equality,

humbleness, modesty, privacy, calmness, directness, and integrity. Also, it is very important to obey the rules, which is also their moral and ethical code. Immigrants of Närpes see locals as civilized, calm, independent, autonomous, and silent people. But if they overcome embarrassment speaking out loudly in public, then they say what they mean and mean what they say. Immigrant people of the Närpes community often say that Finns can be shy as well as suspicious towards the strangers but they are very honest and loyal once you make friends with them.

Närpesians'relation to the foreign cultures

Närpes people's relation to the foreign culture has much to do with about a century long embedded tradition of emigration and immigration. The first migration wave to the US took place in the beginning of the 20th century and during the 1960s and 1970s people migrated for the employment and education opportunities to Sweden, other Nordic countries, and bilingual towns in Finland. When it comes to immigration to the town of Närpes, it has a 29-year-long tradition of integration. In 1988, Närpes was the first Swedish-speaking municipality in Finland that received quota refugees from Vietnam followed by the Balkan countries. Later on, employment based migration from the Baltic countries, Russia, Ukraine, Belarus, Poland, Ecuador, and the Netherlands, just to name view, took place. Thus, marriage based migration brought to town people with Thai, Moroccan, or Slavic backgrounds. At the moment, Närpes municipality is offering resident places to the current quota refugees and asylum seekers. This exchange of interaction between locals and foreigners keeps on continuing. Today, it is relevantly easy for the immigrants to come to Närpes since they already have family members or friends who explored the town before them; they already know what to expect and thus, a new-comer does not have to feel alone or lonely since there are others who have similar cultural background and reasons for immigrating. Occasionally, locals and foreigners might be xenophobic, however, this does not last long since within the small scale community as Närpes is, people get to know each other fast, they interact daily, and so differences start to be seen as advantages for shaping a multicultural community.

Socioeconomic equality and stability in Närpes

Finns and people from the Ostrobothnia region are known as hardworking and have deep-rooted entrepreneurial skills. This is shown in the high levels of work sufficiency and low levels of unemployment (4% unemployment), lowest in the country (13% in all Finland) [14].

In Närpes, economic situation started to progress during the past decades. During the middle of the twentieth century a large proportion of the working age Närpesians emigrated leading to unbalanced age structure. In the beginning of the twentieth first century, there was a big need for a labor force, therefore, immigration from abroad successfully met labor demands. At the moment, labor immigration is more intense than it has been ten years ago and this balances widespread emigration, especially among the youth, due to which labor needs within the sectors of agriculture, healthcare, and metal industries had emerged. These labor immigrants become employed taxpayers that occupy vacant and create new working places as well as they inspire and develop entrepreneurship. Since labor force has increased, entrepreneurs were also able to expand their businesses. Small family-based firms became well-developed companies.

Education, which is a big part of successful integration planning, also gave opportunity to town foreigners to become well-known entrepreneurs, politicians, restaurant owners, photographers, academics, and respected people not only in Närpes but also elsewhere. Immigrants agree that steady income and education is an important factor for their well-being, life quality as well as it allows them to plan their own economy and the future. This financial security also allows raising children that has opportunities to free education, healthcare, and a future in Närpes. Närpes municipality pays a great attention to education for both, adults and children. Immigrant adults can participate in language and culture courses and for immigrant children there are arranged lecturing in native language that could strengthen multicultural identity and create functional bilingualism. This positive inflow of international migration that balanced age structure allowed Närpes to become a transparent society that has transformed from emigration to immigration rural countryside.

Tight interaction among different sectors and institutions

People from Närpes region are known to be as self-assertive and noblest. Day to day life affairs are handled in a tight, smooth, and client oriented manner through dialogue and communication. Within the small scale community such Närpes, errands are fixed based on a close communication between the community inhabitants, immigrants, companies, authorities, and the third sector. For instance, employers actively facilitate integration, employment office or social care services relatively easily can direct people to acquire suitable housing or schooling. People are usually aware of happenings within the community and they are quick to react to any potential problems, issues, and needs. It is relatively easy to communicate and solve problems in a small town with people you know, and so a positive circle of successful actions that manage diversity are created. A

work of a third sector, which is various CSOs, associations, non-profit organizations, and clubs means a lot to Närpes community and their identity. In Närpes, there are 108 registered associations and their networks are connected to traditions, native regions, cultural manifestations and language, as well as they provide a great number of meeting places, which is especially important to the minority. The life of a third sector also has an immense meaning in creating more coherent and interdependent society; it keeps people of different ages and cultural backgrounds active and interactive and it improves relationships and communication within and among Närpes inhabitants.

4. Conclusion

There are many challenges and threats in achieving the targeted UN Global Goals worldwide. However, in the light of our case study, the Närpes model exhibits possibilities for peaceful, inclusive, and nonviolent societies in today's diverse world. This paper presents a holistic example, Närpes model, which is a successful approach to implement the SDG 16 within the small-scale Swedish community in the Finnish context. In this particular case, there are five components, which complement each other to create peaceful, inclusive, and harmonic environment for Närpes inhabitants. If this model to be applied in Finland or elsewhere in the world, the following should be considered; (1) there should be a support for creation of multicultural identities in order to have a prejudice free generation; (2) the values of Närpes inhabitants are welcoming, and so long there is a mutual respect in the society, there can be a presence of positive circles of interactions; (3) exposure to the foreign cultures through migration in the forms of labor, education, or marriage allow people to relate and understand the conditions of others; (4) providing free education and equal working opportunities for all, allow people feel secure to have a positive future; (5) close communication and cooperation within different sectors and institutions allow constructive dialogue creation among the inhabitants to keep them interdependent and solve their daily concerns peacefully. This Närpes model can be used as an example to form more peaceful, inclusive and violence-free social structures within not only the small-scale communities, but also in broader parts of the world.

References

[1] United Nation. Sustainable Development Goals [Internet]. [12 Aug 2017]. Available from: http://www.un.org/sustainabledevelopment/sustainable-development-goals/
[2] United Nation Development Program. Sustainable Development Goals [Internet]. [15 Aug 2017]. Available from: http://www.undp.org/content/undp/en/home/sustainable-development-goals.html
[3] Tilastokeskus . Befolkning 31.12. efter Landskap, Bakgrundsland, Härkomst, År, Kön och Ålder. [23 May 2016]. Available from: http://pxnet2.stat.fi/PXWeb/pxweb/sv/StatFin/StatFin__vrm__vaerak/055_vaerak_tau_124.px/table/tableViewLayout1/?rxid=611ac405-5474-4704-b002-4155dea455cc
[4] Poliisiammattikorkeakoulu. Tutkimus ja kehittäminen [Internet]. [10 Feb 2016]. Avaiable from: http://www.polamk.fi/tki
[5] Granholm, P. (2009). Rätt invandrare till rätt plats - det närpesiska receptet för god integration. [Report]. Ålands fredsinstitut, Finland; 2009. Available from: http://www.peace.ax/images/stories/pdf/Det_nrpesiska_receptet_fr_god_integration.pdf
[6] Mattila, M., & Björklund K. Tomaatteja, teollisuutta ja monikulttuurisuutta, Närpiön malli maahanmuuttajien kotouttamisessa. Turku, Finland: Painosalama; 2013.
[7] Migri. Maahanmuuttovirasto [Internet]. [2 Feb 2016]. Available from: http://www.migri.fi/tietoa_virastosta/tilastot
[8] Söderman, M. Nya och gamla invånare möts på café. Syd-Österbotten [Newspaper], [19 Sep 2015]. Available from: http://www.sydin.fi/
[9] Syd-Österbotten. Syd-Österbotten [Newspaper].[14 Mar 2014]. Available from: http://www.sydin.fi/
[10] Kriminologian ja oikeuspolitiikan instituutti. Tutkimus [Internet]. [14 Mar 2015]. Available from: https://www.helsinki.fi/fi/kriminologian-ja-oikeuspolitiikan-instituutti
[11] Nissen, D. Polisen upphör med servicen i Närpes. Syd-Österbotten [Newspaper]. [12 Jan 2016]. Available from http://www.sydin.fi/
[12] Poliisi. Polisinrättningen i Österbotten [Internet]. [9 Feb 2016]. Available from: http://www.poliisi.fi/sv/osterbotten
[13] Tilastokeskus. Tilastokeskus [Internet]. [17 Mar 2015]. Available from: http://www.stat.fi/org/ index.html
[14] Närings-, trafik- och miljöcentralen. Österbotten: sysselsättningsöversikt^[Internet]. [25 Apr2016]. Available from: http://www.ely-keskus.fi/documents/10191/57761/ELY+POH+Ty%C3%B6llisyyskatsaus

+2016_04_sv.pdf/30631184-bb7d-4169-9f30-01dbd06e61c7 maahanmuuttajien kotouttamisessa. Turku, Finland: Painosalama; 2013.

UNESCO Global Geoparks : A New Management Tools for Sustainable Development and Satun Aspiring UNESCO Global Geopark

Pakkaporn Singhwachiraworakul[1,*], Pratueng Jintasakul[2], Paul Grote[2], Narongrit Thungprue[3]

[1]Faculty of Business Administration, Vongchavalitkul University, Nakhon Ratchasima, 30000, Thailand
[2]Northeastern Research Institute of Petrified Wood and Mineral Resources, Nakhon Ratchasima Rajabhat University, Nakhon Ratchasima, 30000, Thailand
[3]Satun Apiring UNESCO Global Geopark, Satun Province, 91120, Thailand

Abstract

UNESCO Global Geopark model is a new management tool for communities to manage heritages effectively and sustainably. It is one of the best practices on sustainable development regarding to protect and promote international value on geological sites. It aims to empower local communities to balance and raise awareness on how to use their heritages sustainably for the next generation. It is best management tools for local administrative organization to lead by example and manage the area from the bottom up. Instilling the locals to care and share their heritages through public education. 'Geo' part of Geopark recognized as everything that mother earth and our forefather have given us including geology, biodiversity, history, cultural heritages, intangible assets such as custom, belief, myths, and traditions. Geopark has been recognized by UNESCO since 2015 after 24 years of establishment. It is a part of International Geoscience and Geopark program (IGGP) as a new tools for balancing between the conservation of natural heritage, education, infrastructures and sustainable development of socio-economy. In 2017, there are 127 UNESCO Global Geoparks from 35 countries worldwide. UNESCO Global Geoparks support 8 Sustainable Development Goals of the United Nations 2030 Agenda for Sustainable Development especially for people, and planet. Thailand started the project on geopark since 2013 by learning from the Statutes and Operational Guidelines of the UNESCO Global Geopark and international experts. Satun Geopark is the 1st National Geopark with approved and nominated by Thailand's cabinet to apply for UNESCO Global Geopark through Thai National Commission for UNESCO since 2016. It located in Southern Thailand. It has strongly supported and collaborated by many stakeholders and strategic partners including local and central organizations. After establishing geopark, new concept of tourism – geotourism has created. Communities get new opportunities such as extra income, job creation, infrastructures, new local products which related to geology and natural resources. The Petra Islands National park has new model of mutually beneficial collaboration with local communities. Local schools have materials and program for students' outdoor learning. They can better understand their place and heritages especially fossils and geology. Nowaday, Satun Aspiring UNESCO Global Geopark has been known as Fossil Land. It is 1 of 18 submitted applications by Member States for the nominations of UNESCO Global Geoparks. Application dossier of Satun Aspiring UNESCO Global Geopark already passed the desktop evaluation, field evaluation and recommendations on applications by the UNESCO Global Geoparks Council since September 2017. The final decision by the Executive Board of UNESCO will be decided during its spring session.

Keywords: Geopark, Sustainable Development, UNESCO Global Geoparks, Satun Geopark, Thailand Geopark

1. Introduction

Geopark is one of the best sustainable development tool for protection and promotion of geological heritages internationally by local communities involvement. Geopark concept was introduced through a global network since 1991. It took 24 years until the International Geoscience and Geoparks Programme (IGGP) was approved as a programme of UNESCO on 17 November 2015. This program comprises the International Geoscience Programme (IGCP) and the UNESCO Global Geoparks aims to promote sites of international geological value on the basis of local sustainable development. In 2017, there are 127 UNESCO Global Geoparks in 35 countries, varying in size from 57 to 12,884 km^2. [1] There are 49 UNESCO Global Geoparks from 6 countries in Asia-Pacific Geoapark Network (APGN) including 35 areas in People Republic of China, 8 areas in Japan, 2 areas in Indonesia, 2 areas in Republic of Korea, 1 area in Vietnam and 1 area in Malaysia.[2]

* Corresponding author; e-mail: pakkaporn_sin@vu.ac.th

The United Nations Educational, Scientific and Cultural Organization (UNESCO) defines UNESCO Global Geoparks as "A single, unified geographical areas where sites and landscapes of international geological significance are managed with a holistic concept of protection, education and sustainable development". [3] Many people confuse about "Geo" which is part of Geopark. It does not mean geology but it came from Greek word. Mc Keever explained that "Geo" refers to 'Gaia'- Earth itself, and everything that Earth has given us and every way it has shaped us including geodiversity, biodiversity, cultural diversity and even the diversity of our intangible heritage are so intimately linked." [4] Komoo and Patzak added some details that "the geopark concept is defined as one of the sustainable development tools that can ensure balance between three main elements, namely : conservation of heritage resources; development of tourism and infrastructure; and enhancement of local participation and socio-economic development".[5]

The Geopark concept was implemented in Thailand by the Department of Mineral Resources since 2014. Satun province accepted geopark as the tool for sustainable development of the area and established the new aspiring geopark, namely Satun Aspiring Geopark. By the strongly supported of many stakeholders and partnerships including ; local communities, travel agencies, restaurants, hotels, local communities enterprises, schools, community college, universities, provincial administrative organization, subdistrict administrative organizations, Satun Office of Natural Resources and Environment, national parks, wildlife sanctuary, Department of Mineral Resources and etc., especially the experts from Global Geoparks Network (GGN), Asia Pacific Geoparks Network (APGN), and European Geoparks Network (EGN). Satun Aspring Geopark was established since 2014 and declared as the 1st Thailand National Geopark. The application dossier for nomination as UNESCO Global Geopark of Satun Aspiring Geopark was approved by Thai cabinet and nominated to Chief of Section, IGGP Secretary of Section on Earth Sciences and Geohazards Risk Reduction via Thai National Commission for UNESCO since 2016. Satun Aspiring UNESCO Global Geopark has international significance on the richest diversity of Paleozoic fossils, international value of the region and well known globally by geologists, paleontologists and researchers. Satun Aspiring UNESCO Global Geopark is one of the best geopark model for Thailand regarding sustainable development with bottom up approach - community based development. which concern the 2030 Agenda for Sustainable Development for all people and sectors based on societal and geographical conditions.

2. Objective

To study the UNESCO Global Geopark concept as the new management tools for sustainable development of Satun Aspiring UNESCO Global Geopark, Thailand.

3. UNESCO Global Geopak

3.1 Geoparks' concept and development

Geopark is the new tool aimed to protect the geological heritages and promote sustainable development. It comes from 2 words, Geo and Park. McKeever explained that "Geo" part of Geopark refers to 'Gaia' – Earth itself, and everything Earth has given us and every way it has shaped us.[1] Many people get confused on geopark. It does not mean the protection and conservation of geological heritages only. It was the concept which concern the protection between socio-economic, cultural development and conservation of the natural environment for the next generation.

John said that "Philosophy behind the Geopark concept was first introduced at the Digne Convention in 1991" , aimed to protect and promote geological heritage and sustainable development through a global network and it was introduced to support national and international endeavours in Earth heritage conservation in 1997.[6,7] After that, the European Geopark Network (EGN) and the Chinese National Geoparks Network (CNGN) were created in 2000 and a year later, in 2001, EGN was placed under the auspices of UNESCO. In 2004, 17 European and 8 Chinese geoparks came together at UNESCO headquarters in Paris to form the Global Geoparks Network (GGN) where geological heritage initiatives contribute to and benefit exchange and cooperation among their membership of a global network.[7] Global Geopark Network members increase year by year until 17 November 2015, the 195 Member States of UNESCO voted to accept the creation of a new label, the new official brand, the International Geoscience and Geoparks Programme (IGGP), during the 38th General Conference in Paris. Geopark is a part of IGGP, which mainly promotes sites of international geological value on the basis of local sustainable development. This expresses governmental recognition of the importance in managing outstanding geological sites and landscapes in a holistic manner.[8]

UNESCO defines UNESCO Global Geoparks as :

> …a single, unified geographical area where sites and landscapes of international geological significance are managed with a holistic concept of protection, education and sustainable development. A UNESCO Global Geopark uses its geological heritage, in connection with all other aspects of the area's natural and cultural heritage, to enhance awareness and understanding of key issues facing society, such as using our earth's resources sustainably, mitigating the effects of climate change and reducing natural disasters-related risks. By raising awareness of the importance of the area's geological heritage in history and society today, UNESCO Global Geoparks give local people a sense of pride in their region and strengthen their identification with the area. The creation of innovative local enterprises, new jobs and high quality training courses is stimulated as new sources of revenue are generated through geotourism, while the geological resources of the area are protected. [9]

UNESCO Global Geoparks aims to empower local communities and give them the opportunity to develop cohesive partnerships with the common goal of promoting the area's significant geological processes, features, periods of time, historical themes linked to geology, or outstanding geological beauty. UNESCO Global Geoparks are established through a bottom-up process involving all relevant local and regional stakeholders and authorities in the area (e.g. land owners, community groups, tourism providers, indigenous people, and local organizations). This process requires firm commitment by the local communities, a strong local multiple partnership with long-term public and political support, and the development of a comprehensive strategy that will meet all of the communities' goals while showcasing and protecting the area's geological heritage.[3]

3.2 UNESCO Global Geopark and the United Nations Sustainable Development Goals

The United Nations inform us on their formal website that "UN member countries adopted a set of goals to end poverty, protect the planet, and ensure prosperity for all as part of a new sustainable development agenda." [10] UN believes that the specific targets of each goal can be achieved over the next 15 years. A set of goals demonstrate the scale and ambition of this new universal Agenda called the United Nations' 2030 Agenda for Sustainable Development which is a plan of action for people, the planet, prosperity, peace and partnership. [11,12] From the UNESCO websites inform that UNESCO Global Geoparks contributing to 8 Sustainable Development Goals including [9]:

Goal 1 : End poverty in all its forms everywhere (especially target 1.5)

Disaster risk reduction is essential about ending poverty and fostering sustainable about development. The bottom-up approach of the UNESCO Global Geoparks reduces the vulnerability of local communities to extreme events and other shocks and disasters through active risk awareness and resilience training.

Goal 4 : Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all (especially target 4.7)

UNESCO Global Geoparks actively educate their local communities and their visitors of all ages. They are outdoor classrooms and incubators for sustainable development, sustainable lifestyles, appreciation of cultural diversity and the promotion of peace.

Goal 5 : Achieve gender equality and empower all women and girls (especially target 5.5)

UNESCO Global Geoparks strongly emphasize the empowerment of women through educational programmes or the development of women's cooperatives which provide an opportunity for women to obtain an additional income in their own area and on their own terms.

Goal 8 : Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all (especially target 8.9)

The promotion of sustainable local economic development through sustainable (geo) tourism is one of the key pillars of a UNESCO Global Geopark. This creates job opportunities for the local communities through tourism, but also through the promotion of local culture and products.

Goal 11 : Make cities and human settlements inclusive, safe, resilient and sustainable (especially target 11.4)

Protecting, safeguarding and celebrating our cultural and natural heritage are the foundation of the holistic approach of the UNESCO Global Geoparks. UNESCO Global Geoparks aim to give local people a sense of pride in their region and strengthen the identification with the area.

Goal 12 : Ensure sustainable consumption and production patterns (especially target 12.8

and 12.b)

UNESCO Global Geoparks educate and create awareness on sustainable development lifestyles. They teach the local communities and visitors to live in harmony with nature.

Goal 13 : Take urgent action to combat climate change and its impacts (especially target 13.3)

All UNESCO Global Geoparks hold records of past climate change. Through educational activities awareness is raised on the issue and people are provided with knowledge to mitigate and adapt to the effects of climate change.

Goal 17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development (especially target 17.6, 17.9 and 17.16)

UNESCO Global Geoparks are all about partnership and cooperation, not only between local stakeholders, but also internationally through regional and global networks were knowledge, ideas and best practices are shared. Experienced geoparks guide aspiring geoparks to reach their full potential.

3.3 UNESCO Global Geoparks : protection with sustainable development

UNESCO Global Geopark promotes that best geopark should have 4 essential dimentions including geological heritage of international value, management, visibility and networking. [3]

According to the publication of UNESCO on UNESCO Global Geopark, the fundamental features which are an absolute prerequisite for an area to become a UNESCO Global Geopark including :

1) International value of Geological Heritage: This is the most important part of all goepark in order to become the UNESCO Global Geopark. UNESCO Global Geoparks must have the geological heritage of international value. This will be assessed by scientific professionals as part of the "UNESCO Global Geopark Evaluation Team". Based on the international peer-reviewed, published research conducted on the geological sites within the area.

2) Management: UNESCO Global Geoparks are managed by a body having legal existence recognized under national legislation. This management body should be appropriately equipped to address the entire area and should include all relevant local and regional actors and authorities. UNESCO Global Geoparks require a management plan, agreed upon by all the partners, that provides for the social and economic needs of the local populations, protects the landscape in which they live and conserves their cultural identity. This plan must be comprehensive, incorporating the governance, development, communication, protection, infrastructure, finances, and partnerships of the UNESCO Global Geopark.

3) Visibility: UNESCO Global Geoparks promote sustainable local economic development mainly through geotourism. In order to stimulate the geotourism in the area, it is crucial that a UNESCO Global Geoparks has visibility. Visitors as well as local people need to be able to find relevant information on the UNESCO Global Geopark. As such, UNESCO Global Geoparks need to provide information via a dedicated website, leaflets, and detailed map of the area that connects the area's geological and other sites. A UNESCO Global Geopark should also have a corporate identity.

4) Networking: A UNESCO Global Geopark is not only about cooperation with the local people living in the UNESCO Global Geopark area, but also about cooperating with other UNESCO Global Geoparks through the Global Geoparks Network (GGN) , and regional networks for UNESCO Global Geoparks, in order to learn from each other and, as a network, improve the quality of the label UNESCO Global Geopark. Working together with international partners is the main reason for UNESCO Global Geoparks to be a member of an international network such as the GGN.Membership of the GGN is obligatory for UNESCO Global Geoparks. By working together across borders, UNESCO Global Geoparks contribute to increasing understanding among different communities and as such help peace-building processes.

According to the 4 pillars of UNESCO Global Geoparks, All pillars are very important part of all UNESCO Global Geoparks to confirm that geopark has the international value of geological heritages and managed in long term by management body regally. Management body should concern and focus on 10 key elements including : natural resources, geological hazards, climate change, education, science, culture, women, sustainable development, local community, indigenous knowledge and geoconservation. For eco-socio-economic development of the area, geotourism is key issues so visibility should be provided properly for visitors including infrastructures, interpretation panels, sign board, parking lodges, public transportation, websites, leaflets, brochures, maps and etc. UNESCO Global Geopark integrates both tangible and intangible heritages of the area together and promote as ideal destinations for educational activities but distraction or sale of original ornamental geological material is not permitted. [13] Networking is also a key feature of UNESCO Global Geopark both internal and external networking. Internal networking means the cooperation among local

stakeholders and key partners including local communities within geopark area. External networking is the collaboration between geopark and other networks included national or international networks. Networking is very important activity especially for capacity building, learning from other geopark experiences and practices, sharing the knowhow and knowledge among researchers, geologists, teachers, students, managers or local enterprises.

UNESCO has provided and published the Statutes and Operational Guidelines of the UNESCO Global Geoparks via the official website to assist the area to set up the the UNESCO Global Geopark including application dossier, self-evaluation form, template of geological and geographical summary and the timelines for UNESCO Global Geopark proposal and evaluation procedure [14] After the Aspiring Global Geopark submit the application dossier and pass the verification check. The experts form IUGS will do desktop evaluations then 2 nominated field assessors from UNESCO will visit Geopark for 3-4 days. The assessors' report will be recommend by the UNESCO Global Geoparks Council in September and decision will be finalized by the Executive Board of UNESCO during its spring session. After reward the UNESCO Global Geopark label, all geoparks shall be subjected to a thorough revalidation every 4 years.

3.4 UNESCO Global Geopark in Thailand : Satun Aspiring UNESCO Global Geopark

Satun province has been known widely as the destination of palaeontologists, geologists geomorphologists, and stratigraphers from around the world since 1951. It was a part of the Shan-Thai (Sibumasu) paleocontinent during the Lower and Middle Paleozoic. The Lower to Middle Paleozoic rocks with a variety of fossils outcrop in this area including the oldest fossils are represented by trilobites in the Upper Cambrian of the Tarutao Group, especially five new species of trilobite, i.e., Thailandium solum, Eosaukia buravasi, Saukiella tarudaoensis, Pagodia thaiensis, and Coreanocephalus planulatus. [15] Based on stratigraphical and paleontological studies on brachiopods, trilobites, conodonts, microvertebrates and gastropods of many paleontologists from Australia, England, Japan and the USA, it is verified that Thai fauna can be correlated with those of Myanmar, China, Australia and South America. Fossils are protected by the Fossil Protection Act, B.E. 2551(2008).

The Satun Aspiring UNESCO Global Geopark is located exclusively within Satun province, adjacent to the Andaman Sea. It covers Thung Wa, La-ngu, Manang, and part of Mueang Satun District (Tarutao National Park and Mu Ko Phetra National Park), with a total area of 2,597.21 km^2.

Figture 1 Satun Geopark Map
Source: Department of Mineral Resources

Satun Aspiring UNESCO Global Geopark consists of four main topographical features as 1) Karst topography is karst landscape of Ordovician limestone such as monadnocks, karst towers, caves,

sinkholes, lapies, springs, waterfalls, and stromatolite lapies unique to the locality. 2) The Undulating Plain are younger sedimentary rock units (Silurian to Carboniferous including Quaternary) resulting in undulating terrain. 3) The Coastal Plain in the western and southern portion of the Satun Aspiring Geopark, is covered by Holocene alluvial sediments flowing from rivers also occur in this area to the sea. 4) Islands: All islands are located in Phetra National Park and Tarutao National Park consisting 20 islands in Phetra and La-ngu Districts and 51 islands in Mueang District, respectively. The Phetra and Tarutao islands are scenic topographic features of the proposed Geopark. Tarutao Islands is already the ASEAN heritage. Some area of geopark are protected by the National Park Act B.E. 2504 and some are managed by communities.

The population living within Satun Aspiring Geopark area, excluding Pethra and Tarutao National Parks, is about 113,110 people. In addition to ethnic Thai (including Buddhists, Muslim, and Christians), there are minority groups of indigenous people living in the proposed geopark, such as the Semung or Maniq ethnic group, which is a nomadic forest dwelling tribe thriving within inland evergreen forests and the Urak Lawoi or "Chao le" in Thai language who reside on the islands of LiPe and Adang, in the Adang Archipelago. The current population of the Maniq group in Satun Aspiring Geopark (Thungwa and La-ngu Districts) is approximately 100 people. The population of Chao le or sea dwellers is approximately 1,000 people. They live simply and independently on boats near the coastal area. The two ethnic groups live their lifestyle simply and closely connected to nature with their own languages, traditions, cultures, and beliefs

According to the rich uniqueness of geological heritages, Subdistrict Administrative Organizations, local Schools - Kamphaeng Witthaya School and Thungwa Worawit School, Satun provincial Administrative Organization, Satun office of Natural Resources and Environment, Songkhla Rajabhat University, Nakhon Ratchasima Rajabhat University Department of Mineral Resources and many stakeholders created the special event as the 1st Satun Fossil Festival, aimed to promote the fossils and geoheritages to the public in 2014. It was success, more than 30,000 visitors attended. Then all stakeholders realized that this unified area must be protected and promoted to the public for education and tourism internationally. Geopark concept presented by Department of Mineral Resources in the early of 2014. Therefore, Satun Geopark was established and celebrated as the provincial geopark since August 14th, 2014.

Satun Aspiring Geopark has the management organization which appointed by the governor of Satun province and led by Mr. Narongrit Thungprue, director of Satun Geopark. Satun Geoapark signed the memorandum of understanding in term of formal collaboration and strengthening the network among many stakeholders and partners in multi-levels from local to central government services including Provincial Admistrative Organizations, Subdistrict Administrative Organizations, schools, universities, community college, research institutes, tourism agencies, national parks, wildlife sanctuary, communities, local enterprises, hotels, restaurants and etc. for the sustainability of the whole project.

Satun Geopark encourage local communities especially women group to participate the project in many dimensions including creating new products as geoapark products such as the fossils and natural dye batik and bateh by Panya Batik group. New batik and bateh geopark products have the identity and create higher price which geological story and natural friendly. Chim's melon with special taste and texture from Chim Melon Farm. It is a geopark agricultural product relates to the underground water of Karst landscape which contain high concentrate of calcium and magnesium substances. These both elements are important substances for the plants' cell wall development. The fossil pattern on Chim's melon creates the business extra price at least 30% per one melon. A sweet sticky rice in nepenthes pitcher plant is local traditional sweet which local community bring it back. Nepenthes pitcher plant farm has been established and opened for visitors as a learning center for 3 years. The old pitchers are cut for cooking - steamed sticky rice with coconut milk. This is traditional culture of locals. Many unique menus are created and provided by the local restaurants, geopark hotels, local homestay by Stegodon Homestay group – group of women nearby stegodon cave provide their houses as the certified homestay for visitors including local foods and some traditional cooking or handicraft short course, local geopark guides – local people who have additional trained by local community college in term of geological and natural heritage of the area. Kayaking group – local communities who have the para rubber wood farm in the geosite area. After work, they provide kayaking boat and kayaking trails for visitors. They can get additional income from kayaking service in many geosites, more than 40% additional income monthly.

Satun Geopark encourages and supports local school to get involved in this project – Thungwa Worawit school, geopark school is one of the best practiced school which integrated a regular class curriculum with local heritages education. Geological learning centre established and developed by Department of Mineral Resources then, this centre is later operated and supported by Science program of Thungwa Worawit school.

Learning centre provides education materials, exhibition and fossils which were found locally by students and teachers. According to the uniqueness of geological heritages (especially rich of fossils), some students were trained to be local guides by local geologist so they can provide some simple information on local geological heritage including the evolution of their land too. Expanding passion and knowledge from one student to other student, parents, family members and public, more people understand about their area and proud of their heritage. Raising awareness to more and more people to take care of their natural resources for next generation.

Satun Geopark has been well known by school, colleges, universities in the region. It is one of the best outdoor classroom and laboratories of Earth sciences about 500 million years ago. It is the simple evidence for students and visitors to understand the revolution of Earth and create awareness on sustainable development lifestyles, live in harmony with nature and take care of their earth for the next generations.

Satun Geopark has a strong network among the existing UNESCO Global Geoparks including international experts from UNESCO, Global Geopark Network and Asia-Pacific Geopark Network (APGN) and European Geopark Network (EGN) especially Langkawi UNESCO Global Geopark, Chinese Geopark Network and Japanese Geopark Network. Networking is very important issues for Satun Geopark development and management especially in the beginning stage of geopark establishment. Networking is the basic features to strengthen all partners and stakeholder together. It is the best practice for learning from other geopark experiences and knowledge sharing. Geopark is a dynamics process. New activities and projects need implementation and stepping forward.

Satun geopark is one of the best jigsaw to learn about our Earth evolution about 500 million years ago, the best international value outdoor classroom and laboratories of Paleozoic ocean accompany with abundant varieties of fossils. This is the heritage of all mankind. It is a sense of pride for Satun people to share with others. It should be protected and promoted globally. Therefore, on November 8th, 2016, the Thai Carbinet approved the Satun Geopark application dossier to be nominated as the UNESCO Global Geopark. The evaluation mission was done between July 24th - 29th , 2017 by the UNESCO nominated assessors from Portugal and People Republic of China. Recommendations on applications by the UNESCO Global Geoparks Council has been done since September 2017. The final decision by the Executive Board of UNESCO will be decided during its spring session.

Satun Aspiring UNESCO Global Geopark can be one of the best model for Thailand sustainable development empowering local communities involvement according to 2030 Agenda for Sustainable Development and one of the model, which support the development approach on Sufficiency Economy Philosophy (SEP) which has great relevance and wide applications for all people and sectors both poor and affluent alike based on societal and geographical conditions. [16]

4. Conclusions

Geopark is the new integrated management concept which created and developed by Chinese and European networks. Global Geopark is part of the International Geoscience and Geopark program of UNESCO. UNESCO Global Geopark promotes sites of International Value and are the basis of local sustainable development. It is one of the sustainable development tools to ensure the balance between conservation of heritage, development of tourism and infrastructure and enhancement of local participation and socio-economic development. There are 127 UNESCO Global Geopark in 35 countries around the globe in 2017.

UNESCO Global Geoparks support 8 Sustainable Development Goals of the United Nations 2030 Agenda for Sustainable Development including Goal 1 : End poverty in all its forms everywhere, Goal 4 : Ensure inclusive and equitable quality education and promote life long learning opportunities for all, Goal 5 : Achieve gender equality and empower all women and girls, Goal 8 : Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all, Goal 11 : Make cities and human settlements inclusive, safe, resilient and sustainable, Goal 11 : Make cities and human settlements inclusive, safe, resilient and sustainable, Goal 12 : Ensure sustainable consumption and production patterns, Goal 13 : Take urgent action to combat climate change and its impacts and Goal 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development.

UNESCO Global Geoparks has 4 essentials which support the aims of geopark including geological heritage of International Value, management, visibility and networking. UNESCO Global Geoparks are focusing on both tangible and intangible Resources of the area including natural resources, geological hazards, climate change, education, science, culture, women sustainable development, local and indigenous knowledge and geoconservation. In order to achieve the standard of UNESCO Global Geopark, Aspiring Geoparks should follow the Statutes and Operational Guidelines of the UNESCO Global Geoparks. Visibility is very important

part. Aspiring Geopark should provide the visibility in the area for visitors and local communities. Management requires a solid, efficient, flexible and capable structure, system and process which cover protection, promotion, education, socio-economic development and progress of the geopak.

Satun Aspiring UNESCO Global Geopark, located in Southern Thailand with a total area of 2,597.21 km^2 is the 1st Thai National Geopark nominated as the UNESCO Global Geopark by Thai government in 2016. It was formed by the requirement of communities, aimed to protected and promoted their heritage sustainably. It is action from the bottom up. It took at least 3 years to reach the UNESCO Global Geopark criteria by the strongly support of many stakeholders and strategicf partner including the Satun governor office, Satun office of Natural Resources and Environment, Provincial Administrative Organization, 14 subdistrict Administrative Organizations, 2 subdistrict municipalities, Department of Mineral Resources, national parks, wildlife sanctuary, universities, community college, schools, local enterprises, hotels, restaurant, travel agencies, local communities and etc. Satun UNESCO Global Geopark has a strong network among the existing UNESCO Global Geopark including international experts from UNESCO, Global Geopark Network and Asia-Pacific Geopark Network (APGN) and European Geopark Network (EGN)

Acknowledgements

We would like to send our sincere gratitude to the president of Vongchavalitkul University, president of Nakhon Ratchasima Rajabhat University, director general of Department of Mineral Resources, the Japan Geopark Network, the Asia-Pacific Geopark Network and UNESCO Global Geopark Secretariate for supporting on geopark establishment in Thailand and important information.

References

[1] Mc Keever P. UNESCO Global Geoparks. GeoExPro : The favourite petroleum geoscience magazine. 2017. 14(1) : 74
[2] Asia Pacific National Geoparks, APGN Geoparks. 2017. [cited 17 July 2017]. Available from : http://asiapacificgeoparks.org/?page_id=78
[3] UNESCO. UNESCO Global Geoparks. 2017. [cited 17 July 2017]. Available from : http://unesdoc. unesco.org /images/0024/002436/243650e.pdf
[4] Mc Keever,P. UNESCO Global Geoparks. GeoExPro : The favourite petroleum geoscience magazine. 2017. 14(1) : 74
[5] Komoo,I and Patzak, M. Global Geopark Network : An Integrated Approach for Heritage Conservation and Sustainable Use, in Leman, M.S, Reedman, A and Chen, S.P (eds) Southeast and East Asia Geoheritage Conservation, Bangi: LESTARI UKM: 1-13.
[6] Jones, C. 2008. Geological Society of London, special Publications. , 300, 273-277, [cited 11 July 2017]. Available from : http://sp.lyellcollection.org/content/300/1/273
[7] Hashim HS, Azia Sarah, Aziz, Rahimah Abdul. Conservation with development : showcasing Langkawi GEoapark. Planning Malaysia Conservation with development: Focus on Langkawi. 2011; 1-24
[8] IUGS - Geoheritage Task Group (GTG). Some announcements regarding global geoheritage matters at the end of 2015. The new ProGeo Newsletter : Number 1 2017. [cited 17 July 2017]. Available from : http://geoheritage-iugs.mnhn.fr/index.php
[9] UNESCO. UNESCO Global Geoparks. 2016. [cited 1 July 2017] Available from : http://unesdoc.unesco. org/images/0024/002477/247741E.pdf
[10] United Nations. Sustainable Development Goals. 2017. [Cited 19 July 2017] Available from : http://www.un.org/sustainable development/sustainable-development-goals
[11] United Nations. Resolution adopted by the General Assembly on 25 September 2015. 2015. [Cite 19 July 2017] Available from : http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/7/1&Lan
[12] UNESCO. UNESCO Global Geopark contributing to the Sustainable Development Goals. 2017. [cited 17 July 2017]. Available from : http://unesdoc.unesco.org/images/0024/002436/243650e.pdf
[13] Zouros,N. and Valiakos, I., 2010. Geoparks Management and Assessment. Bulletin of the Geological Society of Greece, 2010 and Proceeding of the 12th International Congress, Patras,May, 2010.
[14] UNESCO. UNESCO Global Geoparks. 2017. [cited 17 July 2017] Available from : http://www.unesco. org/new/en/natural-sciences/environment/earth-sciences/unesco-global-geoparks/
[15] Kobayashi, T., 1957, Up per Cambrian fossils from peninsular Thailand, Jour. Faculty of Science, Tokyo University. 2(10) 3, p.367-382.
[16] Sithtichoti K. Sufficiency Economy Philosophy : a Practical Approach toward the United Nations

Sustainable Development Goals. Proceeding international conference of multidiscipline approach on UN Sustainable Development Goals (UNSDGs 2016) . 2016. [cited 17 July 2017]. Available from : http://dept.npru.ac.th/unsdgs2017/data/files/Full%20proceedings%20UNSDGs%202016_1.pdf.

Managing Sustainable Development

Pradip Peter Dey[1,*], Ronald P. Uhlig[1], Laith Al Any[1], Mohammad Amin[1]

[1]Bhaskar Raj Sinha, Hassan Badkoobehi
School of Engineering and Computing, National University,
3678 Aero Court, San Diego, CA, San Diego, California, USA

Abstract

Appropriate management strategies can be advanced for sustainable development using broad-based development strategies that benefit most humans throughout the world for the foreseeable future without causing harm to humanity, resources and environment. Gradually new approaches to development are taking place in the increasing number of wind turbines and solar panel installations, planting new trees and introducing eco-literacy curricula in schools and in many other intuitive ways. Sustainable development may be relatively slow, but it does not do long term harm to environment and humanity. Any nation can play a leading role in developing management strategies for sustainable development with good local applications within a global framework. Population groups in various parts of the world practiced in sustainable development before industrialization, elements of which can be revived now. Modern technology of war, internal combustion engines, deforestation, toxic waste, and other assaults on sustainability often cause long term harm to our environment and dampen our spirit of sustainable development. Despite these obstacles, peoples are rededicating themselves to replace wars by peace and hate by love for the planet and humanity and measurable progress towards sustainable development goals. Sustainable development needs to be supported by careful selection of technology, investment in peace, education and research. Deceptive paradoxical claims about accelerated development should be rejected and their impact on environment needs to be investigated. Development of mathematical models of sustainability for specific applications can be key to identifying which variables to manage for the best results. Research on sustainable development is challenging, because it requires robust multidisciplinary approaches and without a large multidisciplinary team of experts it is difficult to treat various research aspects adequately. However, collaborative research teams of experts can be created taking participants from multiple nations and disciplines in order to serve humanity with a long term view of sustainable development.

Keywords: air pollution, automobiles, environment, economy, global warming

1. Introduction

From our collective knowledge and experience of the past few thousand years we have come to realize that we have a profound relationship with Planet Earth: we need the Earth as the Earth needs us. We need the Earth for sustainable development so that our next generation can live on it without facing catastrophic environmental disasters. The Earth needs us to take friendly actions for cleaning its air and environment for sustaining habitat for life. Every nation wants to achieve and maintain healthy economic development with strong GDP (gross domestic product) growth. However, high GDP growth rates must not be an end in themselves. For example, high GDP growth accompanied by high growth in environmental hazards is not desirable. It is always important to consider potential side effects of growth processes. For example, processes which cause cancer or other health hazards to us or our children, are not likely to be acceptable. In a shared environment, wealth creation that is accompanied by damaging each-other's children's long term health or potentials, is not acceptable. We live in a society. We depend on each-other in so many ways. We share the air we breathe, the seasonal changes, and the planet earth in so many intricate ways that are often not immediately perceived. In consideration of these shared interests, concerns, potentials and risks, we need to reconsider our global citizenship, shared responsibilities, and sustainable development goals. When we think about development we must take into consideration related issues such as possible chemical hazards, climate change, environmental consequences and long-term benefits.

* Corresponding author; e-mail: apdey@nu.edu

Human groups often do not agree on these issues. However, collegial discussions with mutual respect need to be conducted for the benefit of all. Hopefully, our discussions will lead to better understanding of each-other's concerns as well as information exchange and exchange of mutually beneficial ideas. The problem is global and we need to appeal to global citizenship. The United Nations and other organizations often sponsor multicultural events for better understanding of the relationships among environmental concerns, economic development, social progress and health and human issues [1].

The spirit of humanity, to which we aspire, rises to challenges and sacrifices for the good of the coming generations. The UN 2030 Agenda for Sustainable Development says, "We are determined to protect the planet from degradation, including through sustainable consumption and production, sustainably managing its natural resources and taking urgent action on climate change, so that it can support the needs of the present and future generations" [1]. This can be considered, without any hostile feelings, as one of the perspectives among many others without any prejudgments.

The fact that our concerns are shared is fundamental. In addressing shared concerns we need to listen to each other. During the industrial revolution impacts on the environment, such as air pollution, were noticed even by common people. Air pollution increased rapidly with the growth of coal consumption and rapid growth of the automobile industry and other factors. According to David Wallace-Wells, unless there is a significant change to how billions of humans conduct their lives, "parts of the Earth will likely become close to uninhabitable, and other parts horrifically inhospitable, as soon as the end of this century" mainly due to climate change [2]. Many scientists who study the subject give similar warnings about internal combustion engines, use of coal, deforestation, global warming etc. with some variations. At the same time, excellent progress on reducing air pollution has been made in some parts of the world, and this should be encouraging to those parts of the world that are currently plagued with severe pollution.

In this paper, we suggest some mechanisms for developing management strategies that can be effective in reducing the impact of climate change and promoting sustainable growth. Information technology will play an important role in raising awareness about climate change. We discuss below the development of detailed mathematical models to identify specific variables that can be managed to improve sustainability. Using Information Technology to disseminate how the models work may also help in exchange of ideas and coordinating actions of various groups towards achieving the goals stated in United Nations documents [1].

The sustainable development paradigm comes with many studies. It presents a workable "alternative that supports economic viability and healthy ecosystems by modifying consumption patterns and implementing a more equitable social framework" in a pragmatic way [3]. Scientific studies about environment and climate change come with some range of uncertainties. Reasoning with uncertainties presents some challenges. However, our goal is to benefit from these studies with proper understanding and manage the risks. We want to prevent deterioration of the ecosystems on which we depend for our well-being. Taking the uncertainties into proper perspective from multiple studies is important.

2. Review of literature with perspectives

Robust exchange of ideas, views and information on sustainable development is important. Conferences, debates, journal articles, books and magazines should raise sustainable development issues and will allow scientists, engineers, policy makers and political leaders to participate in the discussions. Management of sustainable development is extremely challenging and requires carefully developed well-balanced approaches.

Most experts believe that "the popular interest in management as a discipline and a field of study is fairly recent" [4, page 12]. However, there were several pioneers such as Henry Gantt who developed planning and control techniques with a chart, popularly known as the Gantt chart as early as 1919 [5].

Modern concepts of management were developed in the U.S.A. after World War II and these are currently taught all over the world in institutions of higher education. The four main management functions one may learn in school are "planning, organizing, leading, and controlling" [6, page 5]. One may argue for adding to the list more functions and skills such as communicating, decision making, meeting ethical standards, analytical thinking, coaching, listening, negotiating, visioning and mitigating risks. There are many perspectives on sustainable development and one must be ready to listen to others to find common ground, because it is through the shared views and concepts that initial progress can be made.

One of the challenges for sustainable development is coordinating regional and national development with international institutions and other nations because some aspects of sustainable development requires global cooperation [1, 7, 8]. The United Nations published several articles related to the goals of sustainable development [1, 7, 8]. It continues to sponsor important conferences and symposia addressing very important issues about sustainability. The United Nations conferences provided forums for discussing important issues and for exchanging ideas about managing development. It became apparent that there might not be any centralized global management strategies acceptable to all nations as national leaders were primarily interested in serving their national interests only. The United Nations continued its efforts in coordinating the

development of the distributed decentralized management strategies in a global framework. In the meantime, various global conferences allowed discussions of the global nature of issues of climate change and related challenges of sustainable development. One example is the Earth Summit held in Rio de Janeiro in 1992 as the United Nations Conference on Environment and Development (UNCED) [9]. The United Nations Agenda 21 started some useful debates and critical thinking about sustainable development with objectives such as "To promote patterns of consumption and production that reduce environmental stress and will meet the basic needs of humanity;" [10]. Making statements about global sustainable development goals the United Nations promoted constructive thinking about management issues in this area. As a result, there is a better understanding of the issues today and a greater awareness that The United Nations is calling on everybody to play a role in meeting the sustainable development goals.

We can all benefit from good examples. There are some excellent examples that can be followed in order to replicate their success in many areas. Sweden, Denmark and Norway are among the top performers in sustainable development making excellent progress towards UN (United Nations) 2030 sustainable development goals [11]. "Asia-Pacific's top performers Japan, Singapore and Australia rounded off the list at 18th, 19th and 20th, respectively" [11]. There are opportunities for following some of the management strategies of these countries with appropriate adjustments for local applications.

Nevertheless, it is inevitable that some will feel threatened by proposed management changes, and some may actually be threatened. Ways need to be identified to phase in changes needed for sustainability so that organizations and individuals can absorb the changes without being forced into a position of having their "backs against a wall." If they believe the changes endanger their survival they will fight. This implies compromise, and is part of what the authors meant above when they talked about "listening to each other." Unfortunately, some of the current debate is more like a war than a dialog. Everyone loses in a war.

An important aspect of managing sustainable development is to manage waste and environmental aspects. Management of recycling plastics, metallic cans, containers, and used clothing helps our environment in addition to bringing awareness of sustainability to the general public. Many K-12 schools participate in recycling projects where students' involvement is encouraged. Some schools have an introductory course on sustainability that introduces certain basic aspects of the field in a proper context. Students who develop interests in this area may pursue an undergraduate degree in sustainability which is offered in many colleges and universities. One of the largest global recycling industries that has come into being over the last several decades is recycling of used clothing. The size of this global industry is estimated at over US$4 billion today [12] This is one example of upcycling - the process of changing and transforming waste materials into good products for better environmental value [13]. So-called eWaste is another example. Creatively developing new products from old electronic components is demonstrating excellent service to many communities in several parts of the world. Upcycling creatively makes a positive impact on the environment. Developing appropriate management strategies in more industrial sectors for upcycling will contribute towards more and better sustainable development goals.

3. A mathematical model of sustainability

Most of us have an intuitive understanding of sustainability and we are motivated to have some sustainable development goals for ourselves for our own benefits. We all practice sustainability all the time on an individual basis. To do otherwise would be foolish. We manage our finances so that we do not run out of funds. We conserve our clothing so that it will last until we have sufficient funds to replace worn out items. We manage our food, so that we have enough to last until we can replenish our supply. These few examples are sufficient to illustrate that managing sustainability is a natural and instinctive practice for survival on an individual basis. On an individual basis, we do this precisely, typically using budgets for ourselves and our families. We consider various ways in which we could spend our money and then make choices among the various alternatives. This is a relatively primitive form of mathematical modeling. Problems arise when we begin to address sustainability collectively. It is at that point that competition arises for resources whether or not they can be replenished. One person, group, or nation seeks to use a resource faster than it can be replenished, usually to gain short term profit. At a macro level, non-sustainable practices are counterproductive, because, while they may produce high levels of profit for a short time, they then produce zero or negative profits after resources are depleted. One issue is what is meant by "short time". For sustainability, "short term" probably implies decades and sometimes even centuries. Another issue is whether the resource being depleted is renewable, in other words temporary depletion versus permanent depletion.

From this perspective, the process of sustainability can be viewed as an economic issue, driven by depletion rates, time constraints, cost constraints, and renewability constraints. The time constant is related to the time to replenish key resources being consumed or to find acceptable alternatives (such as replacement). This may be a linear process, or it may involve some more complex relationship. Ideally, we can look at a simple equation stating that the amount we use of a particular resource over a particular time must not be greater than the amount of resource that can be replenished in the same amount of time. This can be stated as:

$$\int_{t1}^{t2} D(t)dt \leq \int_{t1}^{t2} R(t)dt$$

Where D(t) = the depletion as a function of time for a resource and R(t) = the replenishment as a function of time for the resource. t1 = the starting point in time for sustainable management of the resource and t2 = the end point for a particular management period. The variables, "D(t)" and "R(t)", can be quite complex functions, reflecting various approaches to production and to replenishing or replacing resources that are being consumed over the same time period. This simple equation can be extended to multiple resources, but it must be at the heart of any sustainable management practice. Both sides of the equation are functions not only of time, but of many other variables as well.

Managing the quantity of a resource is only part of the picture. Costs must also be addressed. Businesses seek to minimize the cost of processing resources, and this drives things like economic lot sizes, which, in turn, drives the form of the function for "D(t)" in the equation above. From a societal perspective, the cost of replenishment must not exceed the cost of consuming (or depleting) a particular resource. However, the cost of replenishment may not be a cost to the organization which is using the resource; it may be a cost to another organization, or even to a single country. As a result, there may not be a business motivation for ensuring that depletion and replenishment are synchronized.

Cost is a powerful motivation for sustainability on an individual basis, but when the cost accrues to someone other than the individual or organization using up the resource, that missing or mismatched cost motivation makes sustainable management practices difficult. This implies that the integration on the left side of the equation (the depletion side) must go over all individuals and organizations contributing to the depletion, while the integration on the right hand side of the equation must go over all who are concerned with the corresponding replenishment and/or replacement processes. This implies that, in addressing sustainability, we must take a "big picture" view of the process, or at least a "bigger picture" view than is apparent to many organizations.

If the "cost of replenishment" is viewed as a cost to society, it may be treated as a cost to an entire country. It may then be possible to transfer the cost to the organization(s) responsible for the depletion. This could be in the form of taxes, but taxation is a very contentious process, and fraught with political issues. Carbon offsets are an example of an only slightly less contentious approach to transferring responsibility for the cost of "depletion" in the form of pollution of the atmosphere, to entities responsible for the depletion. In this case, we are all responsible for production of excess CO_2 but some activities produce much more CO_2 than others.

True management of sustainability requires identification of a correct set of variables for each side of the equation. In reality the process is too complicated to be reduced to such a simple equation. Instead, each side of the equation must be replaced with mathematical simulations of the depletion process on the left hand side and the replacement or repair process on the right hand side. By developing such simulation models, we can analyze variables on both side of the equation to identify the most important ones; these will be the variables that we seek to manage. Exploring options for the variables requires complex simulation models, using information technology.

A number of simulation models for sustainability have been developed, and more are needed in the future. One example is the work done by Jason Phillips in applying a mathematical model of sustainability to an environmental impact assessment of iron ore opencast mines. This very detailed work, employing the Folchi method [14], suggests how mathematical models can be developed to identify critical variables to be managed for sustainability [15]. Another example is the work done Galal and Moneim [16] in their mathematical analysis of an optimal sustainable product mix for the process industry. They devised a complex mathematical model "to help decision makers in setting up their product mix and other vital operating parameters, so as to maximize manufacturing sustainability." These are but a few of many encouraging examples of detailed mathematical models for managing specific aspects of sustainability. Technology will help in the process of sustainable development in many ways [17].

A geoengineering approach to reduction of global warming is considered by some scientists [18-19] which involves spraying reflective particles into the stratosphere using airplanes or tethered balloons. A "simple model to account for the potential effectiveness of solar radiation management" is presented in [18]. Cost-effectiveness is considered to be one of the main advantages of this approach; however, it has potential environmental risks.

4. Conclusions

A consensus on sustainable development is likely to emerge soon. However, deeper understanding of underlying commonalities among multiple threads and viable models is being achieved due to persistent efforts. Such models represent a modest beginning of sustainable development that is underway in many parts of the world with enormous potentials. Its long-term implications include some profound socioeconomic transformations with global supports for building healthy ecosystems. Managing sustainable development is challenging; however, it also presents opportunities for the future. One of the challenges is that the fruits of sustainable development cannot be usually realized in a short period, because it often takes decades to see measurable effects. So, now is the time to get started. We have a profound realization that we need to work together with everybody in a cooperative friendly manner for a very long time in order to achieve our brilliant goals. Let our sustainable development journey begin with joy. A possible direction of study could be further development of a model of sustainable development management.

References

[1] United Nations. Transforming our world: the 2030 Agenda for Sustainable Development; 2015. Retrieved on July 15 from: https://sustainabledevelopment.un.org/post2015/ transformingourworld

[2] Wallace-Wells, D. The Uninhabitable Earth, New York Magazine, July; 2017.

[3] Edwards, A. R. The Sustainable Revolution. New Society Publishers; 2005.

[4] Drucker, P. Management (Revised Edition), Harper Collins, New York; 2008.

[5] Gantt, H.. Organizing for Work, Harcourt, Brace, and Howe, New York; 1919.

[6] Nelson, B. & Economy, P. The Management Bible, John Wiley & Sons, Hoboken; 2005.

[7] Mochizuki, Y. Educating for Transforming Our World: Revisiting International Debates Surrounding Education for Sustainable Development, Current Issues in Comparative Education (CICE), Volume 19, Issue 1, Fall 2016. Retrieved July 14, 2017 from: http://www.tc.columbia.edu/cice/current-issue/ 09_Mochizuki.pdf

[8] United Nations, Sustainable Development Goals; 2016. Retrieved July 12, 2017 from http://www.un.org/sustainabledevelopment/sustainable-development-goals/

[9] United Nations. The Earth Summit: United Nations Conference on Environment and Development (UNCED). Retrieved July 12; 2017 from http://www.un.org/geninfo/bp/enviro.html

[10] United Nations. Conference on Environment & Development: Agenda 21; 1992. Retrieved July 11, 2017 from: https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf

[11] World Economic Forum. Which countries are achieving the UN Sustainable Development Goals fastest? March; 2017. Retrieved July 26, 2017 from: https://www.weforum.org/agenda/2017/03/ countries-achieving-un-sustainable-development-goals-fastest/

[12] LeBlanc, R. Social Implications of Exporting Second Hand Clothing to Developing Countries, downloaded Aug. 30; 2017 from https://www.thebalance.com/exporting-old-clothes-2878008

[13] McDonough, W. & Braungart, M. The Upcycle: Beyond Sustainability - Designing for Abundance, North Point Press; 2013.

[14] Folchi, R. Environmental impact statement for mining with explosives: a quantitative method, in: I.S.E.E 29th Annual Conference on Explosive and Blasting Technique, Nashville, Tennessee, USA, February 2-5; 2003

[15] Phillips, J., The application of a mathematical model of sustainability to the results of a semi-quantitative Environmental Impact Assessment of two iron ore opencast mines in Iran, Applied Mathematical Modelling, Vol. 37, Issues 14-15, 1; Aug 2013, pages 7839-7854

[16] Galal, N.M. and Moneim, A.F.A., A Mathematical Programming Approach to the Optimal Sustainable Produce Mix for the Process Industry, Sustainability; 2015, 7, 13085-13103; doi:10.3390/su71013085

[17] Vergragt, P. J. How Technology Could Contribute to a Sustainable World, Tellus Institute; 2006. Retrieved July 26, 2017 from: http://www.greattransition.org/archives/papers/How_Technology_Could_Contribute_to_a%20Sustainable_World.pdf

[18] Moreno-Cruz, J., Ricke, K. & Keith, D. A simple model to account for regional inequalities in the effectiveness of solar radiation management, Climatic Change, 110: 649-668, 2012.

[19] Keith, D. & Weisenstein, D. K. Solar geoengineering using solid aerosol in the stratosphere, Atmos. Chem. Phys. Discuss., 2015.

Promoting Sustainable Development Goals through Corporate Social Responsibility (CSR) Practices: Cases of Rural Hotels in Bali, Indonesia

Luh Putu Mahyuni[1,*], I.B Teddy Prianthara[2]

[1]Universitas Pendidikan Nasional (Undiknas University), Jl. Bedugul 39, Sidakarya, Denpasar, Bali, Indonesia 80225
[2]Universitas Pendidikan Nasional (Undiknas University)

Abstract

Sustainability issue is gaining its significance worldwide as the United Nation sets 17 sustainable development goals (SDGs) to be achieved by 2030. Various approaches have been undertaken by many countries to promote SDGs. Many studies have also been conducted to find out the appropriate model, mechanism and method in promoting SDGs. The aim of this paper is to investigate how SDGs are promoted through CSR practices. Case studies of three big rural hotels in Bali, Indonesia were conducted. The results show that the three hotels align their business and social goals through long-term partnerships with the local society. By doing so, the economy of the local society thrives as the hotels grow. Some prominent practices are: (1) assisting the locals in cultivating organic fruits and vegetables to ensure the continuity of supply of organic produces for the hotels' restaurant, (2) green-bank initiative whereby the locals are assisted in reducing, reusing and recycling the wastes to maintain the cleanliness of the hotels environment, (3) employing the locals to obtain support from the local society, (4) English course program for the locals to enable better interaction between the hotel guests and the locals. CSR practices of the three hotels have contributed to the effort to combat poverty and hunger, improve the health and wellbeing, improve quality education, promote decent work and economic growth. However, promoting the 17 SDGs requires not only the private sectors but also the government efforts. This paper contributes to the body of knowledge related to the SDGs by revealing how SDGs could be promoted through CSR practices. This paper also shows that it is possible to align business and social goals through CSR practices.

Keywords: sustainable development goals, corporate social responsibility practices, rural hotels, emerging economy

1. Introduction

On September 25th 2015, the United Nations (UN) sets 17 Sustainable Development Goals (SDGs) to be achieved by 2030. The goals are: 1. No poverty, 2. Zero hunger, 3. Good health and well-being, 4. Quality education, 5. Gender equality, 6. Clean water and sanitation, 7. Affordable and clean energy, 8. Decent work and economic growth, 9. Industry, innovation and infrastructure, 10. Reduce inequalities, 11. Sustainable cities and communities, 12. Responsible consumption and production, 13. Climate action, 14. Life below water, 15. Life on land, 16. Peace, justice and strong institution, 17. Partnerships for the goals. The UN stresses the importance of involvement of many parties, such as governments, private sectors, NGOs and civil society in reaching the goals by 2030.

The academia and researchers contribute in promoting SDGs by conducting research to investigate various approaches, models and mechanisms applied to promote SDGs. One stream of research related to this matter is research on Corporate Social Responsibility (CSR). Altough the number of research on CSR has increased significantly in the last few decades, until now there is no agreed single definition of CSR. The definition of CSR spans from a mere philanthropy activities [1-3] to a complex business strategy [4, 5]. However, the components of CSR are consistently being discussed in the literature, such as concern for economics, legal, ethical, people/ stakeholders and the environment. Among those definitions, the CSR definition used by The Commission of the European Communities is the most cited [6, 7]. CSR is defined as "a concept whereby companies integrate social and environmental concerns in their business operations and in their interactions with their stakeholders on a voluntary basis" [6]. This paper adopts CSR definition defined by The Commission of the European Communities.

The concept of CSR is closely related to the idea of sustainability whereby a company bears responsibility to *take full account of its current and future economic, social and environmental impacts. Hence,*

* Corresponding author; e-mail: lpmahyuni@gmail.com

investigating CSR practices of certain companies could reveal alternative method in promoting UN SDGs. With this regard, this paper contributes by revealing how UN SDGs are promoted through CSR practices.

2. Objective

The objective of this paper is to investigate how Sustainable Development Goals (SDGs) are promoted through Corporate Social Responsibility Practices (CSRPs)

3. Methods

In order to achive the objective of this paper, case studies were conducted on three big rural hotels in Bali. Two hotels are located in Ubud - Gianyar and one hotel is located in Manggis - Karangasem. Ubud is well known as a favourite tourist destination for spiritual retreats and holistic healings. Most hotels in Ubud are located along the bank of the Ayung River. Manggis is famous for its pristine beaches and authentic traditional culture. Big rural hotels are chosen as the object of the case studies for several reasons: 1. Big hotels bring about greater impact to the society and the natural environment, 2. Rural hotels are much dependent on the natural environment, and 3. As most rural hotels are nested in traditional villages, maintaining harmonious relationship with the locals is very important for these hotels. By choosing big hotels that have great dependency on the natural environment and the local society, rich information related to Corporate Social Repsonsibility Practices (CSRPs) is expected can be obtained.

Case study is one type of qualitative study which focus on investigating certain issue or problem exist in certain setting or context [8]. In a case study, certain phenomenon is explored deeply through in-depth data collection from various sources of data. This study collects data through hotels' websites and interviews with hotels' general managers. All participants had been informed prior to the interview that they are guaranteed anonymity. This procedure is applied to minimise social desirability bias, i.e., the participants possibly inaccurately answer questions to present themselves in a more favourable light [9]. The interviews ranged from 45 to 90 minutes in duration. The interviews were conducted in English, Bahasa Indonesia, and some Balinese language. The translations of the interview transcripts to English were checked by a professional translator.

The interview transcripts were coded with the help of NVivo11. Segments of the interview transcripts were then organised according to the core themes identified and quotations that represent a particular theme were extracted from these transcript segments to add richness to the findings.

4. Results and Discussion

4.1. The Context of Bali

Bali is one of 33 provinces in Indonesia. Administratively, the province of Bali is divided into nine regions, namely Denpasar, Badung, Gianyar, Klungkung, Karangasem/ Amlapura, Bangli, Buleleng/ Singaraja, Tabanan and Jembrana/ Negara. Denpasar is the capital city of the Bali province. The locations of the regions are circled in Figure 1.

Figure 1. Bali Map (Source: www.balitravelhound.com).

The tourism industry has been the major driver of the economy of Bali. The number of international tourists visit Bali is almost 92% of the total population of Bali and made up 40% of the total international visitors visit Indonesia [10]. As such, it is clear that Bali has been the main driver of the tourism industry in Indonesia. Hence, the context of Bali is significant for tourism research in Indonesia.

Although the vast development of mass tourism in Bali brings benefits to the economy of Bali, it also creates numerous problems. The problems can be categorised as social, cultural and environmental problems. Therefore, it is very important to investigate the hotels efforts in maximising their contribution to the local society and economy without imposing negative impacts to the environment. Such efforts are discussed deeply in the following sub sections.

4.2. Case 1

Hotel 1 promotes itself as a premium residential health retreat combining holistic healing with exceptional villa accommodation. The hotel is located along the bank of the Ayung River where the natural environment is still pristine. It is also nested in the traditional Balinese villages. The hotel management realises the importance of preserving the natural beauty of its environment and maintaining harmonious relationship with the local society in ensuring the sustainability of the hotel operation. As stated by the general manager, "*I think definitely nowadays more people will come to a resort if they know you care about the environment. They are coming more if they know that you have got the CSR programs in place*". In general there are two types of Corporate Social Responsibility (CSR) practised by the hotel, namely CSR to the local society and CSR to the environment.

The hotel employs many local people. More than 75% of total staff are local people living in the surrounding villages. This policy is driven by motivation to support the villages by providing the opportunity to the locals to get a better future. The hotel also contributes to the economy of the local society by supporting the local entrepreneurs. The hotel is committed to source hotel supplies from the local community, "*We're buying products from local suppliers so we're supporting local entrepreneurs. We're not gonna sourcing outside from Bali. It's a sort of social responsibility in terms of taking care about local production plus reducing the footprint as well*". Besides contributing to the economy of the local society, the hotel also actively engages in various educational programs, such as health education, English language and literacy, and support for primary schools and kindergartens.

In terms of effort to preserve the environment, the hotel involves the local farmer. The hotel provides technical assistance and support for the local farmers to produce organic produces. By doing so, the hotel could ensure sustainable supply of organic produces for its kitchen, at the same time fosters the economic growth of the villages and contributes to the environment preservation effort. The hotel is also committed to use natural products only in its property. It is not just because it is good for the environment but also because it is expected by the guests, "*When you go to the room you'll find that we don't use any chemical. We try to use natural products as much as possible. Our guests frequently ask what kind of product you use for cleaning, what kind of product you use for mosquitos for example*".

In case 1, the management of the hotel practises CSR as a strategic means to ensure the sustainability of the hotel operation and at the same time contribute to the society and the environment. The hotel has contributed in promoting sustainable development goals by: 1. Providing jobs and supporting the local entrepreneurs, therefore contibuted in combating poverty and promoting sustainable economic growth, 2. Delivering health education to the locals, hence promoting good health and well-being, 3. Offering support for primary schools and kindergartens → promoting quality education, 4. Promoting organic farming and using natural products → action to minimise the impact of climate change.

4.3. Case 2

Similar to hotel 1, hotel 2 is also located beside the Ayung River. It is surrounded by lush forest greenery and working rice paddies. The hotel market itself as a special place to restore body, mind and soul. The management acknowledges the interdependencies of the hotel with its surrounding. The general manager stated, *"The successful of the company depends on the surrounding, the local community, the taxi drivers, the people that do the rafting, the art gallery, the restaurant, the local villagers, suppliers and vendors. We are relying on these people. They need us also. It's a kind of mutual benefit. In the long run everybody gains and that's how the company thinks. We cannot work in the environment and being selfish. That's a short term. Maybe in the short term it helps but in the long run you start to get isolated".* With this understanding in mind, the hotel engages in several CSR practices that bring benefits to the hotel, the society and the environment. Similar to hotel 1, hotel 2 also employs many local people and support local entrepreneurs by sourcing from within the community, as mentioned by the general manager, *"We've got 209 employees here, 207 are Balinese and we are the only two foreigners".* Partnership with the local farmers is also practised by hotel 2. The hotel assists the farmers to cultivate rosela and cashew nut on dry and unproductive lands. By doing so, the hotel improves the economy of the local farmers and at the same time saves significant amount of money by buying produces from the local

farmers insted of importing from other areas. In terms of contribution in promoting health and well-being, the hotel is committed to regulary conducting events to raise money for cancer research in Indonesia, *"Every year we do run to collect money to support research on cancer in Indonesia"*

To sum-up, hotel 2 contributes in promoting the UNSDGs, particulary combating poverty, promoting decent work and economic growth, good health and well-being, and minimising the impact of climate change by employing the locals, supporting the local entrepreneurs, assisting the local farmers to cultivate high value produces and raising money for cancer research.

4.4. Case 3

Hotel 3 is a seaside resort in Manggis, nestled between the sea and Mount Agung. Unlike hotel 1 and hotel 2, the management of hotel 3 did not explicitly acknowledge the importance of living in harmony with the locals and the environment to the success of hotel operation in the long-run. Even though it is not explicitly acknowledged, the hotel conducts various practices to maintain good relationship with the locals and to preserve the environment. As well as hotel 1 and 2, hotel 3 also employs many local people, supports local entrepreneurs, promotes health and well-being, supports local kindergartens and uses eco-friendly products.

Hotel 3 has 2 unique programs related to the effort to preserve the natural environment, namely: green-bank initiative and coral-reef conservation program. In the green-bank initiative, the hotel educates the locals to do reduce, reuse and recycle their own wastes. The hotel also assists the villagers to make handicrafts from recycle materials and then sells their products in the hotel. The general manager explained, *"We train the locals to create handicrafts from recycle papers. We are also committed to promote and sell their handicrafts through all hotel chains"*. By doing so, the hotel could maintain the cleanliness of the hotel environment and obtains support from the locals. Hotel 3 has high concern on preserving the coral-reefs, as diving and snorkeling program is the hotel's most favourite tour program. To align business and environmental concern, hotel 3 invites their guests to participate in the coral-reefs conservation program while enjoying diving and snorkeling.

5. Conclusions

This paper shows that the United Nation Sustainable Development Goals (UNSDGs) could be effectively promoted through Corporate Social Responsibility Practices (CSRPs). Analysis of the three cases of big rural hotels in Bali – Indonesia reveals that the hotels could significantly contribute to the effort to combat poverty, to achieve zero hunger, to promote good health and well-being, to promote quality education, to promote decent work and economic growth, to minimise the impact of climate change, and to preserve life below water by engaging in CSR practices. Interestingly, by engaging in certain CSR practices the three hotels could align their business and social goals. This paper focuses on the private sectors contribution only in reaching the UNSDGs. To be more effective, efforts to promote the UNSDGs need to involve many parties, such as government, academia, NGOs and civil society. Future research could explore further how various parties promoting the UNSDGs.

References

[1] Bowen, H.R., Social Responsibilities of the Businessman. 1953, New York: Harper and Row.
[2] Davis, K., Understanding the Social Responsibility Puzzle: What Does the Businessmen Owe to Society? Business Horizons, 1967. 10: p. 45-50.
[3] Preston, L.E. and J.E. Post, Private Management and Public Policy: The Principle of Public Responsibility. 1975, Englewood Cliffs, NJ: Prentice Hall.
[4] Porter, M.E. and M.R. Kramer The link between competitive advantage and corporate social responsibility. Harvard Business Review, 2006. 1-13.
[5] Porter, M.E. and C. Van Der Linde, Green and Competitive. Harvard Business Review 1995. 73 (5): p. 120-134.
[6] Dahlsrud, A., How Corporate Social Responsibility is Defined: An Analysis of 37 Definitions. Corporate Social Responsibility and Environmental Management, 2008. 15: p. 1-13.
[7] Gokulsing, R.D., CSR matters in the development of Mauritius. Social Responsibility Journal, 2011. 7(2): p. 218-233.
[8] Creswell, J.W., Qualitative inquiry and research design. 2nd ed. Choosing among five approaches. 2007, Thousand Oaks, California: Sage publication.
[9] Reimann, F., et al., Local Stakeholders and Local Legitimacy: MNEs' Social Strategies in Emerging Economies. Journal of International Management 2012. 18: p. 1-17.

[10] BPSIndonesia. Growth of Tourism and National Transportation December 2014. 2015 [cited 2015; Available from: http://www.bps.go.id/website/brs_ind/brsInd-20150202181818.pdf.

Session of Pure and Applied Science

Diversity of birds in Hlawga Park, Republic of the Union of Myanmar

Aye Thant Zin[1], San San Myint[2], Myitzu Thinn Aung[2], Khun Aung Naing Oo[2], Kajornsak Jaiyawat[3], Chanatip Vongpraramat[3] and Pongsarun Junshum[1,3,*]

[1]Department of Zoology, Mawlamyine University, Mawlamyine, Republic of the Union of Myanmar
[2]Department of Zoology, University of Yangon, Yangon, Republic of the Union of Myanmar
[3]Department of Biology, Faculty of Science and Technology, Thepsatri Rajabhat University, Lopburi, 15000, Thailand

Abstract

Hlawga Park, 22 miles (35 km) north of Yangon was chosen as study site. This study lasted from June 2014 to May 2015.Twenty five study sites were selected for record the bird species. Point count method was utilized to study the birds. One hundred and twenty nine species belonging to 45 families of **17** orders were recorded during the study period. Of these recorded species 99 species were terrestrial birds and 30 species were waterbirds. In the recorded waterbirds, Ciconiformes was the largest order with 10 species and Passeriformes was the largest order comprising 66 species in the terrestrial birds. In these 27 species were migratory species and 102 species were resident. Shannon Weiner Diversity Index was 2.21, Simpson's index was 0.72, Shannon evenness was 0.46 respectively. Number of bird species was largest in November and smallest in July. Species number of birds gradually declined in monsoon. In present study, maximum observed species were *Dendrocygna javanica, Anastomus oscitans, Anas poecilorhyncha* and *Garrulax pectoralis*. In total 129 bird species comprised one endemic species, three near-threatened and one endangered were identified.

Keywords: Diversity of birds, Hlawga Park, Diversity Index

1. Introduction

Myanmar has been wildly regarded as one of the biodiversity richest countries in the Asia and Pacific Region. Biodiversity is very special for our welfare since it is the major component of life supporting system. With extraordinary tropical variation, there is an unusual ecological diversity and these ecosystems are home to numerous species of fauna and flora. Myanmar supports at least 1,096 bird species, a greater diversity than any other country in mainland Southeast Asia. Despite its high species richness, Myanmar's avifauna contains six national endemic species: Hooded Treepie (*Crypsirina cucullata*), White-browed Nuthatch (*Sitta victoriae*), White-throated Babbler, (*Turdoides gularis*), Burmese Bushlark (*Mirafra microptera*), Jerdon's Minivet (*Pericrocotus albifrons*) and Burmese Tit (*Aegithalos sharpie*) [1]. Four hundred and thirty-three species of birds are recorded in Yangon. In these fourteen species are globally threatened and one species are introduced from other place [2].

2. Materials and Methods

2.1 Study Area: Hlawga Park is situated in 17°00′17″N 96°06′44″E. It is a National Park located in Mingaladon, Yangon Division, Myanmar. It is 22 miles (35 km) north of Yangon. The area of the park is 623-hectare, includes Wildlife Park, 313 hectare, a mini-zoo, 25-hectare and a buffer zone, 267-hectare .First established as an Environmental Education Center in 1982, the National Park is a popular day-trip destination with Yangonites and ecotourists [3].

The Hlawga Park is in coastal Yangon Division, and has a monsoonal climate. Annual average rainfall is about 240 cm most of which is received between late May and October. The coolest months are from November to February (average high: 32°C and average low: 18°C) and the hottest months are from March to May (average high: 37°C and average min: 24°C). The mean relative humidity is 87%. The vegetation type of Hlawga Park is Semi-evergreen forests, Mixed deciduous forests and Swamp forests [3].

2.2 Study period: This study was conducted from June 2014 to May 2015. Twenty five study sites were selected for record the bird species. Data records were taken starting from 6:00 am and continued until 11:00 am. Species abundance and population sizes of the birds were noted on monthly basis using point count method. Point count method was conducted [4].

To establish a representative collection of Myanmar indigenous wild life species of birds, and to measure the richness, evenness and diversity of bird species, Hlawga Park is selected as study site.

* Corresponding author; e-mail: pjunshum@gmail.com

2.3 Methodology:

Point count: Point count method was utilized to study the birds in Car parking, Gate 1, Gate 4, Gate 6, Gate 9, Kan Tha ya, Dam 1, Dam 4, Dam 5, Dam7, Dam 8, Lake near Dam 7, plain near Dam 7, Picnic site 1, Picnic site 2, Picnic Site 3, Picnic Site 4, feeding place 1, feeding place 2, Lake in Buffer Zone, Buffer Zone , Log cabin 1, Log cabin 2, mini Zoo, and other place. When a bird is spotted, size, color, behavior, call and time were recorded [5, 6].

Shannon-Weiner Index: Species evenness, richness, and diversity indices as Shannon-Weiner [7] and Simpson Index were used to evaluate the bird species diversity [8]. The value of Shannon-Weiner Diversity Index usually falls between 1.5 and 3.5, only rarely it surpasses 4.5. A value near 4.6 would indicate that the numbers of individuals are evenly distributed between all the species. Equitability or evenness index value was computed using Shannon's equitability index (J') method [9].

3. Results and discussion

One hundred and twenty nine species belonging to 45 families of **17** orders were recorded during the study period. Of these recorded species 99 species were terrestrial birds and 30 species were waterbirds. In the recorded waterbirds, Ciconiformes was the largest order with10 species and Passeriformes was the largest order comprising 66 species in the terrestrial birds. In these 27 species were migratory species and 102 species were resident [5,6].

Table 1 Bird species recorded during the period of study

No.	Common name	R / M	Scientific name	Family	Order
1	Quail	R	*Coturnix* sp.	Phasianidae	Galliformes
2	Red Junglefowl	R	*Gallus gallus*	Phasianidae	Galliformes
3	Green Peafowl	R	*Pavo muticus*	Phasianidae	Galliformes
4	Lesser Whistling-Duck	R	*Dendrocygna javanica*	Anatidae	Anseriformes
5	Spot-billed Duck	R	*Anas poecilorhyncha*	Anatidae	Anseriformes
6	Cotton Pygmy-goose	R	*Nettapus coromandelianus*	Anatidae	Anseriformes
7	Little Grebe	R	*Tachybaptus ruficollis*	Podicipedidae	Podicipediformes
8	Lineated Barbet	R	*Megalaima lineata*	Megalaimidae	Piciformes
9	Coppersmith Barbet	R	*M. haemacephala*	Megalaimidae	Piciformes
10	Green Bee-eater	R	*Merops orientalis*	Meropidae	Coraciiformes
11	Blue-tailed Bee-eater	R	*M.philippinus*	Meropidae	Coraciiformes
12	Chestnut -headed Bee-eater	R	*M. leschenaulti*	Meropidae	Coraciiformes
13	White-throated Kingfisher	R	*Halcyon smyrensis*	Alcedinidae	Coraciiformes
14	Black capped Kingfisher	R	*Halcyon pileata*	Alcedinidae	Coraciiformes
15	Drongo Cuckoo	R	*Surniculus lugubris*	Cuculidae	Cuculiformes
16	Indian Cuckoo	R	*Coculus micropterus*	Cuculidae	Cuculiformes
17	Plaintive cuckoo	R	*Cacomantis merulinus*	Cuculidae	Cuculiformes
18	Violet Cuckoo	R	*Chrysococcyx xanthorhynchus*	Cuculidae	Cuculiformes
19	Asian Koel	R	*Eudynamys scolopacea*	Cuculidae	Cuculiformes
20	Green-billed Malkoha	R	*Phaenicophaeus tristis*	Cuculidae	Cuculiformes
21	Greater Coucal	R	*Centropus sinensis*	Cuculidae	Cuculiformes
22	Dollarbird	R	*Eurystomus orientalis*	Coraciidae	Coraciiformes
23	Grey headed Parakeet	R	*Psittacula finchii*	Psittacidae	Psittaciformes

Table 1 (continued) Bird species recorded during the period of study

No.	Common name	M /R	Scientific name	Family	Order
24	Blossom-headed Parakeet	R	*Psittacula roseata*	Psittacidae	Psittaciformes
25	Asian Palm swift	R	*Cypsiurus balasiensis*	Apodidae	Apodiformes
26	House Swift	R	*Apus affinis*	Apodidae	Apodiformes
27	Asian barred Owlet	R	*Glaucidium cuculoides*	Strigidae	Strigiformes
28	Green Imperial Pigeon	R	*Ducula aenea*	Columbidae	Columbiformes
29	Mountain Imperial Pigeon	R	*D. badia*	Columbidae	Columbiformes
30	Orange-breasted Green Pigeon	R	*Treron bicincta*	Columbidae	Columbiformes
31	Thick-billed Green Pigeon	R	*T. curvirostra*	Columbidae	Columbiformes
32	Spotted Dove	R	*Streptopelia chinensis*	Columbidae	Columbiformes
33	Red collared Dove	R	*S. tranquebarica*	Columbidae	Columbiformes
34	Common Moorhen	R	*Gallinula chloropus*	Rallidae	Gruiformes
35	Common Coot	R	*Fulica atra*	Rallidae	Gruiformes
36	White-breasted Waterhen	R	*Amaurornis phoenicurus*	Rallidae	Gruiformes
37	Bronze-winged Jacana	R	*Metopidius indicus*	Jacanidae	Charadriiformes
38	Green Sandpiper	M	*Tringa ochropus*	Charadriidae	Scolopacidae
39	Common Sandpiper	M	*Actitis hypoleucos*	Charadriidae	Charadriiformes
40	Curlew Sandpipper	M	*Calidris ferruginea*	Charadriidae	Charadriiformes
41	Black-winged Stilt	M	*Himantopus himantopus*	Recurvirostridae	Charadriiformes
42	Little ringed Plover	M	*Charadrius dubius*	Charadriidae	Charadriiformes
43	Red –wattled Lapwing	R	*Vanellus indicus*	Charadriidae	Charadriiformes
44	Osprey	M	*Pandion haliaetus*	Pandionidae	Falconiformes
45	Crested Serpent Eagle	R	*Spilornis cheela*	Accipitridae	Falconiformes
46	Black Kite	R	*Milvus migrans*	Accipitridae	Falconiformes
47	Shikra	R	*Accipiter badius*	Accipitridae	Falconiformes
48	Oriental Honey Buzzard	R	*Pernis ptilorhynchus*	Accipitridae	Falconiformes
49	Little Egret	R	*Egretta garzetta*	Ardeidae	Ciconiformes
50	Purple Heron	R	*Ardea purpurea*	Ardeidae	Ciconiformes
51	Great Egret	R	*Casmerodius albus*	Ardeidae	Ciconiformes
52	Intermediate Egret	R	*Mesophoyx intermedia*	Ardeidae	Ciconiformes
53	Cattle Egret	R	*Bubulcus ibis*	Ardeidae	Ciconiformes
54	Chinese Pond Heron	R	*Ardeola bacchus*	Ardeidae	Ciconiformes
55	Black -crowned Night-Heron	R	*Nycticorax nycticorax*	Ardeidae	Ciconiformes

Table 1 (continued) Bird species recorded during the period of study

No.	Common name	M /R	Scientific name	Family	Order
56	Oriental Darter	R	*Anhinga melanogaster*	Phalacrocoracidae	Pelecaniformes
57	Little Cormorant	R	*Phalacrocorax niger*	Phalacrocoracidae	Pelecaniformes
58	Indian Cormorant	R	*P. fuscicollis*	Phalacrocoracidae	Pelecaniformes
59	Glossy Ibis	R	*Plegadis falcinellus*	Threskiornithidae	Ciconiformes
60	Spot-billed Pelican	R	*Pelecanus philippensis*	Pelecanidae	Pelecaniformes
61	Asian Openbill	R	*Anastomus oscitans*	Ciconiidae	Ciconiformes
62	Woolly-necked Stock	R	*Ciconia episcopus*	Ciconiidae	Ciconiformes
63	Blue winged Pitta	R	*Pitta moluccensis*	Pittidae	Passeriformes
64	Brown Shrike	M	*Lanius cristatus*	Laniidae	Passeriformes
65	Gray -backed Shrike	M	*L.tepbronotus*	Laniidae	Passeriformes
66	Black Drongo	M	*Dicrurus macrocercus*	Dicruridae	Passeriformes
67	Ashy drongo	M	*D. leucophaeus*	Dicruridae	Passeriformes
68	Greater Racket-tailed Drongo	R	*D. paradiseus*	Dicruridae	Passeriformes
69	Lesser Racket-tailed Drongo	R	*D. remifer*	Dicruridae	Passeriformes
70	Spangle Drongo	R	*D. bottentottus*	Dicruridae	Passeriformes
71	Crow- billed drongo	M	*D. annectans*	Dicruridae	Passeriformes
72	Bronze Drongo	R	*D. aeneus*	Dicruridae	Passeriformes
73	Racket-tailed Treepie	R	*Crypsirina temia*	Corvidae	Passeriformes
74	House Crow	R	*Corvus Splendens*	Corvidae	Passeriformes
75	Large-billed Crow	R	*C. macrorhynchos*	Corvidae	Passeriformes
76	Black-naped Oriole	M	*Oriolus chinensis*	Oriolidae	Passeriformes
77	Slender-billed Oriole	R	*O. tenuirostris*	Oriolidae	Passeriformes
78	Common Iora	R	*Aegithina tiphia*	Irenidae	Passeriformes
79	Rosy minivet	R	*Pericrocotus roseus*	Campephagidae	Passeriformes
80	Swinhoe's minivet	M	*P. cantonensis*	Campephagidae	Passeriformes
81	Ashy minivet	M	*P. divaricatus*	Campephagidae	Passeriformes
82	Black -naped monarch	M	*Hypothymis azurea*	Muscicapidae	Passeriformes
83	Asian browned Flycatcher	M	*Muscicapa dauurica*	Muscicapidae	Passeriformes
84	Brown -streaked Flycatcher	R	*M. williamsoni*	Muscicapidae	Passeriformes
85	Taiga Flycatcher	M	*Ficedula parva*	Muscicapidae	Passeriformes
86	Grey-headed Canary Flycatcher	R	*Culicicapa ceylonensis*	Muscicapidae	Passeriformes
87	Orange headed Thrush	R	*Zootbera citrina*	Muscicapidae	Passeriformes
88	Tickel's Blue Flycatcher	R	*Cyornis tickelliae*	Muscicapidae	Passeriformes
89	Blue-throated Flycatcher	R	*C. rubeculoides*	Muscicapidae	Passeriformes

Table 1 (continued) Bird species recorded during the period of study

No.	Common name	R/ M	Scientific name	Family	Order
90	Oriental magpie Robin	R	*Copsychus saularis*	Turdidae	Passeriformes
91	White-rumped Shama	R	*C. malabaricus*	Turdidae	Passeriformes
92	Chestnut-tailed Starling	R	*Sturnus malabaricus*	Sturnidae	Passeriformes
93	Common myna	R	*Acridotheres tritis*	Sturnidae	Passeriformes
94	Jungle myna	R	*A. fuscus*	Sturnidae	Passeriformes
95	White-vented myna	R	*A. cinereus*	Sturnidae	Passeriformes
96	Crested Myna	M	*A.cristatallus*	Sturnidae	Passeriformes
97	Barn Swallow	M	*Hirundo rustica*	Hirundinidae	Passeriformes
98	Black-winged cuckoo-shrike	R	*Coracina melaschistos*	Campephagidae	Passeriformes
99	Black-headed Bulbul	R	*Pycnonotus atriceps*	Pycnonotidae	Passeriformes
100	Black-crested Bulbul	R	*P. melanicterus*	Pycnonotidae	Passeriformes
101	Red-whiskered Bulbul	R	*P. Jocosus*	Pycnonotidae	Passeriformes
102	Red-vented Bulbul	R	*P. cafer*	Pycnonotidae	Passeriformes
103	Stripe-throated Bulbul	R	*P. finlaysoni*	Pycnonotidae	Passeriformes
104	Streak eared Bulbul	R	*P. blanfordi*	Pycnonotidae	Passeriformes
105	Brown Prinia	R	*P.polychroa*	Pycnonotidae	Passeriformes
106	Plain Prinia	R	*Prinia inornata*	Sylviidae	Passeriformes
107	Common Tailorbird	R	*Orthotomus sutorius*	Sylviidae	Passeriformes
108	Dark-necked Tailorbird	R	*O. atrogularis*	Sylviidae	Passeriformes
109	Arctic Warbler	M	*Phylloscopus borealis*	Sylviidae	Passeriformes
110	Dusky Warbler	M	*Phylloscopus fuscatus*	Sylviidae	Passeriformes
111	Two-barred Greenish Warbler	M	*P. plumbeitarsus*	Sylviidae	Passeriformes
112	White crested Laughing Thrush	R	*Garrulax leucolophus*	Leoithrichidae	Passeriformes
113	Greater Necklaced Laughing Thrush	R	*G. pectoralis*	Leoithrichidae	Passeriformes
114	Lesser Necklaced Laughingthrush	R	*G. monileger*	Leoithrichidae	Passeriformes
115	Abbott's Babbler	R	*Malacocinla*	Pellorneidae	Passeriformes
116	Puff throated Babbler	R	*Pellorneum ruficeps*	Pellorneidae	Passeriformes
117	White-throated Babbler	R	*Turdoides gularis*	Timallidae	Passeriformes
118	Scarlet-backed Flowerpecker	R	*Dicaeum cruentatum*	Dicaeidae	Passeriformes
119	Ruby-cheeked Sunbird	R	*Chalcoparia ingalensis*	Nectariniidae	Passeriformes
120	Olive-backed Sunbird	R	*Nectarinia Jugularis*	Nectariniidae	Passeriformes

Table 1 (continued) Bird species recorded during the period of study

No.	Common name	R/ M	Scientific name	Family	Order
121	Purple Sunbird	R	*Cinnyrisa siaticus*	Nectariniidae	Passeriformes
122	Paddyfield Pipit	M	*Anthus Rufulus*	Motacillidae	Passeriformes
123	Olive-backed Pipit	M	*A. hodgsoni*	Motacillidae	Passeriformes
124	Forest Wagtail	M	*Dendronanthus indicus*	Motacillidae	Passeriformes
125	White wagtail	M	*Motacilla alba*	Motacillidae	Passeriformes
126	Grey wagtail	M	*M. cinerea*	Motacillidae	Passeriformes
127	Eurasian Tree Sparrow	R	*Passer Montanus*	Ploceidae	Passeriformes
128	Scaley breasted munia	R	*Lonchura punctulata*	Ploceidae	Passeriformes
129	White rumped munia	R	*L. Striata*	Ploceidae	Passeriformes

Remark: R=resident, M=migrant

One hundred and twenty nine species were monthly recorded. Of these 47 species of birds were sighted in plain near Dam 7 and 45 species were in picnic site 2 (Figure 1). The relative abundance of bird species might be related to the available of food and habitat condition. Whereas Win [10] recorded 147 species of terrestrial birds and 34 species of aquatic birds in her study period at Hlawga Park. Bird watching and counting were conducted monthly for two years starting from 2000 to September 2002. Community structure, resource utilization, habitat preference and seasonal occurrence of birds were also recorded.

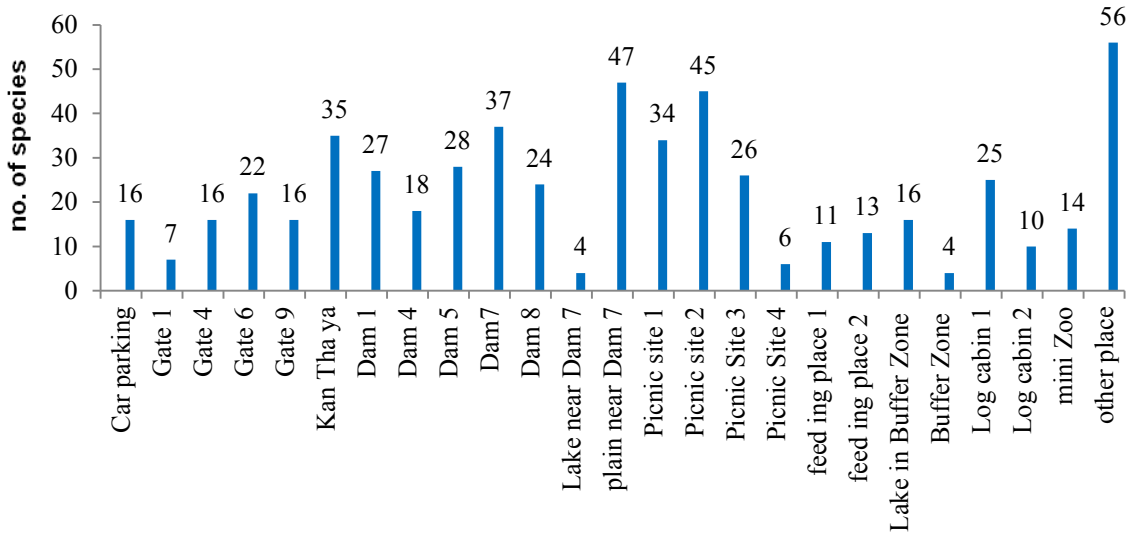


Figure 1 Bids species recorded in each study site in Hlawga Park

Number of bird species was largest in November and smallest in July (Figure 2). Seasonal change of bird species occurred due to the movement of migratory birds. Species number of birds gradually declined in monsoon. These results are in agreement to Paker *et al*. [11] who also observed similar bird species diversity was higher during spring and fall because of the presence of migrating bird species, and found that most bird species were found where trees and shrubs species richness was high.

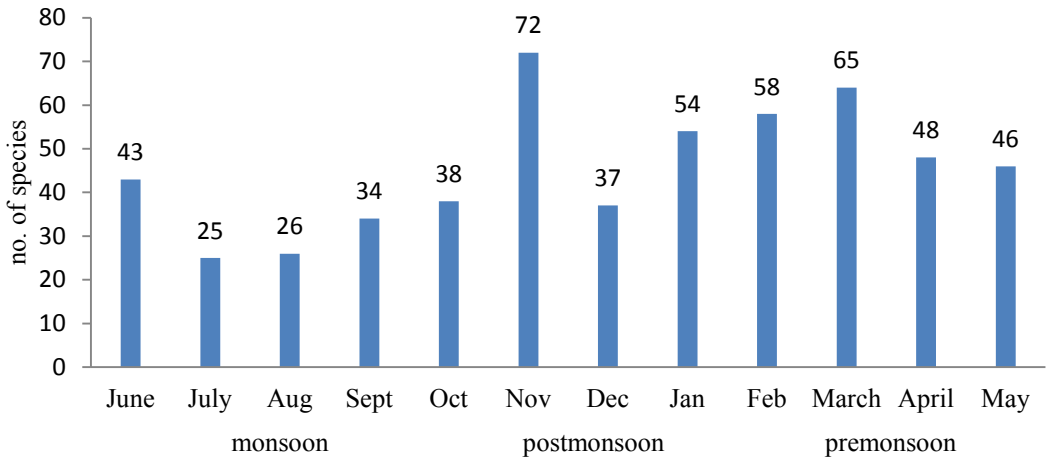


Figure 2 Monthly occurrence of bird species in Hlawga Park

Evenness of bird species compare in the month of 2014 June to 2015 May was 0.95 in 2014 June and 0.86 in 2014 August. Shannon Weiner Index value encountered avifauna was estimated to be 3.56 in 2014 June and 3.28 in 2014 August as shown in Table 2.

Table 2. Diversity of avian-fauna of Hlawga Park

Month	Diversity index (Shannon Weiner Index)	Equitability index (Evenness j')	species richness index
2014 June	3.56	0.95	0.97
July	2.67	0.83	0.89
August	2.43	0.75	0.80
September	2.45	0.695	0.83
October	2.23	0.62	0.79
November	2.75	0.64	0.80
December	0.84	0.23	0.29
2015 January	1.17	0.29	0.38
February	1.28	0.32	0.54
March	1.55	0.37	0.51
April	2.47	0.64	0.83
May	3.28	0.86	0.94

In present study, maximum observed species were *Dendrocygna javanica* (1490), *Anastomus oscitans* (1000), *Anas poecilorhyncha* (100) and *Garrulax pectoralis* (55). Least observed Species of birds (n=1) were Quail , *Coturnix* sp. , Lineated Barbet, *Megalaima lineate,* Large hawk Cuckoo, *Hierococcyx sparverioides* ,Indian Cuckoo, *Coculus micropterus*, Violet Cuckoo, *Chrysococcyx Xanthorhynchus,* Asian Koel, *Eudynamys scolopacea*, Dollarbird, *Eurystomus orientalis*, Blossom-headed parakeet, *Psittacula roseate*, Red collared Dove, *Streptopelia tranquebarica*, Common Moorhen, *Gallinula chloropus*, Common Coot, *Fulica atra*, Bronze-winged Jacana, *Metopidius indicus* , Green Sandpiper, *Tringa ochropus* , Crested Serpent Eagle, *Spilornis cheela*, Black Kite, *Milvus migrans* , Bronze Drongo, *Dicrurus aeneus,* Hooded Treepie, *Crypsirina cucullata*, Asian Browned Flycatcher, *Muscicapa dauurica*, Brown-streak Flycatcher, *M. williamsoni*, Orange headed Thrush, *Zootbera citrina* and Blue-throated Flycatcher, *Cyornis rubeculoides*.

Of these recorded species 102 species were terrestrial birds and 28 species were waterbirds. In the recorded waterbirds, Ciconiformes was the largest order with 10 species and Passeriformes was the largest order comprising 66 species in the terrestrial birds. In these 26 species were migratory species and 104 species were resident. Whereas Zin [12] undertook for two years (July 2002 to June 2004) on species richness and distribution of birds around Yangon area. Eight study sites were selected around Yangon area. Waterbirds of 45 species and 121 species of terrestrial birds were recorded.

In total 129 bird species of Hlawga Park comprised two endemic species, four near-threatened and one endangered were identified according to Avibase - Bird Checklists of the World [2] as shown in Table 3.

Table 3. Status of birds in Hlawga Park

Common name	Scientific name	Status
Green Peafowl	*Pavo muticus*	Endangered
Blossom-headed Parakeet	*Psittacula roseata*	Near-threatened
Darter	*Anhinga melanogaster*	Near-threatened
Spot-billed Pelican	*Pelecanus philippensis*	Extirpated Near-threatened
White-throated Babbler	*Turdoides gularis*	Endemic

4. Conclusions

One hundred and twenty nine species belonging to 45 families of 17 orders were recorded during the study period. In these 27 species were migratory species and 102 species were resident. Shannon Weiner Diversity Index was 2.21 Simpson's index was 0.72, Shnnon evenness was 0.46 respectively. Number of bird species was largest in November and smallest in July. Species number of birds gradually declined in monsoon. In total 129 bird species comprised one endemic species, three near-threatened and one endangered were identified. However one of the foremost threats to bird population in the Hlawga Park was monkey. Number of monkey population size was found to be high gradually. They destruct bird nests and eat bird eggs. For the stability of species and population of birds, control the monkey population size and protecting natural habitat is to be needed.

Acknowledgements

Thanks for the funding support from the bureau of the budget of Thailand.

References

[1] Nyi Nyi Kyaw. National Biodiversity Strategy and Action Plan (2015-2020). The Republic of the Union of Myanmar, Ministry of Environmental Conservation and Forestry; 2015

[2] Lepage D. Avibase - Bird Checklists of the World, Myanmar [internet]. [cited 2014 December 24]. Available from: http://avibase.bsc-eoc.org/checklist.jsp?region=MM&list=howardmoore

[3] Wikipedia. Hlawga National Park. [internet]. [cited 2014 December 24].Available from: https://en.wikipedia.org/wiki/Hlawga_National_Park

[4] Bibby CJ, Bugess ND, Hill DH. Bird Census techniques. London: Acedamic press; 1992.

[5] King B, woodcock M, Dickinson EC. A field guide to the birds of South east Asia. Hong Kong: South China. Printing Co; 1984.

[6] Robson C. A field guide to the birds of Thailand and South East Asia. UK: New Holland Publishers; 2008.

[7] Shannon CE, Weaver W. The Methematical Theory of Communication. Urbana,Illinois: University of Illinois Press; 1949.

[8] Simpson EH. Measurement of diversity. Nature. 1949;163: 688.

[9] Bibi F, Ali Z. Measurement of diversity indices of avian communities at Taunsa Barrage Wildlife Sanctuary, Pakistan, The Journal of Animal and Plant Sciences. 2013; 23(3): 469-474.

[10] Win KS. A study of the avian community of Hlawga Wildlife Park. [dissertation]. Zoology Department, Yangon University; 2003.

[11] Paker Y, Yom-Tov Y, Alon-Mozes T, Barnea A. The effect of plant richness and urban garden structure on bird species richness, diversity and community structure. Landscape and Urban Planning. 2014; 122: 186-195.

[12] Zin AT. Species richness and distribution of avifauna around Yangon area. [dissertation]. Zoology Department, Yangon University; 2005.

Diversity of Culinary Herbs and Ethnobotany in Hlawga Wildlife Park, Yangon City, Republic of the Union of Myanmar

Peangjai Jianwitchayakul[1,*], Soe Soe Aung[2], Thanda Aye[3], Mya Zarli[3], Aye Aye Mu[3] and Zin Mar Myint[3]

[1] Department of Agriculture, Thepsatri Rajabhat University, Thailand
[2] Department of Botany, University of Mandalay, Myanmar
[3] Department of Botany, University of Yangon, Myanmar

Abstract

This research studies, the diversity of culinary herbs and ethnobotany in Hlawga Wildlife Park in Yangon City, Republic of the Union of Myanmar from July, 2013 to October, 2014. A walking survey of plant diversity and three sizes of exploration blocks of the forest areas are conducted: 400 square meters, 16 square meters and 1 square meter, to collect data on trees, shrubs, climbers, and herbaceous plants. The survey revealed that there are 29 families, 59 genera and 62 species of plants. The plants with density, frequency, dominance, relative density, relative frequency, relative dominance and importance value index are *Microcos paniculata L., Gmelina arborea Roxb.,* and *Markhamia stipulata* (Wall.) Seem. eg. K. Schum. from the interview with the locals, the results revealed that there are 5 types of plants according to their utilities and some are used for multiple purposes as follows: 1) culinary herbs: 8 families 9 genera 9 species; 2) edible plants: 9 families 16 genera 17 species; 3) medicinal plants: 9 families 11 genera 11 species; 4) construction materials: 17 families 25 genera 25 species; and 5) other purposes: 20 families 30 genera 31 species. The parts of plants which widely used are stems. The parts of plants which widely used for consumption are fruits. Medicinal plants also used in the treatment of hematologic diseases.

Keywords: culinary herbs, ethnobotany, Hlawga Wildlife Park

1. Introduction

Myanmar, a country with strong cultural heritage, is the largest in South-East Asia. This country is rich in diversified flora and fauna and has unique traditional medicine (TM) culture, which plays an indispensable role in promoting the health care system. A rich heritage of traditional medicine knowledge and the use of plants as medicine still exist in Myanmar which have been inherited from earlier generation [1].

Hlawga Wildlife Park is located in Mingladadon Division, Yangon City, Republic of the Union of Myanmar. The area of this park is 1540 acres comprising a wildlife park, a buffer zone and a mini-zoo including other various recreation centers. It is at 17°00′17″N96°06′44″E. There is more than 295 species of plant in Hlawga which is a significant source of medicinal plant supply. [2]

Ethnobotany is the local traditional knowledge of utilizing indigenous plants, such as for foods, medicines and tools which local people have been practicing for a long time. The utilization of plant species found in nature varies in each region [3]. The development of ethnobotany is expected to bring significant economic benefits, and scientific research is required to provide the evidence base for the development of the active ingredients of traditional medicines. Ethnobotany also protects cultural heritage, inspire more studies of traditional medicines, and provides a basis for the discovery of new drug [4].

Today, rapid socioeconomic development, continued deforestation and environment degradation in many parts of Myanmar result depletion of medicinal plants and their associated knowledge. Therefore, the main objective of this study is to assess the diversity of ethnobotany plants used by local people in Yangon for the conservation of biological resources and their sustainable utilization.

* Corresponding author; e-mail: peangjai04@hotmail.com

2. Materials and methods

1. The study area is conducted in Hlawga Wildlife Park, Yangon City, Republic of the Union of Myanmar between July, 2013 to October, 2014.

2. To study the ecology of culinary herbs and ethnobotany in 15 exploration blocks using purposive random sampling. The classification and analysis techniques of Kutintara (1998) [5] are applied to analyze the density, frequency, dominance, relative density, relative frequency, relative dominance and importance value index of plants.

3. Collect voucher specimens and transfer to the laboratory for further identification. Plants specimens are identified as belonging to families and species base on Flora of Thailand, Flora of the Malay Penisular, Flora of British India and specialists.

4. Studies the utilization of plant using the knowledge and wisdom of local citizen and folk medicine by interview and rapid ethnobotanical appraisal (REA).

3. Results and discussion

Ethnobotany plants

The studies in diversity of culinary herbs and ethnobotany in Hlawga Wildlife Park, Yangon City, Republic of the Union of Myanmar revealed that there are 29 families, 59 genera, and 62 species which divided into 6 groups according to life form such as tree, small tree, scandent shrubs, climbing and herb. The useful plants species are mostly trees of 43 species where as 10 are shrubs, 4 are scandent shrubs, 3 are climbing and 1 for shrub and herb (Table 1).

The Hlawga Wildlife Park is dry evergreen forest. The plants with highest density, frequency, relative dominance, relative frequency, dominance, relative dominance and importance value index are *Microcos paniculata* L., *Gmelina arborea* Roxb. and *Markhamia stipulata* (Wall.) Seem. ex K. Schum. The results of interview in the utilization of plants indicated that there are 5 categories as follows; 1) culinary herbs: 8 families 9 genera 9 species; 2) edible plants: 9 families 16 genera 17 species; 3) medicinal plants: 9 families 11 genera 11 species; 4) construction materials: 17 families 25 genera 25 species; and 5) other purposes: 20 families 30 genera 31 species (Table 1). Additionally, some are used for multiple purposes with various parts of plant as root, stem, leaf, flower, fruit, seed, and whole plant (Table 2).

Table 1 The classification of plant by the utilization of local resident and habit

Category	**Taxonomic rank**			**Number of species categorized by habit**					
	Families	**Genera**	**Species**	**Tree**	**Small tree**	**Shrub**	**Scan S**	**Climbing**	**Herb**
All ethnobotanical	29	59	62	43	10	1	4	3	1
Culinary Herb	8	9	9	3	3	1	-	1	1
Edible	10	16	17	12	5	-	1	1	1
Medicinal	9	11	11	6	2	2	1	-	-
Construction materials	17	25	25	21	3	-	-	1	-
Other purposes	20	30	31	27	2	1	-	1	-

Notes: Some species overlapped among these five categories

Table 2 The utilization composition of plant in Hlawga Wildlife Park, Yangon City, Republic of the Union of Myanmar

Category	No. of species of plant parts						
	Root	**Stem**	**Leaf**	**Flower**	**Fruit**	**Seed**	**Whole plant**
Culinary Herb	1	3	6	-	3	-	1
Edible	-	-	2	3	14	-	-
Medicinal	-	5	1	-	3	1	1
Construction materials	-	25	-	-	-	-	-
Other purposes	1	25	-	1	4	-	-

Culinary Herbs

From the results, there are 8 families, 9 genera 9 species of culinary herbs. The most parts which widely used are leaf (*Combretum latifolium* Blume, *Bridelia tomentosa* Blume., *Tamarindus indica* Linn., *Clatoxylum neriifolium* Kurz, *Microcos paniculata* L., *Premna amplectens* Wall., *Clerodendrum serratum* Spreng.), fruit (*Bridelia tomentosa* Blume., *Microcos paniculata* L.), root (*Combretum latifolium* Blume) and whole plant (*Peperomia pellucida* (L.) H.B.R., *Premna amplectens* Wall.), respectively (Table 3). There are 7 species of culinary herbs that found in Thailand but not utilize as culinary herb in Myanmar (*Spondias mangifera* Willd., *Bridelia ovata* Decne., *Terminalia bellerica* (Gaertn.) Roxb., *Careya arborea* Roxb., *Senna siamea* (Lam.) Irwin & Barneby, *Ziziphus rugosa* Lam., *Bauhinia acuminata* L.) [6-12].

Edible Plants

From the results, there are 9 families, 16 genera 17 species of edible plants. The most parts which widely used are fruit (*Swintonia floribunda* Griff., *Spondias mangifera* Willd., *Stereospermum neuranthum* Kurz, *Terminalia bellerica* (Gaertn.) Roxb., *Baccaurea flaccida* Muell. Arg., *Bridelia ovata* Decne., *Dalbergia volubilis* Roxb., *Bauhinia acuminata* L., *Flacourtia cataphracta* Roxb., *Neolitsea umbrosa* (Nees) Gamble, *Artocarpus chaplasha* Roxb., *Ficus glomerata* Roxb., *Ziziphus rugosa* Lam., flower (*Radermachera glandulosa* (Blume) Miq., *Markhamia stipulata* (Wall.) Seem. ex K. Schum., *Senna siamea* (Lam.) Irwin & Barneby) and leaf (*Dalbergia lakhonensis* Gagnep, respectively (Table 3). The use of edible plant is closely similar in Thailand [6, 7, 9, 10].

Medicinal Plants

From the results, there are 9 families, 11 genera 11 species of herbal plants. The most parts which widely used are bark and wood (*Holarrhena pubescens* Wall. ex G. Don, *Dipterocarpus alatus* Roxb., *Salacia chinensis* L., *Celtis tetrandra* Roxb., *Gmelina arborea* Roxb.), fruit (*Holigarna kurzii* King, *Phyllanthus emblica* L., *Bridelia ovata* Decne.), seed (*Cassia fistula* L.), leaf (*Uvaria cordata* Schum. & Thonn.), and whole plant (*Chromolaena odorata* (L.) R.M.), respectively (Table 3). The 18 species are not reported as medicinal plants in Myanmar but applied in Thailand (*Strychnos nux-vomica* L., *Vitex peduncularis* Wall., *Mitragyna rotundifolia* Roxb., *Ficus hispida* Linn. L. f., *Lannea coromandelica* (Houtt.) Merr., *Spondias mangifera* Willd., *Markhamia stipulata* (Wall.) Seem. ex K. Schum., *Garuga pinnata* Roxb., *Schleicera oleosa* (Lour.) Oken, *Diospyros ehretioides* Wall., *Salacia chinensis* L., *Butea monosperma* (Lam.) Kuntze, *Garcinia cowa* Roxb., *Lagerstroemia floribunda* Jack, *Ixora pubirama* Bremek., *Nephelium ramboutan-ake* (Labill.) Leenh., *Celtis tetrandra* Roxb., *Gmelina arborea* Roxb.). The 3 species have same properties *Chromolaena odorata* (L.) R.M., *Bridelia tomentosa* Blume. and *Phyllanthus emblica* L. [8-12].

Construction materials

From the results, Bignoniaceae (3 genera, 3 species) and Euphorbiaceae are the most common tree for timber in making houses and utensil (Table 3). The 6 species have the same utilization as Thailand (*Dipterocarpus alatus* Roxb., *Neolitsea umbrosa* (Nees) Gamble, *Lagerstroemia floribunda* Jack, *Homalium tomentosum* Benth., *Berrya ammonilla* Roxb. and *Celtis tetrandra* Roxb.) [13].

Other Purposes

From the results, there are 31 species of plants are used for other purposes. The most common purposes are to sculpture the Buddha images; 3 species (*Syzygium cumini* (L.) Skeels, *Ziziphus rugosa* Lam., *Ixora pubirama* Bremek.), to make dyeing color for textile and hair; 3 species (*Holigarna kurzii* King, *Anogeissus acuminata* Wall., *Engelhardtia spitata* Blume), to make refreshment; 2 species (*Strychnos nux-vomica* L., *Ficus hispida* Linn. L. f.), to make bird food; 1 specie (*Vitex peduncularis* Wall.) and to make fishing bait; 2 species (*Butea parviflora* Roxb., *Strychnos nux-vomica* L.) (Table 3). The use of plant is similar to Thailand except *Holigarna kurzii* King, *Anogeissus acuminata* Wall. and *Engelhardtia spitata* Blum [13].

Table 3 Ethnobotanical plants in Hlawga Wildlife Park area used by villagers

Families/Species	Habit	Category					Plants/Application
		Cu	Ed	Me	Co	Ot	
Anacardiaceae							
1. *Holigarna kurzii* King	T			+		+	Stems , barks and leaves for relieve inflammation pain and fever Bark for dye
2. *Lannea coromandelica* (Houtt.) Merr.	T					+	Wood for firewood
3. *Swintonia floribunda* Griff.	T		+				Fruits were eaten
4. *Spondias mangifera* Willd.	T		+				Fruits were eaten
Annonaceae							
5. *Uvaria cordata* Schum. & Thonn.	S			+			Leaves for catarrh
Apocynaceae							
6. *Alstonia scholaris* (*L.*) *R. Br*.	T	+					Bark for bakery and for carminative and Malaria
7. *Holarrhena pubescens* Wall. ex G. Don	ST			+			Fruits and fruits for indigestion, dysentery, flatulence
Asteraceae							
8. *Chromolaena odorata* (L.) R.M.	S			+			Whole plant for wound healing
Bignoniaceae							
9. *Markhamia stipulata* (Wall.) Seem. ex K. Schum.	T		+		+		Flowers and fruits use for vegetable salad, Wood for constructions
10. *Radermachera glandulosa* (Blume) Miq.	T		+		+	+	Flowers and fruits use for vegetable salad, Wood for constructions and firewood
11. *Stereospermum neuranthum* Kurz	T		+		+	+	Leaves were eaten, Wood for constructions and fire wood
Burseraceae							
12. *Garuga pinnata* Roxb.	T					+	Wood for firewood
Combretaceae							
13. *Anogeissus acuminata* Wall.	T					+	Bark for dye

14. *Combretum latifolium* Blume	C	+					Leaves were eaten, Roots for anaplastic thyroid cancer
15. *Terminalia bellerica* (Gaertn.) Roxb.	T					+	Fruits used for fuel oil
Crypteroniaceae							
16. *Crypteronia paniculata* Blume	T				+	+	Wood for constructions and firewood
Dipterocarpaceae							
17. *Dipterocarpus alatus* Roxb.	T			+	+	+	Barks use for external lotion, Wood for constructions and firewood
Ebenaceae							
18. *Diospyros ehretioides* Wall.	T				+	+	Wood for constructions and firewood
Euphorbiaceae							
19. *Baccaurea flaccida* Muell. Arg.	T		+		+		Fruits were eaten, Wood for constructions
20. *Bridelia ovata* Decne.	ST		+		+		Fruits were eaten, Wood for constructions
21. *Bridelia tomentosa* Blume.	ST	+				+	Leaves were eaten, Fruit for blood disease, Wood for firewood
22. Phyllanthus emblica L.	T			+			Fruits for common cold, fever, common cold, fever, tonic, stomatic, antipyretic, hair tonic, anti-inflammatory, peptic ulcer, dyspepsia, digestive, wound healing, detoxification and rejuvenation
23. *Salacia chinensis* L.	Scan S			+			Roots, barks, stems for antidiabetics, rheumatism, skin disease
Fabaceae							
24. *Albizia odoratissima* (L. f.) Benth.	T					+	Wood for firewood
25. *Bauhinia acuminata* L.	ST		+				Leaves were eaten
26. *Butea monosperma* (Lam.) Kuntze	T					+	Wood for firewood
27. *Butea parviflora* Roxb.	C					+	Fruits were bait for fishing
28. *Cassia fistula* L.	T			+			Fruits and seeds for constipate
29. *Dalbergia lakhonensis* Gagnep	T		+			+	Young leaves were eaten, Wood for fire wood
30. *Dalbergia volubilis* Roxb.	C				+		Wood for constructions

31. *Senna siamea* (Lam.) Irwin & Barneby	T		+		+	Flowers were eaten, Wood for firewood
32. *Tamarindus indica* Linn	T	+		+		Leaves and fruits were eaten, Fruits for digestive, carminative and laxative Wood for constructions
Flacourtiaceae						
33. *Flacourtia cataphracta* Roxb.	T		+	+		Fruits were eaten, Wood for constructions
34. *Homalium tomentosum* Benth.	T			+	+	Wood for constructions and firewood
Hypericaceae						
35. *Clatoxylum neriifolium* Kurz	T	+				Leaves were eaten and for laxative
36. *Garcinia cowa* Roxb.	T			+	+	Wood for constructions and firewood
Juglandaceae						
37. *Engelhardtia spitata* Blume	T				+	Barks were used dye for hair and clothes
Lauraceae						
38. *Neolitsea umbrosa* (Nees) Gamble	ST		+	+		Fruits were eaten, Wood for constructions
Lecythidaceae						
39. *Careya arborea* Roxb.	T			+		Wood for constructions
Loganiaceae						
40. *Strychnos nux-vomica L.*	T				+	Roots for brew and baits for fishing
Lythraceae						
41. *Duabanga grandiflora* Walp.	T			+	+	Wood for constructions and firewood
42. *Lagerstroemia floribunda* Jack	T				+	Wood for firewood and charcoal
Moraceae						
43. *Artocarpus chaplasha* Roxb.	T		+		+	Leaves were eating, Wood for firewood
44. *Ficus glomerata* Roxb.	T		+	+		Fruits were eaten, Wood for constructions
45. *Ficus hispida* Linn. L. f.	ST		+	+		Fruits were eaten, Wood for constructions
Myrtaceae						
46.*Cleistocalyx nervosum* (DC.) Kosterm.	T				+	Wood for firewood
47.*Syzygium cumini* (L.) Skeels	T				+	Wood used to sculpture the Buddha images
Piperaceae						
48. *Peperomia pellucida* (L.) H.B.R.	H	+				Whole plant were eaten, Whole plant for asthma

Rhamnaceae						
49. *Ziziphus rugosa* Lam.	ST		+		+	Fruits were eaten, Fruits were used to sculpture the Buddha images
Rubiaceae						
50. *Ixora pubirama* Bremek.	S				+	Flowers were used for worship to Buddha
51. *Mitragyna rotundifolia* Roxb.	T			+	+	Wood for constructions and firewood
52. *Stephegyne parvifolia* Korth.	T			+	+	Wood for constructions and firewood
Sapindaceae						
53. *Nephelium ramboutan-ake* (Labill.) Leenh.	T		+	+		Fruits were eaten, Wood for constructions
54. *Schleicera oleosa (Lour.) Oken*	ST		+			Fruits for menstrual disorder
Sterculiaceae						
55. *Pterospermum semisagitatum* Buch.-Ham.	T			+	+	Wood for constructions and firewood
Tiliaceae						
56. *Berrya ammonilla Roxb*.	T			+		Wood for constructions
57. *Microcos paniculata* L.	ST	+				Fruits were eaten, leaves used for wound cleaning lotion
Ulmaceae						
58. *Celtis tetrandra* Roxb.	T		+			Seeds used for indigestion
Verbenaceae						
59. *Clerodendrum serratum* Spreng.	S	+				Leaves were eaten and menstrual disorder
60. *Gmelina arborea* Roxb.	T		+	+		Flowers for blood disease, Wood for constructions
61. *Premna amplectens* Wall.	ST	+				Leaves were eaten, Whole plants for menstrual disorder
62. *Vitex peduncularis Wall.*	T			+	+	Wood for constructions, Fruits for feeding birds

***Remark** Cu: Culinary Herbs, Ed: Culinary Plant, Me: Herbal Plant, Co: trees for timber in making houses and utensils, Ot: plants for other purposes

4. Conclusions

Myanmar has a rich biodiversity including plant genetic resources which result from altitude and climate also rich heritage of traditional knowledge of the use of plants as medicine. However, only 29 families, 59 genera and 62 species of plants used were recorded in Hlawga Wildlife Park which are lower than expected compares to the rich of natural resources. This might result from the change in the life style of people in new generation. However, the result of study would be benefit as fundamental knowledge to discover new medicine.

Acknowledgements

We are very grateful to Bureau of the budget, The Prime Minister's Office for providing research funding. We also thank all the officers in Hlawga Wildlife Park and all participants for their cooperation.

References

[1] Awale S, Linn TZ, Than MM, Swe T. The healing art of traditional medicines in Myanmar. J. Trad Med. 2006;23: 47-68.

[2] Wikipedia. Hlawga Wildlife Park. Online resources [cited 2012 July 12]. Available from : <https://en.wikipedia.org/wiki/Hlawga_National_Park>

[3] Santasombat Y. Biodiversity and indigenous knowledge for sustainable development. Chiang Mai ; Chiang Mai University. 2001. (in Thai)

[4] Chang N, Luo Z, Li D and Song H. Indigenous uses and pharmacological activity of traditional medicinal in Mouth Taibai, (Online) Available from; https://doi.org/10.1155/2017/8329817. 2017.

[5] Kutintara U. Ecology fundamental basics in Forestry. Bangkok ; Kasetsart University. 1998. (in Thai).

[6] Thailand Institute of Scientific and Technological Research. Edible plants in Sakaerat I. Bangkok; SE-EDUcation. 2008. (in Thai).

[7] Thailand Institute of Scientific and Technological Research. Edible plants in Sakaerat II. Bangkok; SE-EDUcation. 2009. (in Thai).

[8] Phonsena P. Medicinal plants in Khao Hin Son herb garden. Prachinburi; Jetanaromphan. 2007. (in Thai).

[9] Suksri S, Premcharoen S, Thawatphan C, Sangthongprow S. Ethnobotany in Bung Khong Long Non-Hunting area, Northeast Thailand. Kasetsart J. (Nat. Sci.) 39;519-533.

[10] Pawaputanon Na Mahasarakham P. Plant diversity and ethnobotanical studies at Bung Cheelong fresh water swamp forest. Bangkok; Kasetsart University. 2002. (in Thai).

[11] Khuankaew S, Srithi K, Tiansawat P, Inta A, Wangpakakapattanawong P. Ethnobotanical study of medicinal plants used by Tai Yai in Northern Thailand. Journal of Ethnopharmacology 151, 829-838.

[12] Inta A. Ethnobotany and crop diversity of Thai Lue and Akha commun lies in upper Northern Thailand and the Xishuangbanna Dai autonomous prefecture, China. Chiang Mai; Chiang Mai University. 2008.

[13] Veesommai U, Kavduengtian P. Wild tree in Thailand I. Bangkok; H N group. 2004. (in Thai).

Comparison of Radiation Interaction of Clay and Autoclaved Aerated Concrete Bricks for Radiation Shielding Properties

Kittipong Siengsanoh[1,2*], Pruittipol Limkitjaroenporn[2,3], and Jakrapong Kaewkhao[1,2]

[1]Physics Program, Faculty of Science and Technology, Nakhon Pathom Rajabhat University, Nakhon Pathom, 73000, Thailand

[2]Center of Excellence in Glass Technology and Materials Science (CEGM), Nakhon Pathom Rajabhat University, Nakhon Pathom, 73000, Thailand

[3]Industrial Physics Program, Faculty of Science and Technology, Nakhon Pathom Rajabhat University, Nakhon Pathom, 73000, Thailand

Abstract

This research studied the radiation interaction of gamma rays with clay and autoclaved aerated concrete bricks. The clay and autoclaved aerated concrete bricks were determined by used gamma rays spectrometer with Compton scattering arrangement for energy variation and analyzed the composition by X-ray Fluorescence Spectroscopy (XRF). The results were determined mass attenuation coefficient values from theory by WinXCom program and experiment respectively. The Z_{eff} and the N_{el} value were studied for radiation shielding properties of the clay and autoclaved aerated concrete bricks. This research was found that the clay brick had good radiation properties than autoclaved aerated concrete. The experimental values had good agreement with theoretical values.

Keywords: autoclaved aerated concrete, clay brick, mass attenuation coefficient

1. Introduction

Humans have studied and researched in many ways. To make advances in science and technology Science and technology have a role in human's daily life in both industrial aspect agricultural aspect medical aspect including how to use the ray to preserving food by using solar powered oven ,Nuclear power plant by using radioactive substances ,X-raying ,Radiation destroys cancer cells , MRI or CT Scan and so on[1]. As mentioned Radiation is very useful to humans ,However we have to know and understand the correct way to using because radiation also dangerous to a creature, for example, the explosion of nuclear reactor of Chernobyl nuclear power plant in Ukraine on date 26 April 1986 and Earthquake in Japan on date 11 March 2011 which makes reactor lack of coolant the increasing of heat is making melt and radiation leakage ,but radiation is a particular that unable to be known by the human senses, so it unable to know that you already got radiation into your body or not for the safety a person who concern about radioactive need to find the solution to protect damage from radioactive for reduce risk from receiving radioactive by unreasonable based on the principle from International Radiation Protection Organization ALARA (As Low As Reasonably Achievable) by spend the least time to work Use the longest distance and use radiation shielding for protect the body to gain the excessive radiation standard[2]. Nowadays for prevent X-ray and gamma rays materials used for radiation shielding include lead, concrete, steel[3]. From the principle as said so study Interaction between gamma rays and clay bricks and autoclaved aerated concrete. Which used for housing to study radiation shielding properties [4].

In the present there is a high amount of usage gamma rays. It needs to prevent the danger of gamma rays, coupled with the utilization. The residency or house in the present are made from clay bricks or and autoclaved aerated concrete, hence house is a very important factor for prevent radiation that cannot be avoided such as Living near industrial plants or a place where the source of radiation[5]. This research takes 2 of clay bricks and autoclaved aerated concrete to study interaction between ray with clay bricks and autoclaved aerated concrete.

* Corresponding author; e-mail: first_f@windowslive.com

2. Research objective

2.1 Study radiation interaction between clay and autoclaved aerated concrete bricks for radiation shielding properties.

2.2 Compare the value from experiment and theory values of clay and autoclaved aerated concrete bricks.

3. Materials and methods

3.1 Measurement of physical properties of samples

The samples, while the measurement of physical properties was measured density of samples following the relation:

$$\rho = \frac{W_a}{W_a - W_b}\rho_b \quad \textbf{(1)}$$

where ρ is density of sample, W_a is the weight of sample in air, W_b is the weight of sample in water and ρ_b is the density of water.

The analysis of element composition to identify the weight percent in the samples were measured with X-ray fluorescence spectrometer (XRF), Minipal-4, Panalytical. XRF is helpful and accurate analytical instrument widely used for determining element composition in unknown materials. The present weight percent of element composition of samples.

3.2 Gamma-ray shielding studies procedure

The shielding properties of samples were calculated with two processes, first: theoretical calculation were calculate with WinXCom program, second: experimental calculation were calculation with the data from experimental procedure.

3.2.1 Theoretical and Experimental calculation

In this part, the data from XRF, weight percent of element composition of each samples were input in WinXCom. The mass attenuation coefficient (μ_m) in unit (cm^2/g) were calculated with energy range from 223 - 662 keV, based on the rule of mixture:

$$\mu_m = \sum_i w_i (\mu_m)_i \quad \textbf{(2)}$$

where w_i is the weight fraction of element i in samples and $(\mu_m)_i$ is mass attenuation coefficient for individual element i in samples. The value of mass attenuation coefficient μ_m depends on density of the samples, can be used to determine the total atomic cross-section ($\sigma_{t,a}$) following relation:

$$\sigma_{t,a} = \frac{(\mu_m)_{soils}}{N_A \sum_i^n (w_i / A_i)} \quad \textbf{(3)}$$

where N_A is Avogadro's number and A_i is the atomic weight of each element *i* of the samples. Furthermore, the total cross-section ($\sigma_{t,el}$) is following relation:

$$\sigma_{t,el} = \frac{1}{N_A} \sum_{i}^{n} \frac{f_i A_i}{Z_i} (\mu_m)_i = \frac{\sigma_{t,a}}{Z_{eff}} \quad \textbf{(4)}$$

where f_i is the number of atoms of element *i* relative to the number of atom of all elements in samples, Z_i is the atomic number of element *i* in element composition in samples and Z_{eff} is effective atomic number of samples explain with following relation:

$$Z_{eff} = \frac{\sigma_{t,a}}{\sigma_{t,el}} \quad \textbf{(5)}$$

The electron density (N_e) can be defined as the number of electrons per unit mass, and it can be mathematically written as follows [4-9]:

$$N_e = \frac{\mu_m}{\sigma_{t,el}} \quad \textbf{(6)}$$

4. Results and discussion

1. The component element of samples by XRF are result show in table 4.1 and 4.2.

Table 4.1 clay bricks's component elements

Compound	Si	K	Ca	Ti	Mn	Fe	Zn	Rb	Sr	Zr	Pb
Conc (%)	48.387	13.275	4.985	3.058	0.476	28.988	0.095	0.297	0.055	0.255	0.128

Table 4.2 autoclaved aerated concrete brick's component elements

Compound	Si	K	Ca	Ti	Mn	Fe	Cu	Zn	Rb	Sr	Zr
Conc (%)	13.776	1.073	78.162	0.547	0.098	6.013	0.025	0.039	0.031	0.139	0.098

2. The density of samples by Archimedes is principle with 4-position scales from AND company model HR-200 are show in Table 4.3.

Table 4.3 The average density of samples

Sample (brick)	Density (g/cm^3)
AAC	2.5241
Clay	2.5239

3. The mass attenuation coefficient of clay and autoclaved aerated concrete bricks for theoretical and experimental values are show in Table 4.4, Figure 1 and Table 4.5, Figure 2 respectively.

Table 4.4 Mass attenuation coefficient, μ_m of clay brick

Energy (Mev)	Theoretical value, μ_m (cm^2/g)	Experimental value, μ_m (cm^2/g)
0.228	1.22E-01	1.21E-01
0.249	1.17E-01	1.17E-01
0.29	1.10E-01	1.09E-01
0.341	1.02E-01	1.02E-01
0.415	9.41E-02	9.41E-02
0.488	8.78E-02	8.74E-02
0.573	8.18E-02	8.11E-02
0.662	7.66E-02	7.61E-02

Table 4.5 Mass attenuation coefficient of autoclaved aerated concrete

Energy (Mev)	Theoretical value, μ_m (cm^2/g)	Experimental value, μ_m (cm^2/g)
0.228	1.27E-01	1.27E-01
0.249	1.22E-01	1.19E-01
0.29	1.13E-01	1.12E-01
0.341	1.05E-01	1.04E-01
0.415	9.57E-02	9.57E-02
0.488	8.90E-02	8.86E-02
0.573	8.28E-02	8.21E-02
0.662	7.75E-02	7.71E-02

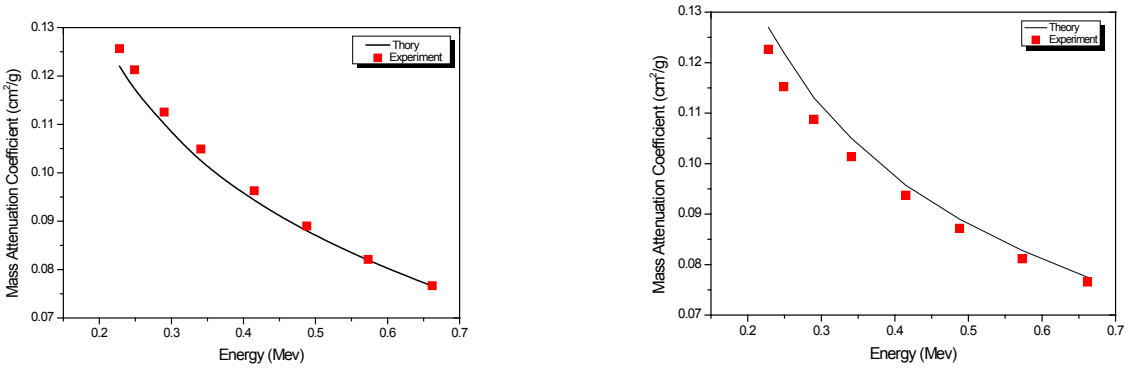


Figure 1 Mass attenuation coefficient and energy of clay brick (left) and autoclaved aerated concrete (right)

The mass attenuation coefficient and energy of clay brick and autoclaved aerated concrete were decrease with increasing gamma-rays energy. The two samples had same trend. The clay brick has more mass attenuation coefficient at all of the same gamma-rays energy.

4. The effective atomic number of clay and autoclaved aerated concrete bricks for theoretical and experimental values are show in Table 4.5, Figure 3 and Table 4.6, Figure 4 respectively.

Table 4.6 Effective atomic number, Z_{eff} value of the clay bricks.

Energy (Mev)	Theoretical value, Z_{eff} (electron/atom)	Experimental value, Z_{eff} (electron/atom)
0.25	1.14E+01	1.14E+01
0.29	1.14E+01	1.13E+01
0.34	1.13E+01	1.13E+01
0.42	1.13E+01	1.13E+01
0.49	1.13E+01	1.12E+01
0.57	1.13E+01	1.12E+01

Table 4.7 Effective atomic number, Z_{eff} value of the bricks of autoclaved aerated concrete.

Energy Mev	Theoretical value, Z_{eff} (electron/atom)	Experimental value, Z_{eff} (electron/atom)
0.23	2.08E+01	2.07E+01
0.25	2.04E+01	2.00E+01
0.29	2.00E+01	1.98E+01
0.34	1.97E+01	1.96E+01
0.42	1.95E+01	1.95E+01
0.49	1.94E+01	1.93E+01

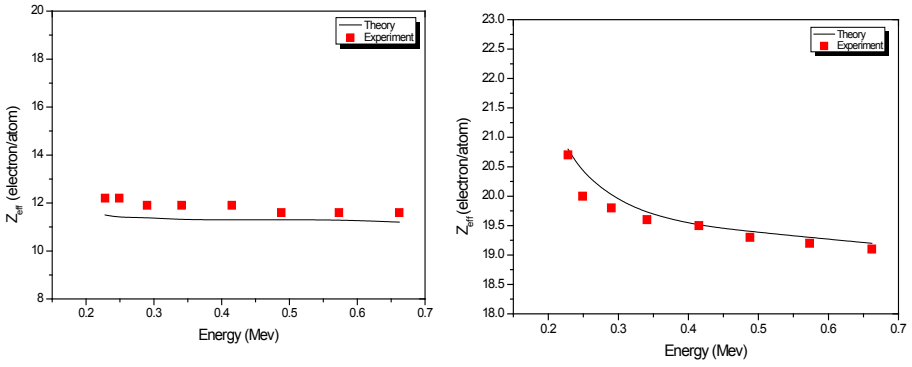


Figure 2 Effective atomic number, Z_{eff} value and energy of the clay bricks(left) and autoclaved aerated concrete(right)

The effective atomic number and energy of clay brick has small decrease with increasing gamma-rays energy and autoclaved aerated concrete was clearly decrease with increasing gamma-rays energy. The autoclaved aerated concrete has more effective atomic number at all of the same gamma-rays energy.

5. The electron density of clay and autoclaved aerated concrete bricks for theoretical and experimental values are show in Table 4.8, Figure 5 and Table 4.9, Figure 6 respectivel

Table 4.8 Electron density, N_{el} value of clay bricks.

Energy (Mev)	Theoretical value, N_{el} ($x10^{23}$electron/gram)	Experimental value, N_{el} ($x10^{23}$electron/gram)
0.228	3.04	3.02
0.249	3.03	3.02
0.29	3.01	2.99
0.341	3.00	2.98
0.415	2.99	2.99
0.488	2.98	2.97
0.573	2.98	2.96
0.662	2.98	2.96

Table 4.9 Electron density, N_{el} value of autoclaved aerated concrete.

Energy (Mev)	Theoretical value, N_{el} ($x10^{23}$electron/gram)	Experimental value, N_{el} ($x10^{23}$electron/gram)
0.23	3.24	3.23
0.25	3.19	3.13
0.29	3.13	3.09
0.34	3.08	3.06
0.42	3.04	3.04
0.49	3.03	3.01

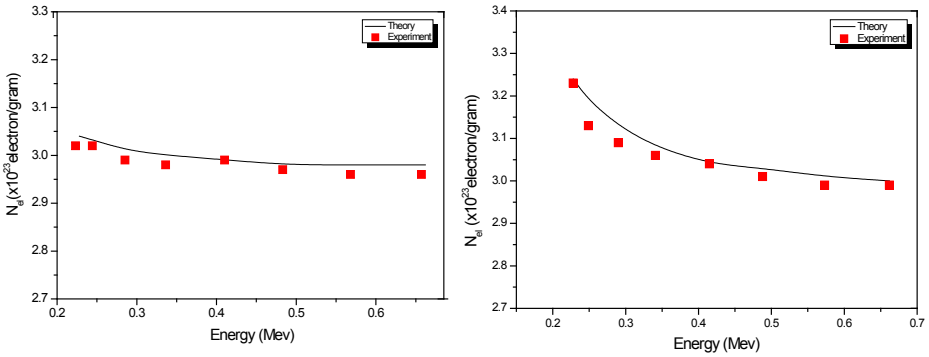


Figure 3 Electron density, N_{el} value and energy of clay bricks(left) and autoclaved aerated concrete.(right).

The electron density and energy of clay brick has small decrease with increasing gamma-rays energy and autoclaved aerated concrete was clearly decrease with increasing gamma-rays energy. The autoclaved aerated concrete has more electron density at all of the same gamma-rays energy.

5. Conclusions

This research has made an experiments for study interaction between radiation of gamma-rays and the clay brick aerated bricks to compare that which one has a best radiation shielding property from 2 samples are clay brick and aerated brick without chemical added then begin the experiments study property of both bricks the result can be concluded that

Property of clay brick and aerated brick from component analysis in both samples of bricks by using spectrometer x-rays energy distribution type. The result of chemical component in samples found high amount of Si , Ca and Fe which are the main components of both bricks ,but clay brick has Pb(0.128%) which not found in aerated brick and aerated brick contain Cu(0.025%) which this not available in clay brick.

Density (ρ) of clay brick and aerated brick from measurement of density of clay brick and aerated brick sample by used Archimedes' s principle with 4-position scales obtain the density of clay brick is 1.7 density value is 2.5241 and density of aerated brick is 1.8 density value is 2.5239 respective.

Mass attenuation coefficient from measurement of gamma-rays spectrometer then calculate mass attenuation coefficient of experiment and compare from theory which get from program winxcom we found that mass radioactive attenuation coefficient of clay brick and aerated brick are in the energy period 0.228 ,0.249 ,0.29 ,0.341 ,0.415 ,0.488 ,0.573 ,0.662 respective. The result shows that clay brick has a better shielding property than aerated brick.

Acknowledgements

The authors are grateful to thank Prof. L. Gerward, Technical University of Denmark for WinXCom software. J. Kaewkhao, Center of Excellence in Glass Technology and Materials Science (CEGM). I would like to thanks Nakhon Pathom Rajabhat University (NPRU).

References

[1] Tamil Nadu, India, Department of Physics, SSN College of Engineering, Kalvakkam, Chennai- 603110, Tamilnadu, India. Department of Physics, Government Arts College, Tiruvanamalai-606603, Tamilnadu, India. Radiation Safety Section, Radiological Safety Division, Indira Gandhi Centre for Atomic Research, Kalpakkam 603102, Measurements of Natural Gamma Radiations and Effects of Physico-Chemical Properties in Samples of Yelagiri Hills, Tamilnadu India with Statistical Approach, Procedia Earth and Planetary Science ,November 2015 ,Pages 531 – 538

[2] David Beamish, British Geological Survey, Enhancing the resolution of airborne gamma-ray data using horizontal gradients, Journal of Applied Geophysics ,Volume 132 , 7 July 2016 ,Pages 75–86

[3] Ramon Casanovas , Elena Prieto, Marçal Salvadó , Calculation of the ambient dose equivalent H*(10) from gamma-ray spectra obtained with scintillation detectors , Applied Radiation and Isotopes, Volume 118 , 27 August 2016, Pages 154–159

[4] N. Karunakara , Assessment of ambient gamma dose rate around a prospective uranium mining area of South India – A comparative study of dose by direct methods and sample radioactivity measurements, Results in Physics ,Volume 4 ,1 March 2014, Pages 20–27

[5] A.M. El-Khayatt,M.A. Al-Rajhi, Analysis of some lunar sample and rocks samples in terms of photon interaction and photon energy absorption, Advances in Space Research, Volume 55, Issue 7, 1 April 2015, Pages 1816-1822.

Session of Electrical Engineering and Technology

Investigating Electric Vehicle (EV) Charging Station Locations for Agartala, India

Somudeep Bhattacharjee[1], Saima Batool[2], Champa Nandi[1] and Udsanee Pakdeetrakulwong[3,*]

[1]Tripura University
[2]School of Information Systems, Curtin Business School, Curtin University
[3]Nakhon Pathom Rajabhat University

Abstract

Selecting the location for installing electric vehicles charging stations is important to ensure EV adoption and also to address some of the inherent risks such as battery cost and degradation, economic risks, lack of charging infrastructure, risky maintenance of EVs, problems of its integration in smart grid, range anxiety, auxiliary loads and motorist attitude. In this article, we investigate these problems by studying three aspects – 1) three types of electrical vehicle charging stations (Level 1, Level 2 and DC), 2) different types of batteries and 3) different types of electric vehicles. We compared and contrasted the features of these charging stations, batteries and EV to identify the best choice for a given scenario. We applied the framework proposed in [1], and used Agartala, India as a case study to identify location for charging stations in and around Agartala suburbs.

Keywords: Electric vehicle, charging stations, electric vehicle battery, charging stations location conditions, infrastructure

1. Introduction

An electric car is actually an alternative-design automobile that basically uses an electric motor to provide power to the car, with the electricity being provided by a battery. On the other hand, a conventional car does have a lead-acid battery as part of its standard equipment but this battery is used for operating the starter and not providing power to the vehicle. This technology works in this way that the electric vehicle uses a motor just like conventional, internal combustion engine cars. The main difference is that the electric vehicle power supply is derived from its battery-stored electricity and not from the mechanical power derived from burning gasoline. The electric vehicle replaces the traditional gasoline or diesel engine and fuel tank with an electric motor, a battery pack and controllers. The vehicle uses a controller that provides power to the electric motor that uses rechargeable batteries as its energy source. The motor itself can be either AC or DC. The main advantage of electric vehicle is mainly the motor and battery configuration. This allows the vehicle to run more fuel-efficiently. PHEV (plug in hybrid electrical vehicle) is a hybrid vehicle that can be plugged into the power grid for charging the battery. In this vehicle, a medium-capacity battery is available that helps the electrical vehicle in allowing it in all-electric modes , to achieve several kilometers , and acceleration rates and also it help to attain top speeds comparable to those of gasoline-powered vehicles. Examples: Chevrolet Volt (often classified as an E R E V), Ford C-Max and Fusion Energi, Cadillac E L R and Toyota Prius P H E V. On the basis of different types of power trains (or drive trains), hybrid electric vehicles can be classified into three categories: (1) Parallel hybrid, (2) Series hybrid, and (3) Power-split hybrid. Among these, the *parallel hybrid electric vehicle* is commonly adopted. PHEVs are usually consists of an electric motor and an additional ICE for propulsion. This mixed propulsion system helps in enabling PHEVs to be driven in two modes: charge depleting (CD) mode and charge sustaining (CS) mode. When this type of electric vehicles operated in CD mode then it mainly drawn energy from on-board battery packs. If the battery state of charge (SOC) has been depleted to a pre- determined level, PHEVs will then switch to CS mode and utilize the ICE system for further propulsion. When it is operated in CS mode, PHEVs combine both power sources so that it can operate as efficiently as possible. Meanwhile, the controller can monitor the battery SOC level and then maintain it with in a pre- determined band.

* Corresponding author; e-mail: udsanee@webmail.npru.ac.th

2. Objectives

Global warming is becoming a major problem and the best way to combat it is to reduce air pollution. Electric vehicles (EVs) are considered a best option to reduce air pollution and making environment safe again. In order to operate, electric vehicles need charging stations at suitable places. If appropriate and recommended places are not chosen then it will decrease the utilization, visibility and effectiveness of a charging station, which results in adoption of traditional carbon- emitting gasoline vehicles and a decrease in EV sales. Hence, it is very essential to carefully select locations for EV charging stations for promotion of EVs and the cause of avoiding global warming.

The main objective of this study is to determine the best locations for installing EV public charging stations in Agartala, India. Our selection for EV charging station location will depend on the set of conditions that have to be met in order to qualify for a place to be established as an EV public charging station. In addition, we will also determine the best type of charging station based on the type and charging duration of the particular EV type. Finally, this research will provide a specific and thorough insight of establishing EV public charging station in growing cities like Agartala, India.

3. Research Methodology

The framework proposed by [1], is used as a guideline to assess the implementation of EV charging infrastructure for Agartala city. To achieve this, 3 areas are studied 1) Different types of charging stations, 2) EV types, 3) battery types. First of all, different types of charging stations are studied and compared. Next, various types of EVs are analyzed thoroughly. Moreover, the charging vehicle location selection conditions, infrastructure and the best suitable places in Agartala are selected based on the electric vehicle charging station location selection conditions and the map of Agartala.

Preliminary Concepts

We know that as the global benefits of a serious energy crisis, alternative energy for sustainable development is renewable energy .The generation of this energy is pollution free and so this is the first choice of many countries of the world like the United states, Japan and Europe and so the development of electric vehicles is a way to save nature and to resolve important issue of planning the national grid. An electrical vehicle requires charging station and so the locations of charging station have to be determined carefully. A charging station is a location where an electric vehicle can be plugged in to have electric charge deposited in to their batteries. They are not chargers, but can be considered as an electrical energy source.

Different types of charging stations:

There are mainly three types of charging stations which are categorized as Level 1, Level 2 and DC charging stations.

LEVEL 1 Charging Station (120 volts and up to 16 amps):

In all electrical vehicles, an on-board Level 1 charger is equipped that can be plugged into any normal power outlet (C S A 5-15R*). It gives an advantage of not requiring any electrical work, or at least minimizes any installation costs. Table 1 shows the charging time using a Level 1 charger based on distance driven. 12-A charging cable and 120-V outlet is considered. Charging cable rated less than 12A require longer charging times [3].

LEVEL 2 Charging Station (240 volts and 12-80 amps):

In this type, the charging time of Level 2 charging stations can be limited by the specifications of the on-board charger and the state of the battery, irrespective of the rated power of the charging station. It is believed that the charger capacity is going to increase in future, for example, Tesla already offers on-board 10 kW and 20 kW chargers. Table 1 shows that level 2 charging stations takes less time to charge as compared to the level 1 charging stations even though the distance traveled is similar. Level 2 charging stations have smart and timeless design. It is simple to use (plug the EV in and let it charge). It helps in reducing energy consumption. In addition, it offers Ethernet network for Radio Frequency Identification (RFI) authorization and vehicle ground monitoring circuit. The cord holder keeps the cord organized and out of the way of parking spaces, sidewalks and streets, etc. One example of this is Schneider EV link Indoor Charging Station, which has ground monitor and user friendly LEDs to display status like charging, detected fault, power etc. It has the capability for automatic recovery and restart after ground fault interrupt or main power loss [1].

DC Fast Charging Station (480 volts and up to 125 amps):

DC fast-charge stations generally support two standards:

The North American S A E J 1772 Combo standard and the Japanese J E V S G105-1993* standard. The configuration of the charging plug and the electrical vehicle socket follows the same basic principle compared to the communication protocol between the charging station and the electrical vehicle but have different standards [1]. Table 1 shows the time required to charge a battery with a 100-km range to 80% of its full capacity.

Analysis of Different Charging Stations

Table 1 shows the comparison of different charging stations which are categorized as Level 1, Level 2 and DC charging stations based on electric vehicle distance travelled in km, estimated energy consumption of electric vehicle in kWh, charging station power of electric vehicle in kW, approximate charging time in hour.

Table 1: The comparison between different charging stations levels (Adopted from [1])

Different types of charging stations	DISTANCE TRAVELED (km)	APPROXIMATE ENERGY CONSUMPTION(kWh)	CHARGING STATION POWER(kW)	APPROXIMATE CHARGING TIME(h)
LEVEL 1(120 volts and up to 16 amps)	25	5.2	1.4	4
	50	10.4		8
	100	20.7		15
LEVEL 2 (240 volts and 12-80 amps) for 15-A station (240-V, 20-A two pole circuit breaker)	25	5.2	3.6	1.5
	50	10.4		3.0
	100	20.7		6.0
LEVEL 2 (240 volts and 12-80 amps) for 30-A station (240-V,40-A two pole circuit breaker):	25	5.2	7.2	0.75
	50	10.7		1.5
	100	20.7		3.0
DC fast charging (480 volts and up to 125 amps):	25	5.2	40	8
	50	10.4		16
	100	15.6		25

Why Level 2 charging station is more suitable?

The answer to this question lies in this fact that the most important condition for selecting an electric vehicle charging station location is that how much time is spend by the consumer for charging his vehicle in the charging station. So the time spend is an important factor.

From these charts, it is clear that for the same amount of distance travelled in km, electric vehicle required different charging time in each type of charging station .Also it is shown that Level 2 charging station provides facility to consumer to charge his vehicle in a very short time as compared to other types of charging station. The charts that are shown above prove this.

Types of Electric Vehicles (EVs)

EVs can be divided into the following categories. First, on-road highway speed vehicle that is an electrical vehicle capable of driving on all public roads and highways. The performance of these electrical vehicles is similar to Internal Combustion Engine vehicles. Second, the city electric vehicles, normally, the city electric vehicles have been BEVs (Battery Electric Vehicle - these vehicles can be powered 100% by the battery energy storage system available on-board the vehicle) that are capable of driving on most public roads, but basically not driven on highways. The maximum speed is typically limited to 55 mph. Third category of EVs is also known as low speed vehicles (LSVs). Actually they are BEVs that are limited to 25 mph and are allowed in certain jurisdictions to operate on public streets posted at 35 mph or less. Commercial On-Road Highway Speed

Vehicles is the last category of EVs. The commercial electric vehicles include commercial trucks and buses. These vehicles are available in both BEVs and PHEVs (Plug-in Hybrid Electric Vehicle – the vehicles utilizing a battery and an internal combustion engine (ICE) which is powered by either gasoline or diesel). Table 2 provides information on several different on-road highway speed electric vehicles, their battery pack size, and charge times at different power levels to replenish a depleted battery.

Table 2: Different types of EVs with battery pack size and charging times at different power levels (Adopted from [1])

EV Configuration	**Battery Size (kWh)**	**110 VAC, 15 amp kW[1]**	**110 VAC, 20 amp 1.5[1]**	**220 VAC, 40 amp** 6 kW[1]	**440 VAC, 85 amp 55 kW[1]**
PHEV-10	4	230 minutes	160 m	40 m	n/a
PHEV-20	8	440 m	320m	80 m	n/a
PHEV-40	16	870 m	640m	160 m	17 m
BEV	24	1308 m	960 m	240 m	26m
BEV	35	1910 m	1400 m	350 m	38m
PHEV Bus	50	n/a	n/a	500 m	55m

Note: Power delivered to battery is calculated as follows: 110VAC x 12Amps x.85 eff.; 110VAC x 16Amps x .85 eff.; 220VAC x 32 Amps x.85 eff.; 480VAC x √3 x 85 Amps x .85 eff. From Table 2, it is clear that different electric vehicle configuration require different charging time for different battery size at different power levels to replenish a depleted battery. This helps to find out the charging time in minutes required by different electric vehicle configurations of different battery size at different power levels. Using Table 3, we study the charging time for 100km of BEV range with power supply, power (in kW), voltage (in V) and maximum current (in A). It helps to show the relation of charging time of fixed 100km distance with its power supply, power (in kW), voltage (in V) and maximum current (in A). Thus, the driver finds charging an electric vehicle as simple as connecting a normal electrical appliance. In addition, Table 12 provides comparison between different recharge times of BEV for 100km range. Consequently, it seems clear that charging through single phase takes longer time then 10 minutes of direct current charging, that is the reason for advocating for DC charging infrastructure for EVs.

Table 3: Charging time for BEV range of Electric Vehicles (Adopted from [1])

Charging time for 100km of BEV range	**Power supply**	**Power(in kW)**	**Voltage(in V)**	**Maximum current (in A)**
6-8 hours	Single phase	3.3	230 V AC	16
3-4 hours	Single phase	7.4	230 V AC	32
2-3 hours	Three phase	10	400 V AC	16
1-2 hours	Three phase	22	400 V AC	32
20-30 minutes	Three phase	43	400 V AC	63
20-30 minutes	Direct current	50	400- 500 V DC	100-125
10 minutes	Direct current	120	300-500 V DC	300-350

ELECTRIC VEHICLE BATTERY

The electric vehicle battery is the core component of an electric vehicle with one of the two propulsion sources of HEV and PHEV. Basically, the battery is the sole propulsion source for BEV. There are still some constraints on present EV battery technology, which works as a barrier for wider EV uptake. The current EV battery has relatively low energy density. This low energy density directly affects the maximum all-electric drive range of

the EV. In addition, high battery cost of EV is also a big disadvantage as the purchase cost of EV is considerably higher than conventional internal combustion engine vehicle. Some concerns are also present about the battery life cycle and its safety features. However, EV battery goes through some tremendous improvements in the past decades. EV battery technology goes through a few development phases for inventing the battery with high-energy density, high power density, inexpensive, safe and durable. Lead-acid battery was the initial battery technology used in transportation and its name comes from the combination of lead electrodes and acid used to generate electricity. Lead-acid battery is a really a matured technology and also cheap. However, some apparent drawbacks of lead-acid battery are present, such as low energy density, heavy, require inspection of electrolyte level and are not environmentally friendly.

Table 4: Comparison of EV Battery Types and their specifications (Adopted from [3])

Battery type	Nominal voltage (V)	Energy density (Wh/ kg)	Volumetric energy density (Wh/L)	Specific power (W/kg)
Lead acid(Pb-acid)	2	35	100	180
Nickel-cadium(Ni-Cd)	1.2	50-80	300	200
Nickel-metal hydride(Ni-MH)	1.2	70-95	180-220	200-300
ZEBRA	2.6	90-120	160	155
Lithium-ion (Li-ion)	3.6	118-250	200-400	200-430
Lithium-ion polymer (LiPo)	3.7	130-225	200-250	260-450
Lithium-iron phosphate (LiFePO4)	3.2	120	220	2000-4500
Zinc-air (Zn-air)	1.65	460	1400	80-140
Lithium-sulfur (Li-S)	2.5	350-650	350	-

Table 5: Comparison of EV Battery Types and their specifications (Adopted from [3])

Battery type	Life cycle	Self-discharge (% per month)	Memory effect	Operating temperature (1C)	Production cost ($/kWh)
Lead acid(Pb-acid)	1000	<5	No	-15 to +15	60
Nickel-cadium (Ni-Cd)	2000	10	Yes	-20 to +50	250-300
Nickel-metal hydride(Ni-MH)	<3000	20	Rarely	-20 to +60	200-250
ZEBRA	>1200	<5	No	+245 to +350	230-345
Lithium-ion (Li-ion)	2000	<5	No	-20 to +60	150
Lithium-ion polymer (LiPo)	>1200	<5	No	-20 to +60	150
Lithium-iron phosphate (LiFePO4)	>2000	<5	No	-45 to +70	350
Zinc-air (Zn-air)	200	<5	No	-10 to +55	90-120
Lithium-sulfur (Li-S)	300	8-15	No	-60 to+60	100-150
Lithium-air (Li-air)	100	<5	No	-10 to +70	-

Charging Vehicle Location Selection

The sites of the charging station have a very significant impact loads, at this point, charging station is very similar to traditional gas station, charging station requires a higher penetration of electric vehicles in areas surrounding the construction of a natural high, such as new urban planning to support key enter prices and so on. Our work contributes to identify suitable locations for construction of public charging stations. In this paper we have analyzed possibilities of establishing a public EV charging station in Agartala, India in particular. Charging stations located along the highways are also in high demand since high speed EVs usually requires fast charging.

Public Charging Stations

In this section we will list and describe the most suitable charging locations for the installation of public charging stations. These charging stations can be located at parking lots that serve train stations, shopping centres, restaurants, hotels and resorts. When selecting a potential charging station, the following criteria should be considered.

Traffic density

The first criterion is traffic density. Traffic density is a necessary factor because the size of the installation should be related to be expected number of users. If the charging station is located near a major road, with high traffic density, then maximum number of people may use it for charging their electrical vehicles. However, areas with high traffic density are in densely populated locations, where the land value is significantly higher. One way to address this concern is to use land that is already allocated for traditional parking lots and convert them to EVSPLs (Electric vehicles solar parking lots) [4]. Further, these lots can also be converted to multi-level parking's where the EV can be on the top where they receive sunlight whereas the traditional vehicles can be underneath.

EV Charging Duration

The second criterion is EV charging duration; i.e. how long does it take to charge an electric vehicle. Electric vehicle need time to charge so it is necessary that the charging stations should be located near public places like shopping centres, work places, educational institutions so that people do not have to wait while their EVs are charging. The charging can happen while they are doing their usual activity such as being at work, weekly shopping etc. As (Nunes et al., 2016) suggests that public charging stations should be installed on worksites and public parks. This allows EV users to charge their EVs without having to wait [4].

Surrounding Vehicle Movement

The third criterion is the surrounding vehicle movement. This is important because charging vehicles must not hinder normal traffic flow, as it will become a hurdle, which may even cause accidents. Further, this location must not hinder pedestrian traffic or be subject to high pedestrian traffic because of the associated risk of vandalism. Public EV charging stations have numerous effects on its surrounding environment, transportation and energy needs and hence these implications have to be examined carefully [4]. One way of implementation would be along the street side parking bays. Electric vehicles (EV) have a very diverse characteristic, as it can act both as consumer and producer. In first case, EV's act as consumer, it is depended on renewable energy resources, batteries, smart grid (G2V- Grid to vehicle) and electric chargers to recharge. In second case, it is producer as well, as EVs can be an essential part of the smart grid. It can act as an energy producer since it stores energy and can provide it back to smart grid when the demand is at peak, this process is known as discharge or (V2G- vehicle to grid). Whereas, there are some concerns about customers' behaviour in participating in V2G programs that is uncertainty about their participation. Describing the solar panels on parking panels and its impacts on energy in the surrounding areas, it is evident that parking lots are a lot more visible and hence can attract potential customers for electric vehicles making EV adoption much more easier [4]. Consequently, EV adoption can have significant positive impacts on human health [4]. Another impact of solar parking lots is their benefit to local market. Since customers will choose a shopping centre with solar parking lots because it will charge their cars while they do their shopping. This will boost the local economy [4]. In addition, there will be lots of employment opportunities for the local technicians to install and maintain a solar parking lot [4]. Hence, installing a solar parking lot is beneficial in a number ways for a particular location like Agartala, India and its surrounding areas.

Winter Accessibility

The fourth criterion is winter accessibility. The location must be cleared and accessible during winter since some countries have severe winters [1]. The use of EVs should not depend on weather and hence EV public charging stations should be available at all times. Photovoltaic covered EV charging stations protect it from severe weather conditions like condensation, freezing rain and frost etc. [5].

Protection from Collisions

The fifth criterion is protection from collisions. The location must provide protection against collisions. It is necessary to provide protection for avoiding accidents and public property damage. Also for maintaining peace in the environment of the road by avoiding fights which may occur due to the collisions of vehicles [1].

Cellular network

The sixth criterion is cellular network access. Access to a cellular network is necessary if required by charging station [1]. Charging stations need to be in line of communication with smart grid since utilities like load management, peak demand and V2G programs depend on the communication that requires cellular network and Internet access as well. These two facilities can attract customers also since they cannot be out of coverage while present at a charging station. WIFI access can also help them connect to apps associated with their EVs and charging stations. In fact, public stations may provide telecommunications features, which will be different for different manufacturers. Many models contain transmitters compatible with cellular telephone networks and do not require additional infrastructure, while others will require a local wireless network, such as a ZigBee protocol network, which involves careful sitting of stations and transmitters. Also many stations communicate over a wired link, such as a twisted-pair or fiber-optic Ethernet network, which should be included in the design of the electrical installation.

Visibility

The seventh criterion is visibility of charging station. Visibility of the charging station to encourage its use by drivers is an important factor [1]. It helps to increase number of users. If users can see the station from far places then it will help them to locate the charging station that increases the use of charging station.

Feasibility of required excavation work and Proximity of distribution panel

The eight criterion is feasibility of required excavation work and the ninth criteria are proximity of distribution panel [1]. Where a distribution panel is the component of an electric panel, its function is is to divide the electricity feed to the “subsidiary” circuits [5]. Both of them are very important factor, which help to make the location more suitable for charging station. The proximity to the electrical service is an important factor in locating the public parking areas.

Table 6: Prime locations in Agartala and their mapping in different criteria

Location	Traffic Density	Surrounding vehicle movement	Winter accessibility	Protection from collisions	Cellular network	Visibility
Holy cross school	✓	✓	✓	✓		✓
Don Bosco School	✓	✓	✓	✓	✓	✓
the Agartala international school	✓	✓	✓	✓		✓
Henry Derozio School	✓	✓	✓	✓	✓	✓
Momos n More	✓	✓	✓	✓		✓
Raaste Cafe	✓	✓	✓	✓		✓
Hotel Sonari Tori	✓	✓	✓	✓	✓	✓
Hotel invitation, Royal Veg,	✓	✓	✓	✓		✓
Curry Club Restaurant	✓	✓	✓	✓		✓
Coffee Tea and Me	✓	✓	✓	✓		✓
Tripura Sundari College of nursing	✓	✓	✓	✓		✓
Women’s College	✓	✓	✓	✓		✓
Maharaja Bikram College	✓	✓	✓	✓		✓
BBM College	✓	✓	✓	✓		✓
Tripura Government College.	✓	✓	✓	✓		✓
CBI Office	✓	✓	✓	✓	✓	✓
Agartala municipal council office	✓	✓	✓	✓		✓

Location	Traffic Density	Surrounding vehicle movement	Winter accessibility	Protection from collisions	Cellular network	Visibility
Directorate of higher education office	✓	✓	✓	✓		✓
Tripura Public Service commission office	✓	✓	✓	✓		✓
Krishi Bhawan office.	✓	✓	✓	✓		✓
Office of the AG	✓	✓	✓	✓		✓
Hotel Welcome Palace	✓	✓	✓	✓	✓	✓
Hotel City Center	✓	✓	✓	✓	✓	✓
Executive INN	✓	✓	✓	✓	✓	✓
Hotel Jaipur Palace	✓	✓	✓	✓	✓	✓
Rajdhani Hotel	✓	✓	✓	✓	✓	✓
Royal Guest House (Hotel)	✓	✓	✓	✓	✓	✓
Ginger Hotel.	✓	✓	✓	✓	✓	✓
ILS Hospital	✓	✓	✓	✓	✓	✓
GB Pant Hospital	✓	✓	✓	✓		✓
Devlok Hospital	✓	✓	✓	✓		✓
GB Hospital Medical College	✓	✓	✓	✓		✓
Tripura Medical College	✓	✓	✓	✓		✓
Agartala Government Medical College	✓	✓	✓	✓		✓
GB Hospital	✓	✓	✓	✓		✓
Green Touch Resort	✓	✓	✓	✓	✓	✓
Shyamali Tourist Resort	✓	✓	✓	✓	✓	✓
Hotel Woodland Park	✓	✓	✓	✓		✓
Rose Valley Amusement park.	✓	✓	✓	✓		✓
Laxminarayan Bari Mandir	✓	✓	✓	✓		✓
Jagannath Mandir	✓	✓	✓	✓		✓
Iskcon Bari, Durga Bari	✓	✓	✓	✓		✓
Ummaneshwar temple	✓	✓	✓	✓		✓
Fourteen Gods Temple	✓	✓	✓	✓		✓
Tripura Sundari temple	✓	✓	✓	✓		✓
M L Plaza, Metro Baazar	✓	✓	✓	✓	✓	✓
Bag Bazar	✓	✓	✓	✓	✓	✓
Agartala City Center,	✓	✓	✓	✓	✓	✓
Femme Zone/FEM Salon and spa	✓	✓	✓	✓		✓
Saradamani Shopping mall.	✓	✓	✓	✓	✓	✓
Agartala airport parking place	✓	✓	✓	✓	✓	✓
Railway station parking place	✓	✓	✓	✓		✓
Rupasi cinema hall	✓	✓	✓	✓		✓
Balaka cinema hall	✓	✓	✓	✓		✓
Tripura puppet theatre	✓	✓	✓	✓		✓

Location Feasibility Analysis

For fast charging station infrastructure requires a concrete base and their installation is similar to that of street side locations. For this station, the conditions are:

The configuration of the station

The locations of any underground lines and tanks

The distance from the street(the charging cable must never extend over the sidewalk)

It required excavation work

The proximity of distribution panel

The planning of any underground conduits and excavation work.

It requires consultation with Info-Excavation before starting work.
The possibility of installing a concrete base
It requires contractor expertise (must have appropriate R B Q and C M E Q licenses).

For publicly available charging, the sitting requirements are involve many questions such as ownership, vandalism, payment for use and maintenance. Also we must take care that flood prone area restrictions must be considered as well as issues of standing water or high precipitation. The people will not be comfortable when operating with the EVSE (Electric Vehicle Supply Equipment – these equipment helps in the transfer of energy between the electric utility power and the electric vehicle.) in standing water. The area designated for Public use should be in a preferred parking area.

Installation Flowchart for Public Charging

The above flowchart summarizes the whole process of installing an EV public charging station. It starts with step one which is "consultation with utility" it includes utility consideration. The second step is "consultation with the governing authority", it includes all the steps associated with public planning. Then, the constructors "consult with the EV enthusiasts", these are the individuals or parties who want to promote and advertise EV and public charging stations. Subsequently, step four the builders consults the EV suppliers and EVSE suppliers that is determining the level of charging stations i.e level- 1, level-2 or fast DC charging stations. The step five of this charging station installation flow chart includes consultation with the local business owners for examples determining the quantity of solar energy for EVs. Step six, involves communication with electric contractors to assess the safety and accessibility measures for electric vehicle parking lots. Step seven, includes consultation with property owners and EV promoters. Step eight, involves the major step of developing the site plan development. It includes drawing the designs for electric vehicles parking lots. Step nine, includes obtaining required permits from government. Here all particular building rules should be satisfied. Step ten is the second last step of conducting installation. Step eleventh, in this step the construction of completed charging station is inspected and if every required is fulfilled then it is approved.

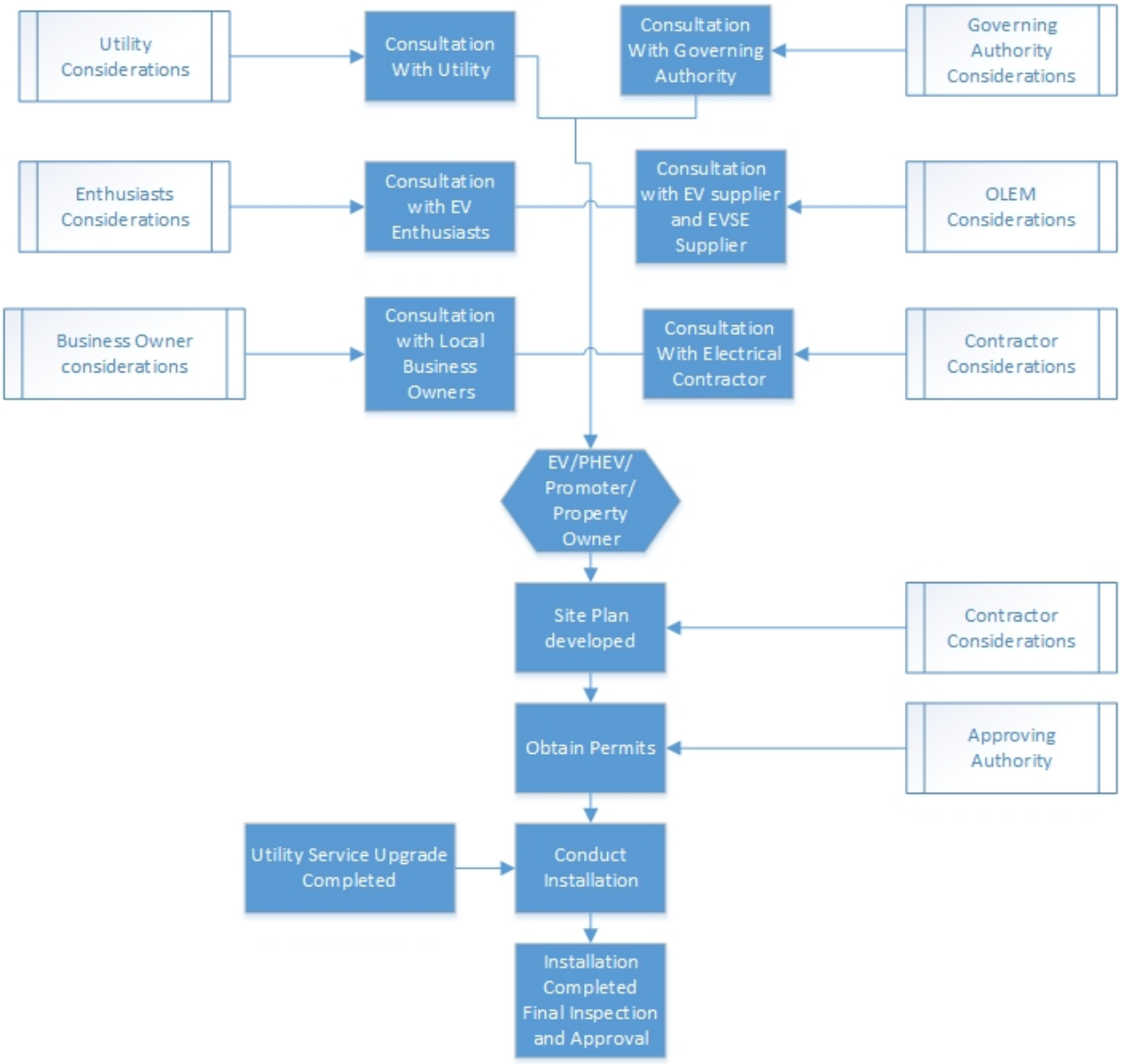


Figure 4 Installation flow chart for installing Public EV charging Station (Adopted from [6])

Proposed Locations for Charging Stations in Agartala

Based on the criteria discussed above, we have identified some places for placing an electrical vehicle charging station that is further divided into some categories:

Schools with parking place

Schools with parking places especially solar parking lots where EVs can recharge is one of the best scenarios. An EVSPL (electric vehicle solar parking lot) is suitable for schools since parents of the students can recharge their EVs while they come to school for any engagement. In the same way since schools have large parking lots specially so it can be an alternative place for recharging EVs when other solar parking lots are fully packed. In addition, number of schools are greater then rare EVSPLs so school locations with EVSPLs can be an effective of reducing "range anxiety" and can result in successful EV adoption.

Keeping in view the earlier mentioned criteria for EVPLs we have identified some schools. These schools' parking lots can be transformed in to EVSPLs. These schools are Holy cross school, Don Bosco School, the Agartala international school, Henry Derozio School.

Restaurant with parking places

Similarly the following places are suitable for EVSPLs. Momos n More, Raaste Cafe, Coffee Tea and Me, Hotel Sonari Tori, Hotel invitation, Royal Veg, Curry Club Restaurant.

College with parking place: Colleges that are suitable for constructing EVSPL are : Tripura Sundari College of nursing, Women's College, Maharaja Bikram College, BBM College, Tripura Government College.

Government offices with parking places: Government offices with EV charging stations can be an effective solution as well for strengthening EV market. CBI Office , Office of the AG, Agartala municipal council office, Directorate of higher education office, Tripura Public Service commission office, Krishi Bhawan office.

Hotel with parking places

These hotels with EV charging stations is ideal since they are public and potential customers spend more hours there. Hotel Welcome Palace, Hotel City Center, Executive INN, Hotel Jaipur Palace, Rajdhani Hotel, Royal Guest House (Hotel), Ginger Hotel.

Hospital with parking place

Hospitals with EV charging stations can be count on in times of emergency as well. ILS Hospital, GB Hospital, GB Pant Hospital, Devlok Hospital, Apollo Gleneagles Hospital Information Center, GB Hospital Medical College, Tripura Medical College, Agartala Government Medical College.

Resort with parking place: Resorts are also a better place to install public charging stations. Since, not only visitors visit this place but hotel staff and general public can also come to resorts for festive seasons. Hence, it becomes a densely populated area with requirement for a electric vehicle public charging stations. Some are of the suitable places for this purpose in Agartala India are Green Touch Resort, Shyamali Tourist Resort, Hotel Woodland Park, Rose Valley Amusement Park.

Temple with parking place

Temples are best locations for installing public electric vehicles charging stations since this is one of the public places with good space. Some of the appropriate places for setting up EV charging stations in temples of Agartala are: Laxminarayan Bari Mandir , Jagannath Mandir, Iskcon Bari, Durga Bari , Ummaneshwar temple, Fourteen Gods Temple, Tripura Sundari temple.

Shopping center with parking place

In addition, shopping centers are one of the most suitable place for public charging stations due to its parking requirements and the frequency of potential EV customers' visit. Some public charging stations can be installed in these shopping centres in Agartala i.e ML Plaza, Metro Baazar, Bag Bazar, Agartala City Center, Femme Zone/FEM Salon and spa, Saradamani Shopping mall.

Agartala airport parking place

Agartala airport parking place is another example of suitable place of installation of EV parking place due to the availability of parking space and public reach. Agartala airport can provide convenience for airport visitors, cab owners and staff of the airport. A public charging station installed at airport can also attract new EV customers due to its convenience.

Other public places for EV public charging stations installation

Subsequently, railway stations, petrol stations and cinema halls with parking spaces are ideal for constructing public EV charging stations. Due to high traffic density, visibility, availability of cellular network and the entire criterion based on above table we can suggest that the EV public charging stations should not only be installed here but it will also strengthen EV customer base in Agartala, India. Some places identified in this regard are Rupasi cinema hall, Balaka cinema hall and Tripura puppet theatre.

4. Future Work

It is better to visit each parking place then make a record of the number of users using these place, infrastructure is needed to make favorable electrical vehicle charging station or making a website showing locations of private and public charging stations in Agartala. It will increase more users and a website can be developed displaying the cost ratings and quality of charging stations in Agartala. We further check which type of charging stations are more suitable for the location based on the number of users utilising it.

References

[1] "ELECTRIC VEHICLE CHARGING STATIONS. Technical Installation Guide." [Online]. Available: http://docplayer.net/9608482-Electric-vehicle-charging-stations-technical-installation-guide.html. [Accessed: 01-Feb-2017].

[2] J. Y. Yong, V. K. Ramachandaramurthy, K. M. Tan, and N. Mithulananthan, "A review on the state-of-the-art technologies of electric vehicle, its impacts and prospects," Renew. Sustain. Energy Rev., vol. 49, pp. 365–385, Sep. 2015.

[3] P. Nunes, R. Figueiredo, and M. C. Brito, "The use of parking lots to solar-charge electric vehicles," Renew. Sustain. Energy Rev., vol. 66, pp. 679–693, Dec. 2016.

[4] T. Lepley and P. Nath, "Photovoltaic covered-parking systems using lightweight, thin-film PV," in Conference Record of the Twenty Sixth IEEE Photovoltaic Specialists Conference - 1997, 1997, pp. 1305-1308.

[5] "Distribution board," Wikipedia. 03-Mar-2017.

[6] "Electric Vehicle Charging Infrastructure Deployment Guidelines," Electric Transportation Engineering Corporation, Jul. 2009.

Session of Computer and Information Technology

Ontology-based Multi-agent Systems: An Overview of Existing Approaches

Pornpit Wongthongtham[1,*] Udsanee Pakdeetrakulwong[2,*] Suksawat Sae-Lim[2] and Atisak Chatcharoenporn[3]

[1]School of Information Systems, Curtin University, Western Australia, Australia
[2]Nakhon Pathom Rajabhat University, Nakhon Pathom, Thailand
[3]Advanced Info Service Public Company Limited, Thailand

Abstract

Software agent and multi-agent systems have attracted considerable attention and become active research areas in recent years. Furthermore, the advent of the Semantic Web technology has provided the underlying infrastructure that allows software agents to process data and performs sophisticated tasks on behalf of users. Consequently, the agent-based technology has become much more practical and the number of emerging real-world applications has increased, spanning a wide range of domains. In this paper, a survey of ontology-based multi-agent systems has been conducted and focused in particular on what they can assist users in software engineering domain. From the result of the survey, some open research issues that are used to outline the motivation for the future work are presented.

Keywords: Agent-based technology, Ontology-based multi-agent systems, Software agent

1. Introduction

The agent-based technology has become much more practical and has attracted considerable attention in recent years. Although an agent can work as a stand-alone entity to perform a particular task on behalf of a user, many of the agent-based applications are operated in environments that contain multiple agents collaboratively working together as a group, otherwise known as a multi-agent system. Multi-agent systems offer various advantages compared with a single agent, such as reliability and robustness, modularity, scalability, adaptability, concurrency, parallelism, and dynamism. They are employed in several real-world applications, spanning a wide range of domains such as e-learning, healthcare, web-services, supply chain management, etc.

This study is aimed at providing the understanding of ontology-based multi-agent systems and what they are used for in each domain. The main purpose is to identify the benefits and usefulness as well as the gaps or issues of the existing systems. The period of study is within the last ten years when those works have been presented in scientific conferences or journals. This paper is structured in the following manner. In Section 2, the background of software agent, multi-agent systems, and the integration of ontology and multi-agent systems are introduced. In Section 3, a survey of ontology-based multi-agent systems are presented. In Section 4, discussion of the surveyed systems and open research issues are described. In Section 5, conclusion and future work are presented.

2. Agent-Based Technology

2.1 Software Agent

The agent-based technology has attracted considerable attention and become active research areas in recent years. In addition, the advent of the Semantic Web technology has provided the underlying infrastructure that allows software agents to process data and perform sophisticated tasks on behalf of users. Regarding the term "agent", the following definition is widely accepted:

"An agent is a computer system that is situated in some environment and that is capable of autonomous action in this environment in order to meet its delegated objectives." [1]

Accordingly, the key properties of an agent are as follows [2, 3]

* Corresponding author; e-mail: [1*]ponnie.clark@curtin.edu.au, [2*]udsanee@webmail.npru.ac.th

- Autonomy: agents encapsulate some state and make decisions on what to do based on this state without the direct intervention of humans or others.
- Reactivity: agents are situated in an environment and are able to perceive this environment through their sensors. Then, through effectors, they respond in a timely fashion to changes that occur in their environment.
- Pro-activeness: agents do not simply act in response to their environment. They are able to exhibit goal-directed behaviour by taking the initiative.
- Social ability: agents are able to cooperate with humans and other agents in order to achieve their design objectives.

Software agents can be differentiated from traditional software applications in terms of certain characteristics. The differences between traditional software applications and software agents are presented in Table 1 which is adapted from [4].

Table 1 Differences between traditional software applications and software agents adapted from [4]

Characteristics	Traditional software applications	Software agents
Nature	Static	Dynamic
Autonomy	Follow instructions	Be able to perform tasks without direct control, or at least with the minimum of human intervention
Manipulation	User initiates every action	Sense the environment and react autonomously
Interactivity	Non-interactivity	Can interact with other agents, humans, or software programs
Temporal continuity	Terminate when process is complete	Continue to run over time (persistent)
Concurrency	Generate process in one dedicated server with limited processing power	Dispatch simultaneously to accomplish several parts of a task in parallel
Mobility	Stay in one place	Be able to travel from one machine to another

From Table 1, it is clear that the software agents are different from traditional software applications. Moreover, compared with the object-oriented paradigm, the agent technology can be considered as a descendant that improves the nature of passive objects with the notion of autonomous actors [5]. In contrast to simple objects with methods that can be invoked by other objects, an agent communicates with other agents by means of message-passing. In addition, it can act proactively to accomplish its individual goal. Agents can work as stand-alone entities to perform particular tasks on behalf of a user. However, many agent applications are based on environments that contain multiple agents collaboratively working together as a group. This is also known as a multi-agent system.

2.2 Multi-Agent System

Even though an individual agent can perform a task on behalf of a single user, its capacity is limited by its knowledge and resources. Thus, agents are usually implemented in a multi-agent context. A multi-agent system (MAS) consists of multiple agents acting in an environment to achieve a common goal or their individual goals [6]. There is an increasing interest in MAS research because of its significant advantages including its ability to solve problems that may be too large for a single agent. MAS allows a complex task to be decomposed into sub-tasks, each of which is then assigned to an individual agent to undertake independently, but which can be supported by a knowledge base. They have distributed architectures which control distribution by utilising the mechanisms of cooperation and coordination.

MAS have various advantages over a single agent, such as reliability and robustness, modularity, scalability, adaptability, concurrency, parallelism, and dynamism [7]. When a system is implemented based on MAS architecture, it is easy to add a new functionality or to modify an existing functionality. Within MAS, the functionality is created by calling the service that a particular agent offers. Therefore, in order to add a new functionality, a new agent responsible for a new service can be added into a system. In order to modify or improve the functionality of the system, the existing agent can be modified or substituted with a new one. In this case, a system is loosely coupled which means that it is easy to extend, remove, and modify without breaking down the system. In addition, MAS can make the system more fault-tolerant by replacing an agent that has crashed with a new agent that can be launched on the fly as a substitute for a failing agent [8].

MAS are suitable for applications that require distributed and concurrent processing capabilities. They are employed in the applications in several domains such as supply chain management [9-11], web-services [12, 13], healthcare [14-16], e-learning [8], etc. When a group of individual agents constitutes MAS, it is crucial to have a mechanism that can control such a group. Communication is a key for MAS to exhibit social behaviour (e.g., share information, coordinate their tasks). Individual agents in MAS interact with one another by exchanging messages using a specific Agent Communication Language (ACL). The purpose of ACL is to enable agents to convey messages to one another with meaningful statements [17]. Most ACLs are based on the speech-act theory. Speech acts are expressed by means of standard key words also known as communicative acts or performatives (e.g., request, inform, confirm, and propose). They are used to inform the intention of the communication from the sender to the receiver. The agent's message consists of various parameters such as sender, receiver, content language, ontology, and the actual content. Examples of well-known ACL languages are KQML (Knowledge Query and Manipulation Language) and FIPA-ACL (Foundations for Intelligent Physical Agents-Agents Communication Language) proposed by FIPA ([18]. FIPA is the relevant standardisation body that promotes agent-based technology and the interoperability of its standards with other technologies.

2.3 The integration of ontology and multi-agent systems

Ontologies play an important role in enabling knowledge representation, knowledge management, and knowledge sharing. Many applications benefit greatly from making use of ontologies as a means of achieving semantic interoperability among heterogeneous and distributed systems. They are considered as one of the key enablers for the emerging Semantic Web by making the Web content accessible to humans and computers [19]. Ontologies are in a machine-understandable and processable format, thereby enabling the software agents to understand the contents autonomously. Therefore, the integration of ontologies and multi-agent systems, also known as the ontology-based multi-agent approach, allows software applications to benefit from both technologies. For instance, ontologies can assist with data retrieval, while the agents can act as autonomous software entities that can interact with the environment and with other agents [20].

In recent years, the ontology-based multi-agent approach has attracted considerable interest in research to support various works operated in distributed and dynamic environments. The majority of research has focused on the use of ontology to facilitate agents' communication, represent domain knowledge and help to locate and retrieve information, and reasoning the knowledge.

- Facilitating agents' communication

In a multi-agent system, each agent usually cooperates with other agents to achieve a common goal; therefore, it needs the ability to communicate and interact with other agents by exchanging messages. The agent communication languages such as KQML and FIPA-ACL specify the syntax of the exchange messages but not the semantics of the messages. In this case, ontology can be additionally supplied in the messages to formalise the semantics of the exchanged message in a format that is understandable by agents in order to facilitate consistent communication and interoperability.

- Representing domain knowledge and helping to locate and retrieve information

Ontology can be used to describe domain knowledge and information content which is pertinent to that domain. With the use of ontologies in MAS, domain knowledge does not need to be embedded within the agents. Therefore, it creates an opportunity to share and reuse the domain knowledge and also has the potential to reuse the MAS infrastructure for other applications. Moreover, software agents have the ability to read and understand knowledge captured in ontologies. Therefore, they are able to locate and retrieve the information requested by their user.

- Reasoning the knowledge

The use of ontologies coupled with MAS can support knowledge representation and reasoning capabilities of software applications that are developed by deploying the MAS approach. The integration of ontologies in MAS can lead to the creation of logic rules that can be applied by a semantic reasoner to infer new knowledge not explicitly defined in ontologies [21].

The benefits of both technologies can be had by integrating ontology and MAS. Ontology is used for knowledge representation, knowledge integration, knowledge sharing and reuse. The features of the software agent and MAS, such as autonomy, reactivity, pro-activeness, social ability, adaptability and dynamism, provide a potential solution for applications that are complex, dynamic and distributed. Therefore, they can be deployed in the application if only one of the approaches cannot satisfactorily resolve the problem. As the ontology and agent-based technology address different aspects of the same problem, they complement each other. Therefore, the ontology-based multi-agent system has been chosen in research as described in the next section.

3. Ontology-based Multi-agent Systems

From the literature, it is evident that considerable efforts have been put into the integration of ontologies and multi-agent systems, also known as 'ontology-based multi-agent' approaches in order to disseminate the knowledge captured in ontologies. Furthermore, some researchers have mentioned them as a means of facilitating knowledge assimilation by capturing and incorporating the knowledge into the ontology knowledge base. These works encompass various domains including software engineering, health, and education, to name a few.

In the software engineering domain, a series of researches related to ontology-based multi-agent systems to support software development activities have been undertaken. MAEST [22] is a multi-agent system that is intended to assist testers during the testing process. An ontology for software testing is developed to model several aspects related to testing software systems such as testing activities, testing methods, software artefacts, information about the environment in which testing is conducted, available resources, and the requirements of the test results. The agents use this information as a means of sharing knowledge and facilitating consistent communications.

In [23], the authors propose an ontology-based multi-agent system to provide support for remote collaboration in multi-site distributed software development environments. In this work, agents are structured into two agencies, namely, user agency and the project agency to create Collaborative Working Spheres (CSW) for software developers to obtain information related to other remote team members' activities. A shared component ontology is created and used by the agents to facilitate consistent communication between the agents in different agencies.

Lee and Wang [24] introduce an ontology-based computational intelligent multi-agent for Capability Maturity Model Integration (CMMI) assessment. This system consists of three main agents interacting with one another to achieve the goal of effectively summarising the evaluation reports of the software engineering process in regard to CMMI assessment. The CMMI ontology is developed specifically based on the fundamental knowledge of the Process and Product Quality Assurance (PPQA) process area of CMMI. The software agents make use of the defined concepts in this ontology to extract key sentences from the evaluated reports in order to enable the relevant team members to comprehend it easily and quickly.

The integration of multi-agent systems and Software Product Lines (SPL) is addressed in [25]. It provides a solution for producing higher quality software at lower development costs and less time-to-market by taking advantage of agent technologies. The ontology is used to model the Multi-agent System Product Lines (MAS-PLs) domain. The agents use this ontology to facilitate inter-agent communication.

The authors of [26] and [27] propose a context processing mechanism called ContextP-GSD (Context Processing on Global Software Development) that utilises contextual information to assist users during the software development process. This mechanism applies agent-based technology to process contextual information and support human resource allocation.

The OntoDiSEN ontology [28] is developed to represent context information in a global software development environment. The software agents use this ontology for context information retrieval and reasoning. In addition, the authors claim that the proposed ontology agent can manipulate the ontology instance knowledge such as updating contextual information or inserting new inferred action and facts. However, no details are provided to show how the ontology agent can perform these tasks.

In [29], the authors offer a case study of an ontology-based multi-agent system in which collaborative agents are interacting and mediating with the Software Engineering Ontology to support multi-site software development teams.

For the health domain, Hadzic, Wongthongtham, Dillon and Chang [30] propose a framework to unify the multi-agent approach with the human disease ontology in order to create an intelligent information retrieval system for human disease. The proposed ontology represents the knowledge regarding human diseases. The agents make use of this ontology for information retrieval and information analysis and to facilitate consistent communications among agents and knowledge reasoning.

Wang, Lee, Hsieh, Hsu, Acampora and Chang [31] introduce an ontology-based multi-agent system for intelligent healthcare applications to assist users to evaluate diets. The ontologies have been developed to represent personal profiles and food models. Agents use these ontologies to analyse appropriate diet information based on a user profile. Li and Mackaness [32] develop a system that is based on a multi-agent architecture to support decision-making for epidemic management. The system is intended to enhance the performance of information retrieval in a dynamic decision-making environment. Inexperienced personnel can use this system to locate online data and to process services for spatio-temporal analysis of a specified environmental epidemic. Ontologies for dataset and service semantics are used to describe general concepts of GIS web service and epidemiology data management, while lightweight ontologies for simple spatial and temporal reasoning are used to add spatial and temporal semantics to the geospatial data. The agents utilise these ontologies to enable automated semantic service discovery and composition.

In educational domain, Oriche, Chekry and Khaldi [33] propose a semantic annotation system based on three main agents to manage the semantic annotation of educational resources. These agents utilise the domain ontology to assign domain knowledge to learning objects. Once these resources have been annotated, they are conceptualised and organised well so that they can be delivered to the users on demand according to their profiles and needs.

Dolia [34] presents an ontology-based multi-agent system to provide useful information regarding academic institutions such as course information, course registration and scheduling. The Academic Institute Ontology is developed to define concepts and relationships that exist in university teaching environments. The agents make use of this ontology to facilitate their understanding for consistent communication and to provide responses to various types of queries.

In [35] and [13], the authors propose an ontology-based multi-agent framework to automatically discover, compose, invoke and monitor web services. Several kinds of ontologies, namely, application and domain ontology, agent local knowledge ontology, negotiation ontology, and semantic web services ontologies are utilised in this framework. In these works, the agents make use of these ontologies to automatically discover, compose, and invoke the available web services, and to facilitate consistent agent communication. The researchers evaluated the proposed framework by applying it to the e-commerce and biology domains.

In [36], the authors develop an ontology-based multi-agent system to discover appropriate cloud services as requested by consumers. The system consists of three agents collaboratively working to provide dynamic searching for a cloud service. The Cloud Service Ontology is developed to represent cloud service description. The agents use this ontology for reasoning about the services and for information retrieval.

In addition to the abovementioned works, ontology-based multi-agent approaches have been used extensively in other domains. For example, Yang, Lo and Steele [37] introduce an ontology-based multi-agent system for the accommodation services industry to support the online accommodation market. The domain ontology is used to facilitate agent communication and collaboration as well as the development of an ontology-based data transformation mechanism for data structure translation.

Ying, Ray and Lewis [38] introduce MOMA, a framework for creating ontology-based multi-agent systems, and incorporated an experiment in financial application development. MOMA consists of two main development phases: ontology development and agent development. However, the researchers focus only on the development of ontology and the use of the ontology to drive the implementation of the agent application. The agent development part is treated as a black box, but no details are provided regarding the design of the agent's application. The agents make use of the ontology to facilitate consistent inter-agent communication and coordination.

Iribarne, Padilla, Ayala, Asensio and Criado [39] propose an ontological web trading agent approach for environmental information retrieval. This work attempted to address the complexity of information retrieval in the information system to support environmental management. The ontologies used in this system are

intended for information retrieval and to facilitate agent communication. Table 2 provides a summary of the aforementioned ontology-based multi-agent systems.

Table 2 Review of some existing ontology-based multi-agent systems

Application Domain	Source	Objectives of ontology-based multi-agent systems	Purpose of agent's use of ontology
Software Engineering	(Maamri and Sahnoun 2007) [22]	Provide assistance to software testers by automating the process of test.	- Represent domain knowledge about software testing - Facilitate agent communication
	(Palacio et al. 2009) [23]	Assist software development team to identify or create opportunities for remote collaboration establishment	-Facilitate consistent communication between the agents in different agencies.
	(Hadzic et al. 2009b) [29]	Provide support for multi-site software development teams as a communication framework	- Represent software engineering domain knowledge - Information retrieval - Facilitate agent communication
	(Lee and Wang 2009) [24]	Summarise the evaluation reports of the software engineering process in regard to CMMI assessment	- Use defined concepts to extract the key sentences from the evaluated reports - Support reasoning of the term relation
	(Nunes et al. 2011) [25]	Provide a solution for producing higher quality software at lower development costs and less time-to-market	- Facilitate inter-agent communication
	(Monte-Alto et al. 2012) [26]	Process contextual information and support human resource allocation	- Contextual information retrieval - Knowledge reasoning
	(Teixeira and Huzita 2014) [27]	Support human resource allocation in globally distributed software projects.	- Information retrieval - Knowledge reasoning - Knowledge manipulation
Health	(Hadzic et al. 2009a) [30]	Intelligent and dynamic information retrieval of human disease information	- Represent medical domain knowledge regarding human diseases - Information retrieval and analysis - Facilitate agent communication - Knowledge reasoning
	(Wang et al. 2010) [31]	Evaluate the health of diets	- Represent personal profile and food model - Information analysis
	(García-Sánchez et al. 2008) [35]	Dynamically retrieve biological information	-Facilitate agent communication and coordination - Information retrieval
	(Li and Mackaness 2015) [32]	Enhance the performance of Epidemiology information retrieval in a dynamic decision-	- Information retrieval - Spatial and temporal reasoning

Application Domain	Source	Objectives of ontology-based multi-agent systems	Purpose of agent's use of ontology
		making environment	
Education	(Dolia 2010) [34]	Provide useful information for users in academic institutes	- Facilitate the interactions among different agents - Information retrieval
	(Oriche, Chekry and Khaldi 2013) [33]	Automate the semantic annotation of educational resources	- Assign domain knowledge to educational resources
E-commerce	(Yang, Lo and Steele 2007) [37]	Support communication, interaction, and management among different parties engaged in the accommodation e-market	- Facilitate agent communication - Describe agent services
	(García-Sánchez et al. 2009) [13]	Facilitate the selection of the provider whose proposal best matches the users' preferences	-Facilitate agent communication and coordination - Information retrieval
Finance	(Ying, Ray and Lewis 2013) [38]	Automate some market analysis tasks	- Represent financial domain knowledge - Facilitate agent's communication and collaboration
Environment	(Iribarne et al. 2014) [39]	Address the complexity of information retrieval in the information system supporting environment management	- Information retrieval - Facilitate agent communication
Cloud service	(Parhi, Pattanayak and Patra 2015) [36]	Discover appropriate cloud services as requested by consumers	- Represent cloud service description - Reasoning - Information retrieval

4. Discussion and open research issues

In this section, with the survey conducted in the previous section, we will discuss the open issues that can be addressed to help to increase the quality of future ontology-based multi-agent systems. Although there is substantial literature on ontology-based multi-agent systems, the existing approaches have two shortcomings that this paper intends to address, namely, the ontology-based multi-agent system for manipulating ontology instances, and the ontology-based multi-agent system that can provide support covering various activities in the software development life cycle.

First, in the literature, most of the ontology-based multi-agent systems focus on facilitating the dissemination of knowledge captured in the ontology. However, very little attention has been paid to utilising the ontology-based multi-agent approach for assimilating knowledge captured in the ontology, i.e., the ontology instantiation manipulation. The purposes for which the software agents make use of the ontology can be categorised as follows:

- representing application and domain knowledge (e.g., [22], [29], [24], [31], [38], [36])
- locating and retrieving the information (e.g., [13], [26], [29], [30], [32], [35], [39])
- reasoning the knowledge (e.g., [26], [27], [29], [32], [35], [39])
- facilitating agents' communication (e.g., [22], [37], [13], [34], [25], [38], [39])
- Maamri and Sahnoun 2007; Yang, Lo and Steele 2007; García-Sánchez et al. 2008; Hadzic et al. 2009a; Hadzic et al. 2009b; Palacio et al. 2009; García-Sánchez et al. 2009; Dolia 2010; Nunes et al. 2011; Ying, Ray and Lewis 2013; Iribarne et al. 2014); and
- facilitating semantic annotation of resources (e.g., [33]).

Although some research (e.g., [26],[27]) mentions the utilising of software agents to manipulate the ontology instantiations, no details or supporting information are provided to explain how the agents work on the ontology manipulation task. Because software agents are able to read and reason published knowledge with the

guidance of the ontology [29], it would be a challenge to utilise the ontology-based multi-agent approach for assimilating knowledge in order to manage the evolution of ontology instantiations.

Second, over recent years, the deployment of ontology-based multi-agent systems for effectively disseminating software development knowledge to support software team members has become more prevalent. Nevertheless, many of the works are specific in that they address only a particular task or a certain issue. Thus, it would be a challenge to investigate the use of the ontology-based multi-agent approach to provide useful support for software development team that can cover several tasks spanning the software life cycle.

5. Conclusion and future work

In this paper, we have summarized state of the art ontology-based multi-agent systems proposed in several domains. From the survey, we identify some open research issues for the future research on the ontology-based multi-agent systems. In the future work, we outline the motivation of our research on developing a novel methodology to use utilise the ontology-based multi-agent approach for assimilating knowledge in order to manage the evolution of ontology designed for multi-site software development instantiations.

References

[1] M. Wooldridge, An Introduction to Multiagent Systems: John Wiley & Sons, 2009.

[2] M. Wooldridge, and N. R. Jennings, “Intelligent agents: Theory and practice,” The knowledge engineering review, vol. 10, no. 02, pp. 115-152, 1995.

[3] N. R. Jennings, “On agent-based software engineering,” Artificial Intelligence, vol. 117, no. 2, pp. 277-296, 2000.

[4] E. Turban, R. Sharda, and D. Delen, Decision Support and Business Intelligence Systems: Prentice Hall Press, 2010.

[5] L. Braubach, A. Pokahr, D. Bade, K.-H. Krempels, and W. Lamersdorf, "Deployment of distributed multi-agent systems," Engineering Societies in the Agents World V: 5th International Workshop, ESAW 2004, Toulouse, France, October 20-22, 2004. Revised Selected and Invited Papers, M.-P. Gleizes, A. Omicini and F. Zambonelli, eds., pp. 261-276, Berlin, Heidelberg: Springer Berlin Heidelberg, 2005.

[6] D. Ye, M. Zhang, and A. V. Vasilakos, “A Survey of Self-Organization Mechanisms in Multiagent Systems,” IEEE Transactions on Systems, Man, and Cybernetics: Systems, vol. PP, no. 99, pp. 1-21, 2016.

[7] A. H. Elamy, “Perspectives in agent-based technology,” AgentLinkNews, vol. 18, pp. 19-22, 2005.

[8] K. Terje, and D. Marius, “Design and development of a multi-agent e-learning system,” International Journal of Agent Technologies and Systems (IJATS), vol. 7, no. 2, pp. 19-74, 2015.

[9] H. A. Rady, “Multi-agent system for negotiation in a collaborative supply chain management,” International Journal of Video & Image Processing and Network Security IJVIPNS-IJENS, vol. 11, no. 5, 2011.

[10] R. Zimmermann, Agent-based Supply Network Event Management, Switzerland: Birkhäuser Verlag, 2006.

[11] L. D. Ngan, and R. Kanagasabai, “Semantic Web service discovery: State-of-the-art and research challenges,” Personal and Ubiquitous Computing, vol. 17, no. 8, pp. 1741-1752, 2013.

[12] G. Mohamed, and D. Makhlouf, “To implement an open-MAS architecture for Semantic Web services discovery: what kind of P2P protocol do we need?,” International Journal of Agent Technologies and Systems (IJATS), vol. 3, no. 6, pp. 58-71, 2014.

[13] F. García-Sánchez, R. Valencia-García, R. Martínez-Béjar, and J. T. Fernández-Breis, “An ontology, intelligent agent-based framework for the provision of Semantic Web services,” Expert Systems with Applications, vol. 36, no. 2, Part 2, pp. 3167-3187, 3//, 2009.

[14] A. Dolgui, J. Sasiadek, M. Zaremba, N. Benhajji, D. Roy, and D. Anciaux, “15th IFAC Symposium onInformation Control Problems in Manufacturing Patient-centered multi agent system for health care,” IFAC-PapersOnLine, vol. 48, no. 3, pp. 710-714, 2015/01/01, 2015.

[15] E. Shakshuki, and M. Reid, “Multi-agent system applications in healthcare: Current technology and future roadmap,” Procedia Computer Science, vol. 52, pp. 252-261, 2015.

[16] D. Isern, D. Sánchez, and A. Moreno, “Agents applied in health care: A review,” International Journal of Medical Informatics, vol. 79, no. 3, pp. 145-166, 3//, 2010.

[17] S. Vaniya, B. Lad, and S. Bhavsar, “A Survey on Agent Communication Languages,” in International Conference on Innovation, Management and Service, Singapore, 2011.

[18] "The Foundation for Intelligent Physical Agents," January 5, 2016; http://www.fipa.org.

[19] L. Li, B. Wu, and Y. Yang, “Agent-based ontology integration for ontology-based applications,” in Proceedings of the 2005 Australasian Ontology Workshop - Volume 58, Sydney, Australia, 2005, pp. 53-59.

[20] N. O. Garanina, E. A. Sidorova, and E. V. Bodin, "A multi-agent approach to unstructured data analysis based on domain-specific onthology." pp. 122-132.

[21] A. Freitas, A. R. Panisson, L. Hilgert, F. Meneguzzi, R. Vieira, and R. H. Bordini, "Integrating ontologies with multi-agent systems through CArtAgO artifacts." pp. 143-150.

[22] R. Maamri, and Z. Sahnoun, “MAEST: multi-agent environment for software testing,” Journal of Computer Science, vol. 3, no. 4, pp. 249-258, 2007.

[23] R. R. Palacio, A. L. Moran, V. M. Gonzalez, and A. Vizcaino, "Providing Support for Starting Collaboration in Distributed Software Development: A Multi-agent Approach." pp. 397-401.

[24] C.-S. Lee, and M.-H. Wang, “Ontology-based computational intelligent multi-agent and its application to CMMI assessment,” Applied Intelligence, vol. 30, no. 3, pp. 203-219, 2009/06/01, 2009.

[25] I. Nunes, C. P. Lucena, U. Kulesza, and C. Nunes, "On the development of multi-agent systems product lines: A domain engineering process," Agent-Oriented Software Engineering X, Lecture Notes in Computer Science, pp. 125-139: Springer Berlin Heidelberg, 2011.

[26] H. Monte-Alto, A. Biasão, L. Teixeira, and E. Huzita, "Multi-agent applications in a context-aware global software development environment distributed computing and artificial intelligence," Advances in Intelligent and Soft Computing, pp. 265-272: Springer Berlin / Heidelberg, 2012.

[27] L. O. Teixeira, and E. H. M. Huzita, "DiSEN-AlocaHR: A multi-agent mechanism for human resources allocation in a distributed software development environment," Distributed Computing and Artificial Intelligence, 11th International Conference, S. Omatu, H. Bersini, M. J. Corchado, S. Rodríguez, P. Pawlewski and E. Bucciarelli, eds., pp. 227-234, Cham: Springer International Publishing, 2014.

[28] A. P. Chaves, I. Steinmacher, L. Leal, G. Camila, E. H. M. Huzita, and A. B. Biasão, “OntoDiSENv1: An ontology to support global software development,” CLEI Electronic Journal, vol. 14, no. 2, pp. 2-2, 2011.

[29] M. Hadzic, P. Wongthongtham, T. Dillon, and E. Chang, "Case study II: Ontology-based multi-agent system for software engineering studies," Ontology-Based Multi-Agent Systems, Studies in Computational Intelligence, pp. 217-270: Springer, 2009.

[30] M. Hadzic, P. Wongthongtham, T. Dillon, and E. Chang, "Case Study I: Ontology-Based Multi-Agent System for Human Disease Studies," Ontology-Based Multi-Agent Systems, Studies in Computational Intelligence, pp. 179-216: Springer Berlin Heidelberg, 2009.

[31] M.-H. Wang, C.-S. Lee, K.-L. Hsieh, C.-Y. Hsu, G. Acampora, and C.-C. Chang, “Ontology-based multi-agents for intelligent healthcare applications,” Journal of Ambient Intelligence and Humanized Computing, vol. 1, no. 2, pp. 111-131, 2010.

[32] S. Li, and W. A. Mackaness, “A multi-agent-based, semantic-driven system for decision support in epidemic management,” Health Informatics Journal, vol. 21, no. 3, pp. 195-208, September 1, 2015, 2015.

[33] A. Oriche, A. Chekry, and M. Khaldi, “Intelligent agents for the semantic annotation of educational resources,” International Journal of Soft Computing and Engineering (IJSCE) vol. 3, no. 5, pp. 2231-2307, 2013.

[34] P. M. Dolia, “Integrating ontologies into multi-agent systems engineering (MaSE) for university teaching environment,” Journal of Emerging Technologies in Web Intelligence, vol. 2, no. 1, pp. 42-47, 2010.

[35] F. García-Sánchez, J. T. Fernández-Breis, R. Valencia-García, J. M. Gómez, and R. Martínez-Béjar, “Combining semantic web technologies with multi-agent systems for integrated access to biological resources,” Journal of Biomedical Informatics, vol. 41, no. 5, pp. 848-859, 10//, 2008.

[36] M. Parhi, B. K. Pattanayak, and M. R. Patra, "A multi-agent-based framework for cloud service description and discovery using ontology," Intelligent Computing, Communication and Devices: Proceedings of ICCD 2014, Volume 1, C. L. Jain, S. Patnaik and N. Ichalkaranje, eds., pp. 337-348, New Delhi: Springer India, 2015.

[37] K. Yang, A. Lo, and R. Steele, “An Ontology-based Multi-Agent System for the Accommodation Industry,” in The Thirteenth Australasian World Wide Web Conference, AusWeb07, New South Wales, Australia, 2007, pp. 193-205.

[38] W. Ying, P. Ray, and L. Lewis, “A methodology for creating ontology-based multi-agent systems with an experiment in financial application development,” in System Sciences (HICSS), 2013 46th Hawaii International Conference on, Wailea, Maui, Hawaii, USA, 2013, pp. 3397-3406.

[39] L. Iribarne, N. Padilla, R. Ayala, J. A. Asensio, and J. Criado, “OntoTrader: An ontological web trading agent approach for environmental information retrieval,” The Scientific World Journal, vol. 2014, pp. 25, 2014.

[40] H. Hammouch, H. Medromi, and A. Sayouti, "Toward an intelligent system for project management based on the multi agents systems." pp. 1-6.

Evaluation of Linux I/O Schedulers on SSD for HDFS

Kritwara Rattanaopas[1,*], Sureerat Kaewkeeree[2], Sarapee Chunkaew[1] and Supawadee Mak-on[3]

[1] Computer Department, Faculty of Science and Technology, Songkhla Rajabhat University, Songkhla, Thailand
[2] Department of Computer Engineering, Faculty of Engineering, Prince of Songkla University Hatyai, Thailand
[3] Department of industrial, Rajamangala University of Technology Srivijaya Rattaphum College

Abstract

HDFS is base storage of Hadoop cluster and it directly affects Hadoop performance. This research focuses on HDFS storage and we purpose Linux disk scheduler for increasing HDFS storage performance in virtualization environment and SSD. We use TestDFSIO to evaluate Linux disk scheduler with HDFS storage over SSD and use Flexible IO to compare HDFS storage performance with local SATA disk and NFSv4-SSD. In HDFS storage, we use Linux disk scheduler include CFQ, NOOP and Deadline. The results show that HDFS storage performance has better performance than NFSv4-SSD with NOOP and Deadline schedulers. Also, their performance has a better than local with SATA disk. Moreover, we create a fail scenario which shot down one data node when use Flexible IO. The results present a similar performance as other HDFS storages. In TestDFSIO, Deadline has more performance than other disk schedulers. Moreover, the least IO performance of disk scheduler is CFQ. In Flexible IO, Hadoop's NFSv3 gateway is mounted by client and evaluated by FIO read command. The results show HDFS storage cases having similar performance to NFSv4-SSD.

Keywords: HDFS, CFQ, Deadline, NOOP, TestDFSIO

1. Introduction

Storage is a basic device for all computers. There are also various types of storage. The network attach storage is one of the most popular type since a study of the Internet Data Center (IDC) found that the capacity of a new storage can grows up to 100TB. In Big Data era, the new storage platforms or models has been proposed including Amazon (DynamoDB), MongoDB, DataStax (Distribution of Apache Cassandra), Amazon (EMR), Cloudera (Hadoop), Hortonworks (Hadoop), MapR (Hadoop), Microsoft (HDInsight), and Pivotal (HD). Nowadays, many open-source storages are based on Hadoop HDFS. It has a reliable disk cluster because its architecture is the distributed technology that distributed raw data across all nodes. HDFS is based on Google's GFS (Google File System), it combines all physical redundant storages to one logical amount of data. All Service of data center can attach HDFS storage with Network File System (NFS) or Filesystem in Userspace (FUSE). Moreover, it can provide data over HTTP which is called Hadoop HDFS over HTTP (HttpFS). The last one, NFS gateway of HDFS is easy to use and customize for all services similar to NFS server in data center. This research chooses NFSv3 gateway to evaluate the distributed network storage which is the most popular storage along others distributed storage (e.g. Ceph [7] and GlusterFS [8]) because HDFS use to store data for Hadoop. It has more challenge to improve the performance because its performance will directly affect Hadoop performance.

HDFS node must assign directory path for storing data. On each node, it has the various types of disk scheduler including CFQ, NOOP and Deadline. The Linux disk schedulers are one of the popular topics in Virtualization's researches [1][2] which found a better performance by using disk scheduler with virtual machine. They attempt to use disk scheduler with Solid State Disk (SSD) in the virtualization environment. SSD is a new type of disk storage providing high-IOPS for enterprise storage device. It also uses semiconductor devices (solid state memory). The benefit of using SSD is a fast-access like memory or RAM-disks because it is based on Dynamic Random Access Memory (DRAM). Even though it has a better performance than the magnetic disk, but its price is extremely expensive. In Big Data era with Linux I/O Schedulers, we can increase performance with the configuration of disk storage by using Linux disk scheduler on various types of the Big data processing including Terasort, Wordcount and TestDFSIO in Hadoop. In best practices of Hadoop

* Corresponding author; e-mail: kritwara.ra@skru.ac.th

performance-tuning [3], researchers suggested to use the Linux disk scheduler in OS Configuration Tuning topic. This research has the current hypothesis about using Linux disk scheduler with SSD in order to evaluate a storage performance of HDFS storage. In Young Jin Yu's research 0 can increase a disk performance of SSD with block I/O scheduler that not only SSD has a benefit from I/O performance but also we can investigate Linux disk scheduler to improve better than default performance with SSD. Linux disk scheduler is the most popular method which is intermediate software between operating system layer and physical storage device. In this research, we use the virtualization environment of Kernel-based Virtual Machine (KVM) which is the most popular of open-source virtualizations. It is also supported in OpenStack. In Amazon EMR, it is the most popular web service based on Hadoop on virtualization environment same environment as this research. Amazon's Hadoop services are fast and cost-effective to use Big Data analytic. By the motivation of the similarity of the idea to this research, we deploy test-bed architecture in the private cloud by using KVM.

This research is including Background review and related works, Materials and methods, Evaluation and Conclusion. This session related work and background information (e.g. HDFS, Linux disk scheduler and NFS). All Linux disk schedulers with HDFS storage are describe in our methodology. In evaluation, we use Hadoop benchmark and Flexible IO for file benchmark in every scenario. In concluding, we present a performance and future works.

2. Research objective(s)

To present a comparison of storage performance on SSD by using Linux disk scheduler in Hadoop HDFS storage.

3. Background and related work

This section, we review the related components of this research including Hadoop, Hadoop Distributed File System, Linux disk scheduler, Network file system and Flexible IO. In related work, we describe related topic in distributed storage with Linux disk scheduler.

3.1 Hadoop

Currently, Big data analytic is the most popular topic in Big data processing. Hadoop cluster is the best answer for this solution and widely used with commercial support which include Cloudera, Hortonworks and MapR. It is not only contributed by Apache which is the creator and the original developer of Hadoop. Hadoop is a portable program over the Java JDK. The Hadoop Distributed File System (HDFS) is a logical storage that is created from local directory on each node of Hadoop cluster. Moreover, Hadoop has more various softwares including Hive which is a relational warehouse, R Connectors for Statistic function with R language and Mahout which is machine learning. Hadoop architecture is shown in Figure 1. It has three frameworks include MapReduce, Tez and Spark for Big data process.

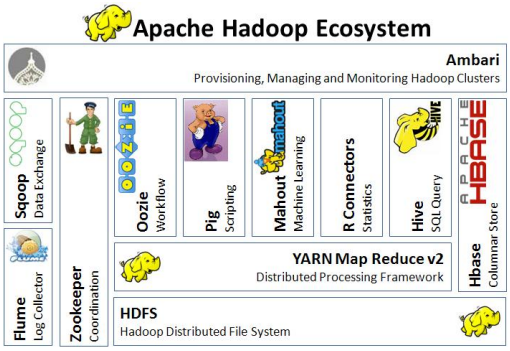


Figure 1 Hadoop Ecosystem [4]

3.2 Hadoop Distributed File System (HDFS)

Apache Hadoop is a cluster of nodes that is possible to scale. Hadoop Distributed File System (HDFS) [6] is the most popular storage service of Hadoop. It includes Name node for containing namespace of HDFS and Data node for storing block replicate of HDFS file. For high availability, data in HDFS cluster can lost in some blocks when a Data node downs and other Data nodes can distribute same blocks by using replicate. The goal of HDFS is to use available a lot of nodes in a large cluster with inexpensive disk storages for maintaining high availability and high performance. HDFS storage is known as data locality and can integrate to a storage area network (SAN), or network attached storage (NAS). It provides large size of storage by using inexpensive

drive and server over Hadoop cluster. The data in HDFS is divided into blocks and copied to each Data node in cluster. It is actually stored as small blocks and replicated on each Data node. HDFS architecture on cluster can described as follows:

NameNode is the HDFS namespace. It includes a hierarchy of files and directories in HDFS logical drive. HDFS's files and directories are represented by inode record. They are split into blocks and replicated to Data nodes.

Image and Journal represent inode and the list of blocks that define the metadata of image. It stored the entire namespace image of inode in memory. Journal represents location of block replicates. It is flushed and synced before acknowledging to client when each client initiated transaction.

DataNodes stored each block replicate that they are represented by two files in local filesystem or DFS's datanode folder as follows: The first file is raw block data and the second file stored the block's metadata with checksums.

3.3 Linux disk scheduler

Linux disk scheduler [5] is the best practice for disk performance in CentOS that has three I/O schedulers including Completely Fair Queuing (CFQ), NOOP and Deadline. We describe all I/O schedulers as follows:

Completely Fair Queuing (CFQ), this scheduler provides the fairness scheduler by supporting multiple processes integrated into Linux kernel 2.6.23 and selected to be default scheduler of Red Hat Enterprise Linux 6 I/O scheduler. It has 3 scheduler classes including real-time, best-effort and idle. The default of CFQ is the best-effort class. The real-time class can starve out I/O and perform with load, but idle class only serve if other I/O pending. CFQ assigns a time slice to each I/O process to take fairness. All I/O processes can have up to 8 requests and CFQ try to predict an application. Also, CFQ make more I/O processes.

Noop, the simplest I/O scheduler by using first-in first-out (FIFO) scheduling. It can merge individual request at block layer. Noop is the best I/O scheduler for making systems with fast storage.

Deadline, it aims to guarantee latency for I/O processes. Deadline assign an expiration time for each device by focusing on an expiration time of requests. For example, more similar requests at close disk locations will be serviced for better efficiency and reading processes have a high priority over writing processes.

3.4 Network File System (NFS)

NFS is the most popular network attach storage that uses mount command to attach server storage over a network with those file systems. Currently, NFS has three versions include NFS version 2 (NFSv2 use RFC-1094), NFS version 3 (NFSv3 use RFC-1813) and NFS version 4 (NFSv4 use RFC-7530). NFSv2 is older and widely use. NFSv3 has more features with 64 bits file and Async mode to write data. Latest, NFSv4 can work on firewall with port mapper and ALC.NFS use Transmission Control Protocol (TCP) over IP but NFSv2 and NFSv3 can use User Datagram Protocol (UDP) which their connection under normal conditions has less Protocol overhead than TCP.

3.5 Flexible IO

Flexible IO [9] is represented by fio command that is a special test case program. It can create workload in any number of threads or processes and simulate an I/O workload. It can measure both the quantity and depth of storage including high-performance storage devices such as PCIe or high-performance network storage over long time period. It can be tested in multiple thread with depth profiles and produce the results which include Throughput, Average Latency, Max Latency and Latency Standard Deviation. For enterprise, it has a synthetic workload analysis which includes different profiles as real-world tasks. For example, read and write speed 70/30 in 8k is widely used for enterprise hardware.

3.6 Related work

Linux disk scheduler on SSD is the most popular in a new data center with virtualization technology. In Shrinivas B. Joshi research [3] related to Haoop performance-tuning suggested by using I/O schedulers for improving the performance in OS Configuration Tuning. There were also other techniques proposed by him such as BIOS, OS, JVM and Hadoop configuration parameters. Those techniques are possible to increase performance of Hadoop cluster. Kenji Nakashima et al. [2] were improved I/O performance of Hadoop cluster by static method and striping layout ST2 with EXT3 file system. They evaluated I/O performance by using Hadoop benchmark including TeraSort and TestDFSIO in virtualized environment. In Big data, Abdelmounaam Rezgui et al. [1] used Hadoop cluster with Linux I/O schedulers including CFQ, Deadline, Noop and Anticipatory on the Global Environment for Network Innovations (GENI). Their results with Hadoop benchmark showed a little differences performance in default parameters on each scheduler. That research focused on Linux I/O schedulers on SSD for improving I/O performance in Hadoop cluster. The test-bed

architecture used a virtualization of KVM and Hadoop NFSv3 gateway which used to share HDFS storage for other services in data center. We do not only evaluate I/O performance on Hadoop cluster, but we also evaluate HDFS storage via NFSv3 gateway from client's mount with flexible IO benchmark.

4. Materials and methods

In this section, we describe our test-bed HDFS storage on Hadoop cluster architecture. We design the test scenarios to investigate the disk performance on virtualization with Linux disk scheduler on KVM virtual machines.

4.1 Experiment Setup

We investigate HDFS storage over Hadoop cluster by using 4 virtual machines (1 name node and 3 data nodes) on full virtualization of KVM hypervisor in 2 desktop computers. Each desktop computer has Intel i7-2600 Quad core @ 3.40 GHz which enabled Intel-VT, 4 GB DDR3, 500 GB SATA and 128 GB SSD shown in Figure 2. Our HDFS storage cluster architecture is described as follows:

Master Node employed only 1 big virtual machine in Host01 with 2 vCPU and 2 GB RAM

Data Node involved 3 virtual machines on each physical Host01 and Host02 with 2 vCPU and 2 GB RAM

In Software components of physical Host machine, they installed CentOS 7.2 64 bits with KVM virtualization software. The image of virtual machines stored in SSD with XFS partition. All of virtual machines installed CentOS 7.2 64 bits, Java JDK version 1.8 and Hadoop version 2.8.2

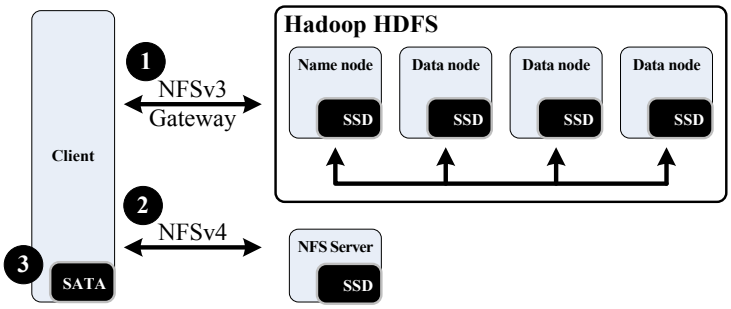


Figure 2 Test-bed architecture of the 3 storage scenarios

In Figure 2, it presents 3 scenarios of a comparison of storage performance which include HDFS storage, NFSv4 with SSD and local SATA storage. In No. 1, it is HDFS storage. We installed Hadoop 2.8.2 in Name node and three Data nodes with 3 replicates. Client can mount with "nfs ver=3". In this scenario, we compared the I/O performance of three disk schedulers which include CFQ, Noop and Deadline. In No. 2, we investigated NFSv4 on SSD storage. The last one used a local SATA disk showed as No. 3. We evaluated 3 storage scenarios by using Flexible IO's read feature.

4.2 HDFS with NFS3 gateway

NFSv3 gateway allows HDFS that can mount as part of client. It supports and enables as follows:

Client can browse HDFS's file and directory on NFSv3 mount path with compatible OS

Client can download and upload file from HDFS to local file system.

Client can stream data directly to HDFS. File append is supported but random write file is not supported.

HDFS used Name node for start NFSv3 gateway service with portmap as following command:

"hdfs start portmap" for initiation portmap

"hdfs start nfs3" for starting nfs version 3 service of HDFS root directory "/"

4.3 Workload

We have 2 scenarios of workload can described as follows:

TestDFSIO, it is native disk benchmark of Hadoop. We used 10 job with 500 Megabytes file for evaluate read performance of HDFS storage with three disk scheduler including CFQ, NOOP and Deadline

Flexible IO, it is the most popular file benchmark. We used 128 Megabytes file and 10 step for iodept to compared read performance between local SATA disk, NFSv4 with SSD and various HDFS storage cases.

In both scenarios, we used three disk schedulers which include CFS, NOOP and Deadline. Command of disk scheduler can be described as follows:

Checking disk scheduler command is "cat /sys/block/sdf/queue/scheduler"

Editing disk scheduler command is "echo 'cfq' > /sys/block/sdf/queue/scheduler"

For special case, we took a fail of one data node for evaluating an available performance of HDFS in Flexible IO.

5. Results and discussion

We conducted experiment to improve the I/O performance of HDFS with NFSv3Gateway by using Linux disk scheduler. Our system architecture uses Hadoop cluster in KVM as same as cloud solution including a single Master node virtual machine and multiple Data node virtual machines on a SSD storage. The results of I/O performance include average throughput of read data processes by using TestDFSIO shown in Figure 3, I/O throughput by Flexible IO shown in Figure 4, Bandwidth by Flexible IO shown in Figure 5 and IOPS by Flexible IO shown in Figure 6. In Flexible IO, we use 128 MB file for time base evaluation. The iodepth parameter is set as 10.

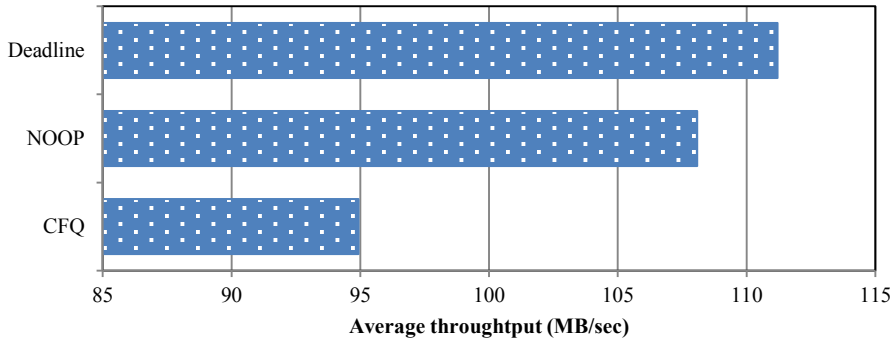


Figure 3 Average throughput of TestDFSIO in read data processes with three Liux disk schedulers

Figure 3 shows the average read rate by using TestDFSIO. This testing evaluates the three types of disk scheduler which include CFQ, NOOP and Deadline on SSD storage. Deadline provides the better performance than NOOP and CFQ around 110 MB/sec. CFQ has the least performance of disk scheduler around 95 MB/sec which is the same as the result in Abdelmounaam Rezgui et al. [1]. They also found that CFQ using default value providing poorer performance than others disk scheduler. The results represent NOOP and deadline schedulers can increase performance. Currently, CFQ is a default value of all operating system (e.g. CentOS, Redhat Enterprise and Fedora).

5.2 I/O results of Flexible IO

All of results of I/O performance with Flexible IO at 128MB that HDFS storage has a better performance as same as NFSv4 with SSD shown in
Figure **4**.

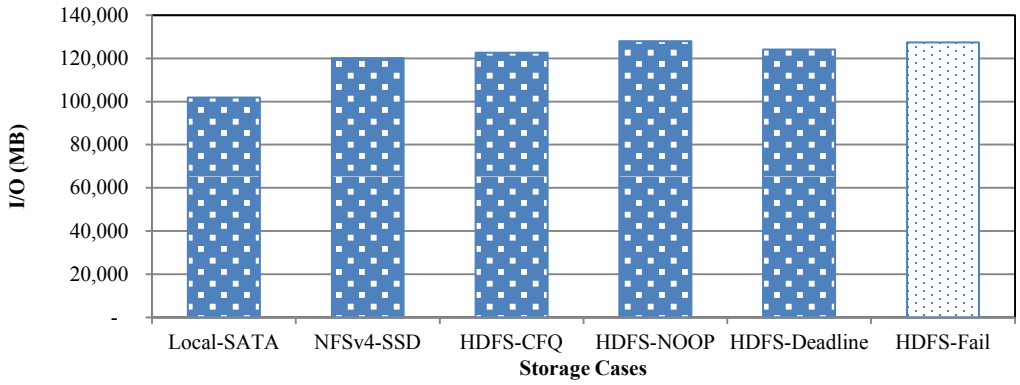


Figure 4 I/O throughput of storage cases

In Figure **4**, the results show the best I/O in HDFS storage with NOOP disk scheduler 128,021 MB. The least performance in Local storage with SATA disk 101,790 MB. For HDFS storage with fail of one data node 127,387 MB that it can keep I/O performance during test period. HDFS with three scheduler have a quite similar I/O performance same as NFSv4 with SSD that they are around 120,000 MB.

5.3 Bandwidth results of Flexible IO

All of results of bandwidth by using Flexible IO at 128MB that HDFS storage has a better performance as same as NFSv4 with SSD shown in Figure 5.

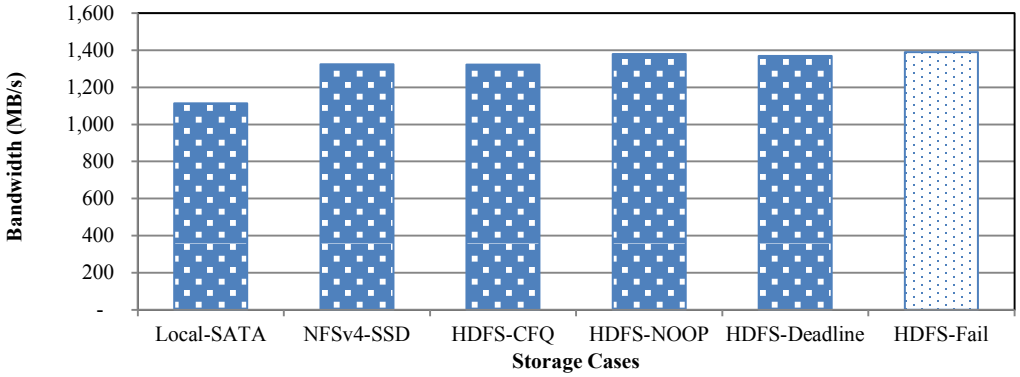


Figure 5 Bandwidth of storage cases

In Figure 5, the best bandwidth can show in HDFS storage with all types of disk scheduler and in case of fail of one data node. Their results are around 1,300 MB per second. The least performance is local with SATA disk same as previous results in I/O performance. All of HDFS storage cases are a quite similar to NFSv4 with SSD.

5.4 IOPS results of Flexible IO

The last one, IOPS results of Flexible IO at 128MB that HDFS storage still has a better performance as same as NFSv4 with SSD shown in Figure 5.

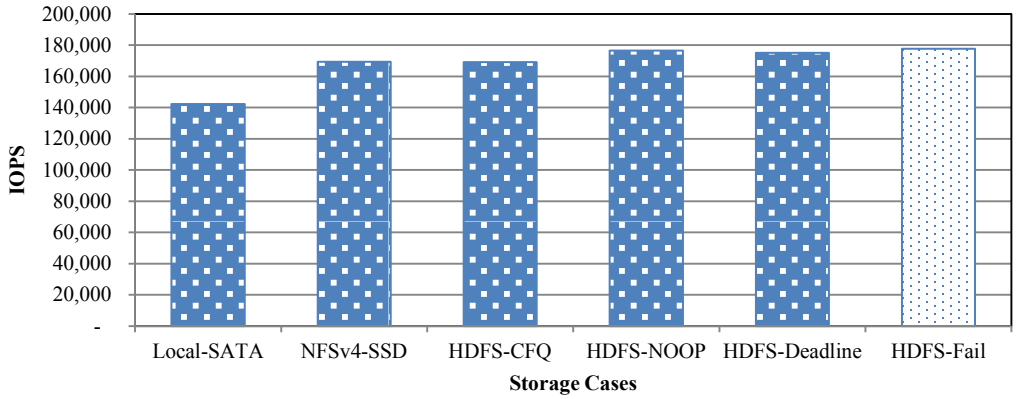


Figure 6 IOPS performance of storage cases

In Figure 6, the best bandwidth can show in HDFS storage with NOOP disk scheduler 176,554 IOPS and the least one still is local with SATA 142,345 IOPS. This result shows the available performance of HDFS in case fail of one data node that has a similar performance with other HDFS storage cases. All HDFS storage on SSD with schedulers has a similar performance with only SSD but HDFS storage has high availability and can keep IOPS in fail case.

6. Conclusions

In concluding, we investigated disk scheduler with SSD which is the fast storage device that can be used to improve IO performance of HDFS storage. The results show NFSv3 gateway with HDFS storage performance has a quite similar performance NFSv4 with single SSD. Moreover, HDFS fail case with SSD can keep performance like other storage cases. The results were represented by the two HDFS's benefits of purpose

method including; First, NFSv3 gateway with HDFS storage can keep performance same as a single SSD with NFSv4. Second, Linux disk scheduler can improve I/O performance for HDFS storage shown in Figure **4**, Figure 5 and Figure 6. The results show that the Noop and Dead line schedulers have better than CFQ and a single SSD with NFSv4. The I/O performance by using Flexible IO, we show a comparison between a local SATA disk with others HDFS storage case on SSD. This research only evaluated a HDFS disk performance with SSD. HDFS performance can increase with others method. For example, disk policy storage. It can swap block data on various disk types including DISK, SSD and RAM. Moreover, Nfsv3 software can use UDP protocol which is challenging to deploy and evaluate performance. The pass-through method with native storage device of QEMU is suggested to increasing storage performance in more researched field related to the performance of HDFS storage. It has more challenges to improve in the future.

Acknowledgements

The authors would like to acknowledge Faculty of Science and Technology, Songkhla Rajabhat University, Thailand for support of this research.

References

[1] Rezgui A, White M, Rezgui S, Malik Z .Evaluation of Linux I/O Schedulers for Big Data Workloads . In : 2014 IEEE Fourth International Conference on Big Data and Cloud Computing .2014 .p .227–34.

[2] Nakashima K, Fujishima E, Yamaguchi S .File Placing Control for Improving the I/O Performance of Hadoop in Virtualized Environment .In :2016 Fourth International Symposium on Computing and Networking)CANDAR .(2016 .p .402–7.

[3] Joshi SB .Apache Hadoop Performance-tuning Methodologies and Best Practices .In :Proceedings of the 3rd ACM/SPEC International Conference on Performance Engineering]Internet .[New York, NY, USA :ACM; 2012]cited 2017 Oct 31 .[p .241–242) .ICPE '12 .(Available from :http//:doi.acm.org/10.1145 /2188286.2188323

[4] Apache .Hadoop .Retrieved from Hadoop :http//:hadoop.apache.org) .accessed May 18, 2017(

[5] Red Hat Inc., Red Hat Enterprise Linux 6, Performance Tuning Guide .Retrieved from Technical White Paper :https//:access.redhat.com/documentation/en-US/Red_Hat_Enterprise_Linux/6/html/ Performance_ Tuning_Guide/ch06s04.html) .accessed May 18, 2017 (

[6] IBM Analytics .HDFS . Retrieved from Hadoop Distributed File System :https//:www.ibm.com/analytics/us /en/technology/hadoop/hdfs) ./accessed May 18, 2017(

[7] Inktank Storage, Inc. and contributors. Ceph Filesystem. Retrieved from : http://docs.ceph.com/docs /jewel/cephfs/. (accessed May 18, 2017)

[8] Red Hat, Inc. The Gluster Blog. Retrieved from : https://www.gluster.org/gluster-monthly-newsletter-november-2017/

[9] StorageReview.com .Fio -Flexible I/O Tester Synthetic Benchmark : http//:www.storagereview.com / fio_flexible_i_o_tester_synthetic_benchmark) ./accessed May 18, 2017(

[10] Young JY, Dong IS, Woong S, Nae YS, et al .Optimizing the Block I/O Subsystem for Fast Storage Devices]Internet] .[cited 2017 Dec 3 .[Available from :https//:dl.acm.org/citation.cfm?id=2619092

Social Media Framework Incorporating Fuzzy Regression for Affective Design: State-of-the-art, Challenges, and Opportunities.

Pratima Jain[1,*] Pornpit Wongthongtham[1,*] and Kit Yan Chan[2,*]

[1]School of Information Systems, Curtin University, Perth, Australia
[2]Department of Electrical and Computer Engineering, Curtin University, Perth, Australia

Abstract

Nowadays, social media has become an integral part of business, providing a platform to communicate, integrating customers directly into business procedures and acting as an information pool. However, to ensure the accuracy of information taken from social media sites, it is essential to combine information from multiple channels; this aids the legitimacy of the information extracted. Social media data analytics contribute to a variety of domains such as tourism, government, politics and product co-creation among others. In the ground of new product development, the key to the success of a new product is the ability to capture the voice of consumers. In recent years, users have become concerned not only with the basic functional attributes of a new product they might be purchasing, but also the affective attributes of the product. For example, users are more concerned about the colour, shape, look and feel, of a product (such as the affective design and quality of cars, smart phones etc.). Hence affective design is essential in new product development.

In the development or evaluation of a new product's affective design, the voice of consumers can be derived through various social media networks including product review blogs and product discussion groups. Using data from social media networks, it is possible to extract opinion information regarding the affective satisfaction of a product. However, as a user's opinion is subjective, social media data has a level of uncertainty. Therefore, the evaluation of human perception requires estimation of the amount of uncertainty in human evaluations. This paper utilises social big data to extract precise affective design values and uncertainty in evaluating affective quality from user's product related opinion. To evaluate the amount of uncertainty in human perception or subjective judgement of social media data, the proposed framework will incorporate fuzzy regression techniques. A novel algorithm based on fuzzy regression techniques is suggested to determine affective quality magnitudes and uncertainty factor in evaluating affective quality. Finally, the effectiveness of the proposed framework is proposed to be evaluated and validated based on a case study on affective car design by using car design attributes as independent variables to predict affective design value as dependent variable. Towards the study aim, this paper reviews four major streams of project i.e. (i) social media, (ii) data fusion, (iii) affective design, and (iv) fuzzy regression.

Keywords: Affective Design, Uncertainty, Social media analytics, Fuzzy Regression, Data Fusion.

1.Introduction

The rapid rise in social media use has revolutionised the power of expression in recent times. The development of the internet and expansion of mobile technologies have been the primary force behind the rise of social media use, providing technological platforms for information dissemination, content generation, and interactive communications [1]. Continually, social media is spreading worldwide at an exponential rate. For example, in 2016, 68.3% of internet users were social media users; these figures are expected to grow [2]. Facebook, YouTube, Twitter, Instagram and Wikipedia are just a few of the most popular social media web applications. The amount of time people spend on these sites is also constantly increasing. For instance, Australians are now spending more than half a day per week (12.5 hours) on Facebook alone [3]. Hence, social media landscapes can be viewed as widespread communication platforms for consumption and for sharing a rich source of day to day information.

Social media plays an ever-growing significant role in an individual's social life by introducing enhanced features concerning their emotions and behaviour. For example, Facebook allows users to update their status or post information not only in text but using graphic emotion icons. By way of illustration – suppose an individual driving a newly released model of a car had recently updated his views on a social media account. His feelings and behaviours toward that product can now be analysed based on his comments and the use of any emotion icons. Such information can collectively form online knowledge and insights related to products,

* Corresponding author; e-mail: [1]pratima.jain@student.curtin.edu.au, [1]ponnie.clark@curtin.edu.au, [2]Kit.Chan@curtin.edu.au

services and brands that are shared by disparate users [4]. Rathore, Ilavarasan, and Dwivedi, also consider social media as a major factor influencing users' behaviour in the form of opinions, perceptions, feedback, usage, intention, purchase habits, depth of analysis and the variety of shared information. In this context, collecting information from these interrelated multiple sources opens opportunities for more reliable and accurate knowledge which can further contribute to better business insights [5], [6]. For instance, having uniform information from multiple sources are likely to build consumer trust in a product. It can also help authenticate the information. Therefore, the fusion of information from social media can be beneficial for effective organisational analytics.

Furthermore, social media has considerably altered the traditional way of communication and interaction between businesses and consumers. These virtual communities are now penetrating the mass public, transitioning social media communication into the main form of communication. As a consequence, social media has enhanced the ability for industries to integrate customers into their business model [4]. For example, in new product development, the key factor of success of a new product is to capture the "voice of the consumers" [7]. Consequently, satisfying consumers' requirements is not only a "need" but also a "must" for every company. In this context, it is suggested that to cover all emotional aspects of a user, a product must exhibit three categories: (1) it must be useful (it must perform the designed tasks); (2) it must be usable (easy to use and interact with); and (3) it must be desirable (provides feelings of pleasure and creates attraction) [8]. With social networks, designers can use online consumer data to understand their requirements, affections and desirability. Hence, extracting and incorporating emotional, behavioural and demographical social media texts into the product design process may contributing to enhanced affective design.

Affective design involves the processes of identifying, measuring, analysing and understanding the relationship between the affective needs of the customer and the perceptual design attributes in the design domain [9]. The purpose of affective design is to satisfy the affective needs of users, by integrating their affective requisites in the design attributes of a new product [10]. This gives designers the ability to generate designs which appeal more to their target market. Affective design has been shown to excite customers' psychological feelings and can help improve customer satisfaction [11]. Conventional methods of affective design focus on predicting or determining the amount of affective quality, such as Neural Networks [12] and the Kansei Methodology [13], [14] which predicts consumer perceptions when the perceptual design elements of the products are given. However, perceptions are subjective; hence uncertainties are inevitable. In this context, the estimation of the amount of uncertainty in affective quality has been of limited focus in previous literature. Major works in this area include Chan et al. [10], who proposed an intelligent fuzzy regression technique to generate models for relating design variables to affective responses in which both non-linearity and fuzziness are considered. Chan and Engelke [15] presented a novel fuzzy regression method to predict affective quality and fuzziness in human assessments, for given objective features.

This paper discusses the possible ways to predict human evaluation of affective quality as well as the uncertainties in evaluating the affective quality by incorporating a fuzzy regression technique. Social media data is suggested to create Data Fusion for affective design. This paper presents a literature review of existing literature presented in four major streams; (i) social media, (ii) data fusion, (iii) affective design, and (iv) fuzzy regression. The rest of this paper is organised as follows. In section 2, we address the existing literature on social media for affective design. In section 3, we focus on the existing literature on data fusion with a requirement to deal with social media data and related challenges. In section 4, we outline the existing literature on affective design demand and various existing approaches. In section 5, we focus on the existing literature on the use of fuzzy regression techniques in calculating affective quality values. In section 6, we present the prospect framework and the paper ends with conclusion and future work in section 7.

2.Social media

Social media is drawing significant attention from both application and research perspectives. Not only it is an integral part of information ecosystems, but also rapidly growing among users, consumers, corporations, governments and many other entities [1]. Breur [16] discusses social media as one of the four major streams of data analysis, which contains user generated data and sentiments. In addition, social media is considered a major factor influencing users' behaviour in the form of opinions, awareness, reviews, emotions, intention, purchasing habits, analysing and information sharing [4]. As a result, to leverage this, there arises a need to collect and analyse social media data to extract useful patterns and investigate current trends, user affective information etc.

Several works have been submitted for social media analytics techniques, as it plays a principal role in developing tools and frameworks to collect, analyse, summarize and visualise social media data. Zeng et al. [1]

discusses various challenges involved with social media analytics processes such as, retrieving massive data and related metadata, computing dynamic streams of rapidly increasing data, the integration process, user generated information mining etc. In addition, Zeng et al. explores social media intelligence as a source of more productive information, however this idea seems to be in the early stages of development. Similarly, Fan and Gordon [17] discuss the various scopes of social media analytics, by means of which useful patterns and users' affective information can be retrieved. In relation to this, a framework has been presented [18] for acute analysis of affective experiences to gain marketing insights. Grassi et al. [19] created a sentic web to manage affective information from social media by combining semantic analysis techniques and artificial intelligence methods, though the retrieval of dynamic emotions from social media presents as a limitation for this approach. In order to uncover these sentiments, Cambria [20] listed the major approaches for affective computing. These approaches did not clearly identify a common-sense knowledge base or reveal new affective knowledge in order to detect and perceive real emotions.

Another consideration is the co-creation of products through the use of social media networks, where consumers work online with company product designers to obtain user requirements [4]. It is also stated that, current patterns suggest social media could produce an additional $940 billion in annual consumption, particularly in relation to the sale of electronics, hardware, software, and mobile technologies [4]. Thus, social media results in significant possibilities for product design and other commercial needs. The significance and applications of social media data has been covered extensively in previous studies. However, from a decision perspective, social media data still contains a level of uncertainty and is inherent with subjective opinion based information [1].

In view of the fact that social media data is essentially a collection of user generated data i.e. blogs, posts, comments, reviews and other forms of social media which is created by consumers [21], it is based on, or influenced by, personal feelings, tastes, or opinions. Hence, it is inherently ambiguous and uncertain. Taking this into account, a significant need arises to estimate the amount of uncertainty in social media data when obtaining user information.

3.Data Fusion

These days, we are living in a digitized society where every single step is being recorded in some format, for which companies employ a number of social platforms in the market to stay in touch with their customers [16]. Social media data is generated from these wide range of internet applications and web portals. Example include, but are not limited to, Facebook, Twitter, LinkedIn and Instagram. These rapidly growing social sites allow companies to connect with users and has created a new generation of users who are enthusiastic about interacting, sharing, and collaborating, thereby forming a new mode of communication [22]. As a result, information dissemination through social media takes place in almost every area that includes business, education, tourism, day to day life and health among others. Hence, there arises a demand to collate and analyse data from these sources, to enhance the legitimacy and accuracy of the information.

Information Fusion ('IF'), involves the combination of information into a new set of information, aimed at reducing redundancy and uncertainty [23]. Along the same line, Data Fusion, which is a subset of Information Fusion, (or Information Integration), is the process of integrating multiple data sources to produce more consistent, accurate, and useful information than that which is provided by any individual data source [24]. It is applied in different fields where data is distributed and generated from diverse sources. Thus, to get a holistic view of customers, businesses ought to integrate information from multiple channels. In the field of literature related to data fusion, various methodologies have been proposed to accumulate heterogeneous information from a range of diverse sources. For instance, the crowdsourcing semantic big-data fusion approach has been used for heterogeneous media in the IoT environments, which provides higher-quality semantic fusion and more precise retrieval of information [25]. Breur discusses data fusion as one out of the four useful data analysis streams available to researchers [16]. Bello-Orgaz, Jung, and Camacho [22] summarise the challenges of data fusion which include: (1) obtaining more reliable methods for fusing the multiple features of multimedia objects for social media applications; and (2) studying the dynamics of individual and group behaviour, characterizing patterns of information diffusion, and identifying influential individuals within social networks.

Data fusion refers to resolving conflicts from different sources and identifying the truth that reflects the real world. Unlike schema mapping and- record linkage, data fusion is a relatively new field. Its motivation is exactly the veracity of data: the web has made it easy to publish and spread false information across multiple sources [26]. To overcome the challenges of data fusion, different techniques are being developed to suit real world applications. These intensive techniques are derived from different computing areas including artificial

intelligence, statistical estimation, pattern recognition, and so on [6]. However, given the very large heterogeneous dataset obtained from social media, one of the major challenges is to identify the valuable data and determining how to analyse it to develop useful knowledge [22]. Emerging big-data applications can be seen as a solution to the integration of the heterogeneous and dynamic stream of data from diverse social media channels.

4.Affective Design and Kansei Engineering

In today's competitive world, optimization of customer satisfaction is essential in new product development, in order to achieve optimal success [10]. To address customer satisfaction, Lee [27] developed a methodology to better understand user preferences based on perceived usability and perceived aesthetics. Results from this study show that before any actual use of a service or product, user preference was significantly affected by the aesthetics of the product rather than by usability factors. This is the reason why a lot of companies focus on the beauty of their products.

Affect, mood, and emotion are fundamental aspects of human beings and are found to influence, reflexes, perception, cognition, social judgment, and behaviour [28]. Fong [28] presents an approach for automatic generation of Personal Web Usage Ontology ('PWUO') of periodic access patterns from web usage logs. In this study, apart from efficiently providing users with periodic web personalisation patterns, Fong also discovered that emotional influence contributed positively to the results. Therefore, affective design plays an important role, in the development of designs which better appeal to their intended market. The sole purpose of affective design is to further satisfy user's affective needs rather than solely optimizing the functional needs for a product. This is done by integrating user's affective requisites within the design attributes of a new product [10]. Better affective design of a product increases that products' appeal to potential buyers and produces a more harmonious product [32].

Affective design draws its inspiration from Kansei engineering and attempts to relate subjective requirements to measurable product properties that can be tested and verified. Kansei Affective Engineering ('KE') [29] is defined as the technology of translating the consumer's Kansei into the product design domain. Nagamachi defined this process of performing Kansei Affective Engineering as: (1) grasp the consumer's Kansei in the specific product domain using psychological or psychophysiological measurements, (2) analyse the Kansei data by statistical, medical, or engineering methods in order to clarify the Kansei structure, (3) interpret the analysed data and transfer the data to the new product domain and (4) design a new Kansei product. KE methodology has successfully contributed to the development of many different products such as motor vehicles, coffee cans, beer cans, milk cartons and body cosmetics [9], [14], [30], [31].

Further, in relation to prioritising customer preferences, Chou [32] presents a Kansei evaluation approach based on the technique of computing with words ('CWW'), with the purpose of validating the classification of Kansei attributes using Kansei words, establishing priorities for customer preferences of product alternatives with respect to each attribute, and synthesising the priorities for the evaluated alternatives. Diego-Mas and Alcaide-Marzal [12] use a neural network based approach, to present a theoretical framework which enables single user responses to predict different product designs. Yadav et al. [33] utilises the application of the fuzzy Kano model into quality function deployment ('QFD') with the objective of analysing the customer's aesthetic feeling toward customer satisfaction. Jiang et al. [9] proposes and describes a methodology of simultaneous consideration of affective design and the determination of engineering specifications to determine design attribute settings and engineering requirement settings for a new product. An artificial intelligence (AI) based methodology [11], has been proposed for integrating the affective design, engineering, and marketing for defining design specifications, at an early product design stage. This study utilises the static market trend however, in the current technology climate, the world is evolving towards an era where online communities will define future products and services [4]. Hence, there arises a need to consume dynamic market in relation to affective design. In addition, inappropriate affective designs can only be determined by past affective information and data. Hence, there is a need for an approach that continuously updates user's affective quality information.

Much previous research has been conducted to estimate affective quality for better affective design. However, data relating to affective satisfaction is inherently vague or uncertain. The above-mentioned approaches are relatively unable to address this issue. In order to estimate the level of uncertainty or vagueness, recent research have shown that the fuzzy regression model is a more commonly used method for developing consumer preference models. The fuzzy regression model is explicit meaning that analytical information can be identified for use in new product development and developed models can address the fuzziness in consumer

preferences [34]. Chan and Engelke [15] propose a novel fuzzy regression method to predict affective quality and estimate fuzziness (i.e. vagueness or uncertainty) in human assessments, when objective features are given. So far, studies have targeted fuzziness in observed survey data or static data yet there seems to be no research on estimating the effect of fuzziness on affective design datasets, which varies with time and can be captured online through the use of social media.

5.Fuzzy Regression

Previous studies have anticipated the significance of good affective design in new product development. In order to evaluate affective design, researchers have introduced different methodologies to measure the amount affective quality/aesthetic quality by either 'surveying in order to obtain users' subjective perceptions of object aesthetics' or by 'predicting affective qualities by means of objective features based on product design attributes' [35]. Survey techniques were used for a number of studies. For example, Diego-Mas and Alcaide-Marzal [12] used a neural network-based mathematical model to present a theoretical framework which enables single user responses to predict different product designs. This is done using limited survey responses and thus offers less statistical power. Similarly, a large amount of research has been proposed using the Kansei engineering methodology [30], [13], [4] to better understand consumer perception and affective requirements. These studies are conducted using surveying techniques, that may contain too many subjective evaluation items in the questionnaires or survey questions, and there is a possibility for uncertainty to arise out of the subjective evaluations by participants. However, the uncertainty of interviewees in answering the survey data may not be analysed using traditional statistical methods. In addition, it is ambiguous to conduct a survey for every single design attribute of products. Surveying is time consuming and expensive, with limited access to the population of concern [35].

Another approach of predicting affective quality is based on the assumption that objective features of products are correlated with user's affective quality perception [15]. As a result, empirical models can be built using objective features such as colours, product style, outlook, interfaces etc. in order to determine the affective quality of a product. Statistical regression techniques are generally used to estimate the correlation and significance of variables [15], [35], however uncertainty in subjective human evaluation cannot be taken in account. Since human emotions are uncertain, crisp values from statistical regression does not correspond effectively when assessing affective quality. To overcome this, the fuzzy regression methodology was developed, which evaluates the uncertainty in human perceptions.

A number of studies have used fuzzy regression techniques to estimate affective quality and uncertainty in human perception [15], [32], [10], [33]. In this context, products with acute affective quality are easy to evaluate. However, products with relatively moderate affective quality have a significant level of uncertainty.

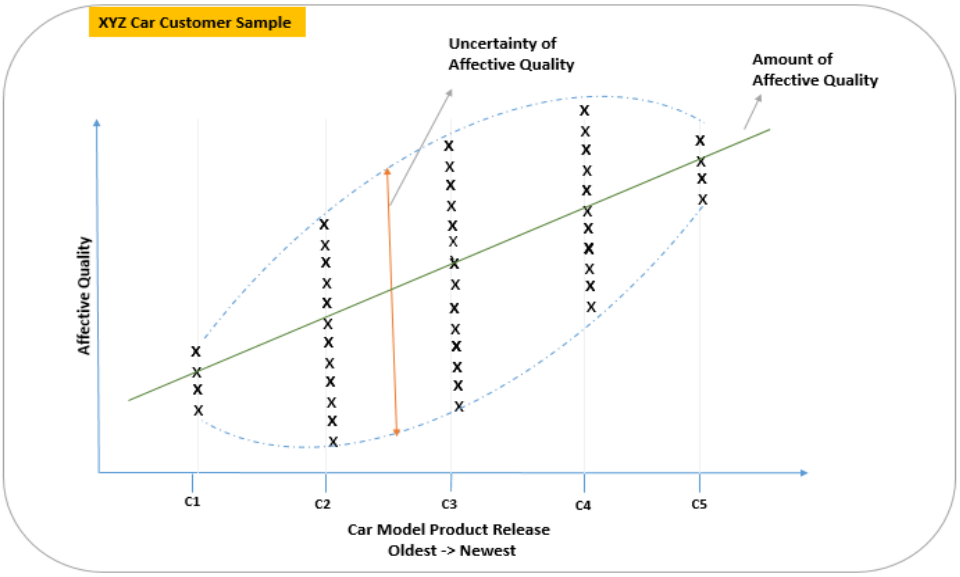


Figure 1 - Uncertainty of Affective Quality

Figure 1 illustrates the uncertainty of affective quality. For instance, suppose C1, C2, C3, C4, and C5 are different car models. C5 is the most recent model with the highest price and the highest affective design when compared to C4. C4 is the second most recent model with better affective quality than C3. C3 is the third most recent model with better affective quality than C2, and so on. Likewise, C1 is the basic model vehicle with the lowest price and the lowest affective design. As the affective quality evaluation is subjective, users may have more confidence in determining the affective quality of C5 and C1. Hence the evaluation of uncertainty is low. On the other hand, for intermediary models i.e. C2, C3, and C4, users have less confidence in evaluating the affective quality. Therefore, the uncertainty in evaluating the affective quality is higher for the average model vehicles, which have average affective qualities. Although Chan and Engelke [15] have developed a fuzzy regression method for predicting affective quality and uncertainty when evaluating affective quality, fuzzy regression coefficients are determined based on heuristic algorithms, which are time consuming and indeterminate. A more time-effective and determinate approach is essential to determine fuzzy regression coefficients. This approach will determine affective design of a product and uncertainty in evaluating affective quality which will help in attaining affective design of the car.

6.Prospect Framework

This section discusses a prospect framework to determine the perceptual uncertainty in affective design evaluation, while incorporating a social media big data framework and fuzzy regression techniques. As part of the social media framework, data fusion for affective design will be produced first by integrating two or more social media platforms. Customer segmentation will be achieved by clustering social big data on the basis of users' geographic location or age, to match different demands. Then, an algorithm based on the fuzzy regression model is suggested to detect the amount of uncertainty in social media affective data. This will contribute to the development of an affective design framework for a dynamic market.

The design and development involve the creation of the objects and model that employ data fusion by integrating affective design data from multiple social media channels and incorporating it with a fuzzy regression algorithm to evaluate the uncertainty in affective design evaluation. Since social media data is a part of big data, it adheres to the big data ('BD') value chain presented by Hu et al. [36] which covers the big data life cycle. This chain consists of four main phases: (1) data generation (or data extraction), (2) data acquisition, (3) data storage, and (4) data analysis. The prospect framework will pass through the lifecycle of big data to achieve the key objectives of the study. Figure 4 illustrates the detailed design structure which includes four phases of the big data life cycle to handle data and affective design evaluation.

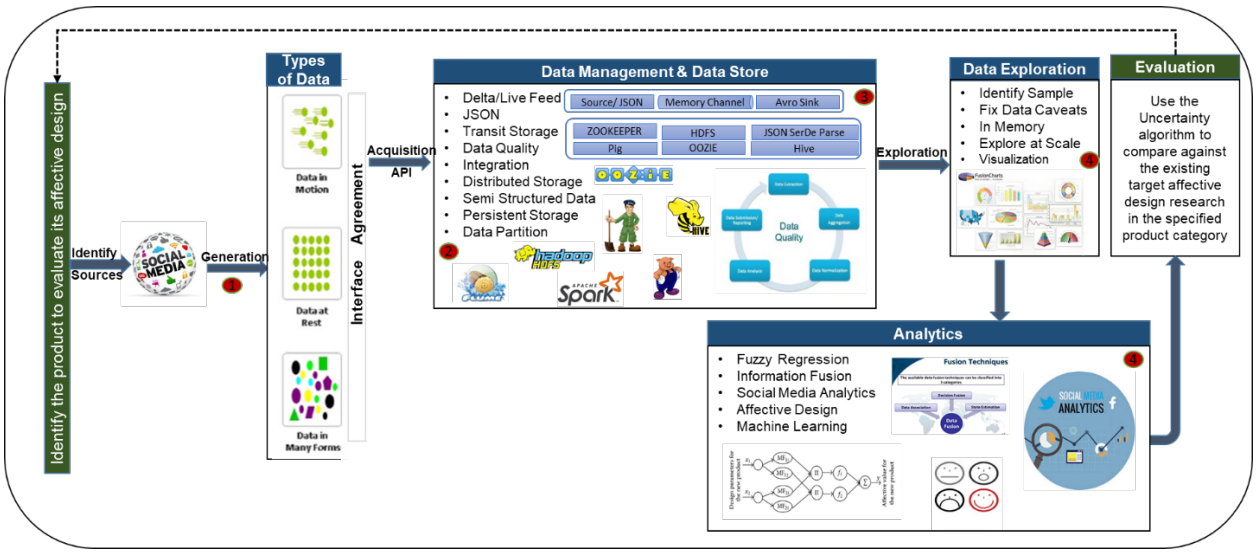


Figure 4 - Detailed Design Structure

- Data extraction

Every source (e.g. social media platforms) generates heterogeneous types of data which form a variety of dimensions of unstructured social media data. The scope of this research will focus on social media streams such as Facebook, Twitter, Instagram, and blogs.

- Data acquisition

In this stage of the study, using the interface agreement with social media (i.e. social big data) sources, the heterogeneous data is extracted in an unstructured/semi structured form, mainly in a JASON data format.
Accessing data requires a compatible Application Programming Interface ('API') which is a software program that has a defined way to access and retrieve data. Generally, social sites have their own compatible API's for connectivity. To capture a constant stream of data, a custom Cloudera Distribution Hadoop ('CDH') or an equivalent can be put together to build a data pipeline to ingest the data from the API to the Hadoop Distributed File System ('HDFS') [37].

Apache Flume is one of the data ingestion systems that consumes data delivered to it by an external web source. The concept on which it works involves processing the data through the following stages; Flume source; channel; sink; external repository. To elaborate, the external source sends data to Flume that is recognized by a Flume source; in this study, a JASON Flume flow agent or similar is required. When the Flume source receives the data, it will store the data in passive data storage channels and stay there until they are consumed by a Flume sink. The sink then removes the data and moves it into external repositories; this study uses the HDFS using a Flume HDFS sink [38].

- Data storage

A combination of HDFS, Hive and Oozie will be used to store, query and maintain the data partition. Once the Flume agent data loads the data into the HDFS (HDFS is NoSQL and hence difficult to query), it can be prepared for analysis by creating a table in the Hive using the Hive Serde interface to interpret the format. As the volume increases, it demands a need for partition which can be achieved by using Oozie [39].

SAS in its recent blog commented on the importance of the quality of big data. Data quality can be achieved within Hadoop. This is a critical aspect that requires consideration to ensure that data is well profiled and standardized [40].

- Data Exploration and Analytics

Hadoop will be used to interpret the unstructured and semi-structured data into a structured format which can be further analyzed using SQL or SQL equivalent queries. The next step is to understand the data, identify the sample for analysis, fix the data caveats and visualize the data for audit and visual interpretation. The following analytical tools are used; SAS Enterprise Guide, RStudio, SAS Visual Analytics, PostgreSQL, and Python. The ideal tool for this stage would be the SAS Visual Analytics tool, which works on memory concept.

An algorithm will be developed to evaluate the amount of uncertainty in this data by using fuzzy regression techniques. As part of fuzzy regression technique, independent variables will be taken as the design attributes of a car model i.e. body type, color, transmission etc to predict dependent variable i.e. magnitude of affective design and uncertainty in evaluating affective design. To deal with affective design attributes, keywords such as body configuration, color, automatic control will be selected from social media texts. This case study will segment customers to deal with different group interests. The tools in consideration include R and SAS Miner.

7. Conclusion and Future Work

In the current technology climate, the world is evolving towards an era where online communities will define future products and services [4]. This is the reason why, there arises a need to consume dynamic market trends in relation to affective design of products. Taking this into account, social media, majorly contributes to the big pool of online information, which is essentially a collection of user generated data i.e. blogs, posts, comments, reviews and other forms of media, created by consumers [21], also it is based on, or influenced by, personal feelings, tastes, or opinions. Hence, it is inherently ambiguous and uncertain. Thus, a significant need arises to estimate the amount of uncertainty in social media data when obtaining user information. In addition, with growing social media channels there arises a demand to collate and analyse data from these sources, to enhance the legitimacy and accuracy of the information.

Thus, an approach for determining the amount of perceptual uncertainty in human evaluation is required, while considering social media data analytics. The focus of this study is to develop a model using social media data and fuzzy regression techniques to estimate human uncertainty in evaluating the affective design of new products. To improve the effectiveness of the model, a case study will be performed, to evaluate

user's affective design preferences based on the research outcomes. Also using the suggested framework, customer segmentation based on age /ethnicity/geographic location can be generated in order to understand different group interests. Thus it can add value to product marketing as a future scope.

References

[1] D. Zeng, H. Chen, R. Lusch, and S. H. Li, "Social Media Analytics and Intelligence," IEEE Intell. Syst., vol. 25, no. 6, pp. 13–16, Nov. 2010.

[2] * All products require an annual contract Prices do not include sales tax, "Number of social media users worldwide 2010-2020," Statista. [Online]. Available: https://www.statista.com/statistics/278414/number-of-worldwide-social-network-users/. [Accessed: 27-Jun-2017].

[3] "Sensis Social Media Report." [Online]. Available: https://www.sensis.com.au/about/our-reports/sensis-social-media-report. [Accessed: 27-Jun-2017].

[4] A. K. Rathore, P. V. Ilavarasan, and Y. K. Dwivedi, "Social media content and product co-creation: an emerging paradigm," J. Enterp. Inf. Manag. Bradf., vol. 29, no. 1, pp. 7–18, 2016.

[5] Z. Yan, J. Liu, L. T. Yang, and N. Chawla, "Big data fusion in Internet of Things," Inf. Fusion, vol. 40, pp. 32–33, Mar. 2018.

[6] I. Yaqoob et al., "TEMPORARY REMOVAL: Information fusion in social big data: Foundations, state-of-the-art, applications, challenges, and future research directions," Int. J. Inf. Manag., May 2016.

[7] Y.-C. Lin and C.-C. Wei, "A hybrid consumer-oriented model for product affective design: An aspect of visual ergonomics," Hum. Factors Ergon. Manuf. Serv. Ind., vol. 27, no. 1, pp. 17–29, Jan. 2017.

[8] T. van Gorp and E. Adams, "Chapter 1 - Why Design for Emotion?," in Design for Emotion, Boston: Morgan Kaufmann, 2012, pp. 1–18.

[9] H. Jiang, C. k. Kwong, Y. Liu, and W. h. Ip, "A methodology of integrating affective design with defining engineering specifications for product design," Int. J. Prod. Res., vol. 53, no. 8, pp. 2472–2488, Apr. 2015.

[10] K. Y. Chan, C. K. Kwong, T. S. Dillon, and K. Y. Fung, "An intelligent fuzzy regression approach for affective product design that captures nonlinearity and fuzziness," J. Eng. Des., vol. 22, no. 8, pp. 523–542, Aug. 2011.

[11] C. K. Kwong, H. Jiang, and X. G. Luo, "AI-based methodology of integrating affective design, engineering, and marketing for defining design specifications of new products," Eng. Appl. Artif. Intell., vol. 47, pp. 49–60, Jan. 2016.

[12] J. A. Diego-Mas and J. Alcaide-Marzal, "Single users' affective responses models for product form design," Int. J. Ind. Ergon., vol. 53, pp. 102–114, May 2016.

[13] Y. Cho and S. Kim, "A Study on Affective Design by Subjective-Objective Co-Approach," World Congr. Eng., vol. 2, pp. 1120–1124, 2014.

[14] C. Barnes and S. P. Lillford, "Decision support for the design of affective products," J. Eng. Des., vol. 20, no. 5, pp. 477–492, Oct. 2009.

[15] K. Y. Chan and U. Engelke, "Varying Spread Fuzzy Regression for Affective Quality Estimation," IEEE Trans. Fuzzy Syst., vol. 25, no. 3, pp. 594–613, Jun. 2017.

[16] T. Breur, "Data analysis across various media: Data fusion, direct marketing, clickstream data and social media," J. Direct Data Digit. Mark. Pract. Basingstoke, vol. 13, no. 2, pp. 95–105, Dec. 2011.

[17] W. Fan and M. D. Gordon, "The Power of Social Media Analytics," Commun ACM, vol. 57, no. 6, pp. 74–81, Jun. 2014.

[18] "Social media analytics empowering marketing insight- A framework for analyzing affective experiences from social media content (PDF Download Available)," ResearchGate. [Online]. Available: https://www.researchgate.net/publication/304113102_Social_media_analytics_empowering_marketing_insight-_A_framework_for_analyzing_affective_experiences_from_social_media_content. [Accessed: 21-Jun-2017].

[19] M. Grassi, E. Cambria, A. Hussain, and F. Piazza, "Sentic Web: A New Paradigm for Managing Social Media Affective Information," Cogn. Comput., vol. 3, no. 3, pp. 480–489, Sep. 2011.

[20] E. Cambria, "Affective Computing and Sentiment Analysis," IEEE Intell. Syst., vol. 31, no. 2, pp. 102–107, Mar. 2016.

[21] "User-generated content," Wikipedia. 15-Jun-2017.

[22] G. Bello-Orgaz, J. J. Jung, and D. Camacho, "Social big data: Recent achievements and new challenges," Inf. Fusion, vol. 28, pp. 45–59, Mar. 2016.

[23] "Information integration," Wikipedia. 26-Jul-2017.

[24] "Data fusion," Wikipedia. 14-Jun-2017.

[25] K. Guo, Y. Tang, and P. Zhang, "CSF: Crowdsourcing semantic fusion for heterogeneous media big data in the internet of things," Inf. Fusion, vol. 37, pp. 77–85, Sep. 2017.

[26] X. L. Dong and D. Srivastava, "Big data integration," in 2013 IEEE 29th International Conference on Data Engineering (ICDE), 2013, pp. 1245–1248.

[27] S. Lee, "The role of usability, aesthetics, and cognitive style on user preference for interactive applications," Ph.D., The Pennsylvania State University, United States -- Pennsylvania, 2010.

[28] "Fong - generation of personalized ontology based on consumer emotion and behaviour analysis.pdf." [Online]. Available: https://www.dropbox.com/scl/fo/inb14ccvz6vbk9pa6o47q/AADEK8kQ4p1ht8Djf2RzaQM7a?dl=0&preview=Fong++generation+of+personalized+ontology+based+on+consumer+emotion+and+behaviour+analysis.pdf&r=AAVJ7_wsTvJxmIadVmogEY4Lzmq9yWt7zZWFxQmS6znJ2d6sMDHVpSYFT_A_uye8c0nftjRYkRibxVLrKBuGDPIy_CwQ9l3p6Oourydm0I0I9FW5GtX9b2LfB4x8ZdbuckknOSWQ8VkzZoOaGOJrBa9SGercJFKIGg4IHpinDHuzQ&sm=1. [Accessed: 05-Jul-2017].

[29] M. Nagamachi, "Kansei/Affective Engineering and History of Kansei/Affective Engineering in the World," in Kansei/Affective Engineering, 2 vols., CRC Press, 2010, pp. 1–12.

[30] "A Kansei Engineering Approach to Evaluate Consumer Perception on Social Media A Case Study of Giant Manufacturing Company.pdf." [Online]. Available: https://www.dropbox.com/scl/fo/inb14ccvz6vbk9pa6o47q/AADEK8kQ4p1ht8Djf2RzaQM7a?dl=0&preview=A+Kansei+Engineering+Approach+to+Evaluate+Consumer+Perception+on+Social+Media+A+Case+Study+of+Giant+Manufacturing+Company.pdf&r=AAVJ7_wsTvJxmIadVmogEY4Lzmq9yWt7zZWFxQmS6znJ2d6sMDHVpSYFT_A_uye8c0nftjRYkRibxVLrKBuGDPIy_CwQ9l3p6Oourydm0I0I9FW5GtX9b2LfB4x8ZdbuckknOSWQ8VkzZoOaGOJrBa9SGercJFKIGg4IHpinDHuzQ&sm=1. [Accessed: 05-Jul-2017].

[31] S. B. Sutono, S. H. Abdul-Rashid, H. Aoyama, and Z. Taha, "Fuzzy-based Taguchi method for multi-response optimization of product form design in Kansei engineering: a case study on car form design," J. Adv. Mech. Des. Syst. Manuf., vol. 10, no. 9, pp. JAMDSM0108-JAMDSM0108, 2016.

[32] J.-R. Chou, "A Kansei evaluation approach based on the technique of computing with words," Adv. Eng. Inform., vol. 30, no. 1, pp. 1–15, Jan. 2016.

[33] H. C. Yadav, R. Jain, S. Shukla, S. Avikal, and P. K. Mishra, "Prioritization of aesthetic attributes of car profile," Int. J. Ind. Ergon., vol. 43, no. 4, pp. 296–303, Jul. 2013.

[34] K. Y. Chan, H. K. Lam, T. S. Dillon, and S. H. Ling, "A Stepwise-Based Fuzzy Regression Procedure for Developing Customer Preference Models in New Product Development," IEEE Trans. Fuzzy Syst., vol. 23, no. 5, pp. 1728–1745, Oct. 2015.

[35] K. Y. Chan, H. K. Lam, C. K. F. Yiu, and T. S. Dillon, "A Flexible Fuzzy Regression Method for Addressing Nonlinear Uncertainty on Aesthetic Quality Assessments," IEEE Trans. Syst. Man Cybern. Syst., vol. 47, no. 8, pp. 2363–2377, Aug. 2017.

[36] H. Hu, Y. Wen, T. S. Chua, and X. Li, "Toward Scalable Systems for Big Data Analytics: A Technology Tutorial," IEEE Access, vol. 2, pp. 652–687, 2014.

[37] © 2017 Cloudera, I. A. rights reserved A. Hadoop, associated open source project names are trademarks of the A. S. F. F. a complete list of trademarks, and C. Here, "CDH Overview." [Online]. Available:https://www.cloudera.com/documentation/enterprise/5-9-x/topics/cdh_intro.html. [Accessed: 20-Jul-2017].

[38] "Flume 1.7.0 User Guide — Apache Flume." [Online]. Available: http://flume.apache.org/FlumeUserGuide.html. [Accessed: 20-Jul-2017].

[39] J. Natkins, "How-to: Analyze Twitter Data with Apache Hadoop," Cloudera Engineering Blog, 19-Sep-2012. [Online]. Available: http://blog.cloudera.com/blog/2012/09/analyzing-twitter-data-with-hadoop/. [Accessed: 20-Jul-2017].

[40] "The growing importance of big data quality," The Data Roundtable. [Online]. Available: http://blogs.sas.com/content/datamanagement/2016/11/21/growing-import-big-data-quality/. [Accessed: 20-Jul-2017].

Service Measurement Tool for Internet Service Provider

Somkiat Chormuan[1,*] and Worachet Uttha[1]

[1]Department of Software Engineering, Faculty of Science and Technology,
Nakhon Pathom Rajabhat University, Nakhon Pathom, 73000, Thailand

Abstract

In this paper, we propose a new service measurement tool that ISPs can be used to assure their clients of the quality of service in different areas. Our tool uses PHP API of RouterOS to control MikroTik devices. The RouterOS allows us to verify network performance and control the network's service measurement both in manual mode and scheduled mode. In the latter mode, we can specify the data size, the network we want to measure or the interval to repeat the same operation then save the result to the database, our tool will send the notification to the ISP via SMS. We also use the Fullcalendar2 framework to visualize the result in a calendar depending on the selected date. The result is shown in form of the bandwidth graph, average upload-download speed and percentage of measurable data that obtained from Canvas.js. The result presents the connection map of devices made from Google Map. Our tool is divided into 3 parts: 1) MikroTik router management, 2) service measurement and 3) user management that we separate users into 3 levels: 1) Maintenance officer, 2) District chief and 3) central authorities.

The result indicates that 1) users at every level can use our tool over the internet 2) the district chief can manage users and verify devices' performance in every area 3) maintenance officer can install and register devices via our tool 4) the management and measurement the performance of the network in each area are centralized and controlled by central authorities. Our tool has the flexibility to measure the performance of the network and the results are reliable that we can use to improve the service and more than that we can apply our tool to the various organizations for a low-cost software package.

Keywords: Service Measurement, MikroTik, RouterOS, Network Probe, Software API

1. Introduction

The internet service provider (ISP) is the company we pay a fee to get the access to the internet. All internet connected devices send a service request through their ISP to access to servers, those servers themselves have to send a response to the request via their own ISP. To maintain the stability and availability of services, the ISPs have to measure frequently the performance of their service and they can use that information to improve the quality of service and manage their system. There are several criteria for measuring the network such as performance, reliability and security[1]. The main objective of service management is 1) to monitor and detect anomalies in the system 2) to collect service's statistics that can be used to upgrade management and organization of the system. In general, ISP uses the Active Monitoring to collect all statistics and use them to analyze and organize the network management, for example, the Multi Router Traffic Grapher (MRTG)[2] is used on large networks. It is required both software and hardware with high capabilities, that means we need to pay at a high cost to measure the performance of the whole system, in order to increase service quality.

The use of technology in the measurement and testing of telecommunications systems, the administrators must focus on the assurance of services qualities as follows:

1) We must measure and test the telecommunication system by verifying different performance aspects such as availability of the service, network congestion and time of errors detection, etc.
2) The measurement and testing of telecommunications systems should not perturb the performance of the system.
3) The maintenance of telecommunication devices must be always in place in order to make sure that the service will always available.

Moreover, the management of complex and numerous networks drives the many difficulties to the manager to verify the operation of their devices, that why we need a tool that helps us to understand the problems and how to solve them correctly and quickly. Since the system is in the failure state for a long time

* Corresponding author; e-mail: tko@webmail.npru.ac.th

that can make a significant impact on their business. So that, the main objective of our research is to study and develop a service measurement tool for telecommunication networks using MikroTik devices. Plus, reduce the testing cost and add expressivity of service measurement tool by adding users and devices management.

In this research, we propose a new system that can measure the service performance based on the standard RFC2554[3] for the testing of Ethernet Service in Telecom Networks that the management is the Centralized Network Monitoring[4] using MikroTik[5] in each area in order to verify and measure the operation of the network. Our approach can reduce the cost of hardware that needs for the service measurement, and the mobility of measurement devices is easier. We can use our tool to verify the failure of the main communication devices without the interruption of service. Further details are presented in the following sections. Section 2 explains materials and methods used in this research, focusing on MikroTik devices and RouterOS, mechanism and architecture of our tool and the development of the system. Section 3 presents results and discussion on our work and Section 4 draw conclusions and suggestion for future works.

2. Materials and methods

2.1 State of the art

The monitoring of Quality of Service (QoS) in telecommunication infrastructure can be done via various methods such as 1) Using software agent to track and collect the information we need sometimes it can work with the Artificial Intelligence. The software Agent approach has a constraint that both monitoring software and the operating system must be compatible and we need to verify if the agent still active. The well-known software is ManageEngine OpManager, PRTG Network Monitor, Site24x7, SysAid and Spiceworks IT Desktop. 2) Sending a small program to the target device and waiting for the occurred anomalies signals for example, when the system is down. The program is customized to specific devices and specific proposes.

In our research, we use the second approach that named Action Packed that combines detailed network topology, device, and flow visualizations with direct interactive monitoring and configuration of QoS, NetFlow, LAN, Routing, IP SLA, Medianet and AVC features.

2.2 MikroTik and RouterOS

MikroTik[5] is a Latvian company which was founded in 1996 to develop router and wireless ISP systems. It provides hardware and software for internet connectivity from around the world. The well-known MikroTik's software, RouterOS, is a system that provides extensive stability, controls, and flexibility for all kinds of data interfaces and routing.

We can control MikroTik router using RouterOS via PHP API [6,7] named PHP_PEAR that we must install it on the server to use PEAR2_Net_RouterOS which is a package for sending a command via IP Address of the devices in the network. We can download the package from http://pear2.github.io/Net_RouterOS/ then enable API service for the devices.

2.3 System overview

We use GNS3[8] along with RouterOS to simulate the operation of the system that uses MikroTik devices before the application in the real environment as shown in figure 1.

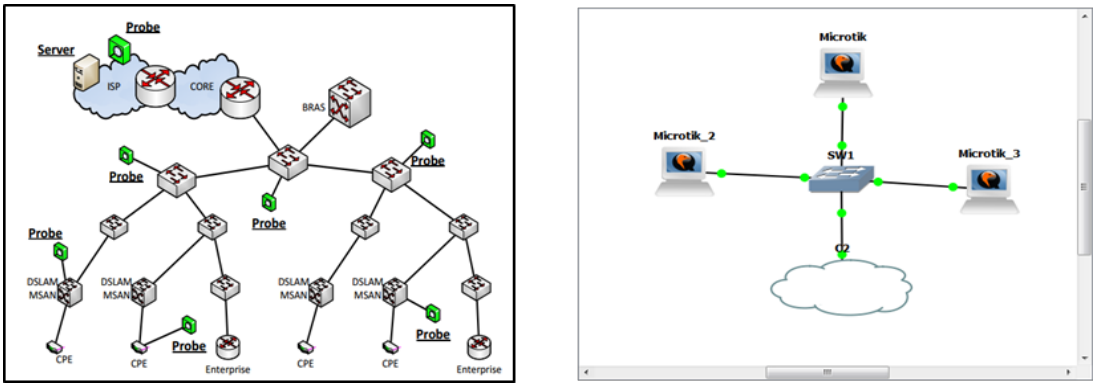


Figure 1 Simulation of MikroTik devices' connections

In the classic service measurement system[9] to measure a service performance, we need to write a script then send it to the device that we want to measure via FTP protocol then waiting for the result file sent to the server to display the result in the system as shown in figure 2. When we want to edit the script, we need to

resend a new script to the target device that can drive us to the connection problem and we need more time to operate.

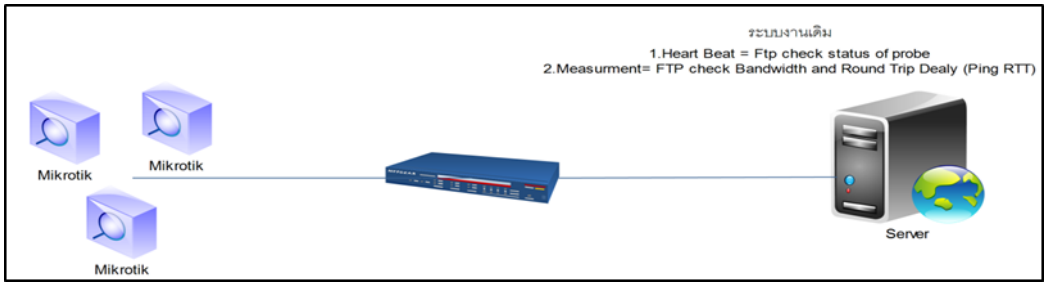


Figure 2 Classic service measurement system

In our method, the system is developed based on distributed approach. We distribute the control from central server to the core unit of each area (figure 3) to share the workload with the server. Moreover, we can easily control and manage devices in each sub-area.

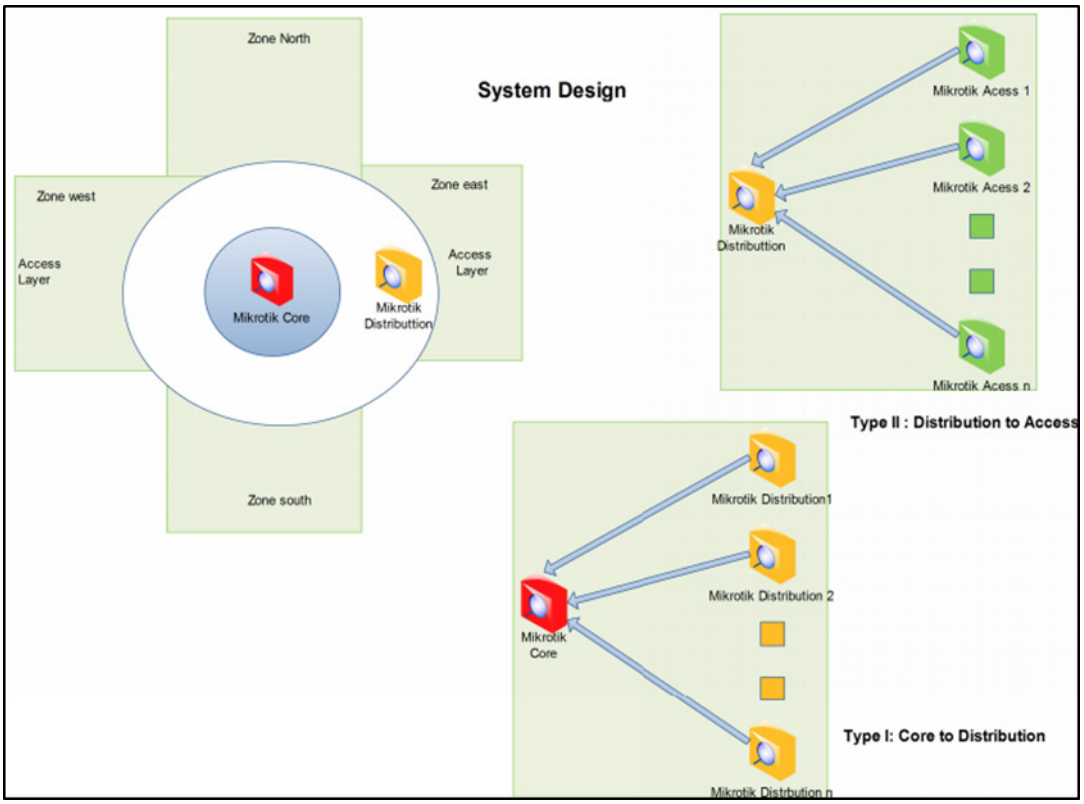


Figure 3 New service measurement System Overview

2.4 System's workflow

The operation flow of our system (figure 4) can be divided into 3 sections as follow:

1) User Management: we separate users into 3 levels, each has different right to control devices:
   a. Maintenance officer can do a Probe's test within his zone
   b. District chief can do a Probe's test across different zones
   c. Central authorities can do which Maintenance officer and District chief can do

2) Probe Management: we can register every device and fix its IP Address to check its performance later, we can verify devices' status and set device's working time and point device's location on Google Map.

3) Performance measurement: we can measure various aspects such as Ping, Bandwidth and show the result in form of graph and we can set measurement timer and the interval of auto-testing.

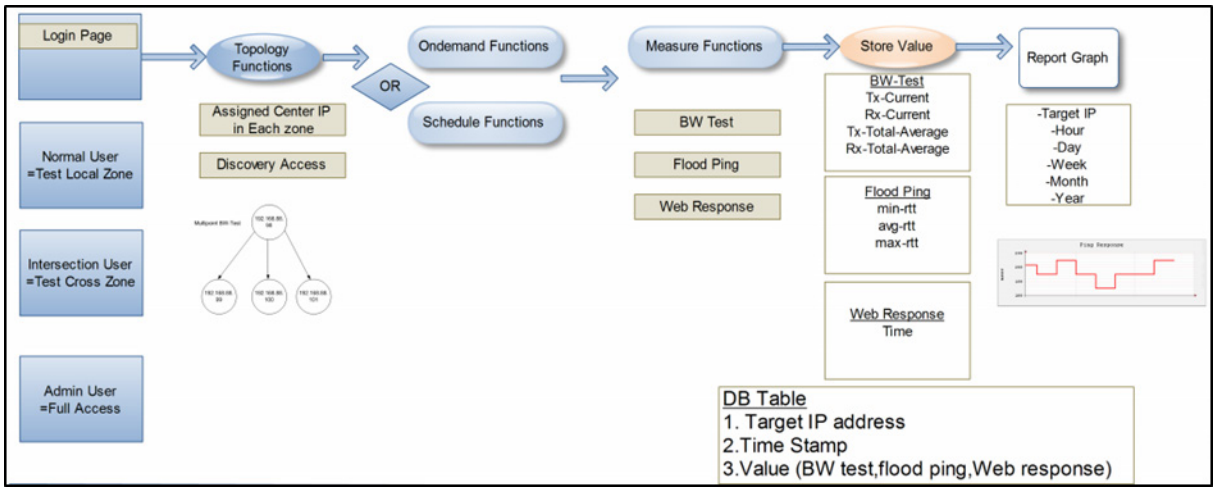


Figure 4 System's workflow

2.5 System development

```php
<?php
$sla_no=$_POST["sla_no"];
//$sla_no="sla01";
$comm=sprintf("php canvas_json_db_sh.php %s",$sla_no);
passthru($comm);
?>
```

Figure 5 Remote Code Execution

```php
 $probe_ip=mysql_result($rs1,0,2);
 $probe_user=mysql_result($rs1,0,3);
 $probe_pw=mysql_result($rs1,0,4);
$client = new RouterOS\Client($probe_ip, $probe_user,$probe_pw);
$responses= $client->sendSync(new RouterOS\Request('/tool/netwatch/print'));
$p1=count($responses)-1;
$sql4="select * from probe";
$rs4=mysql_query($sql4,$netview) or die ("x");
$p2=mysql_num_rows($rs4);
$sql2="Select probe.probe_ip from probe left outer join probe_ch_status on probe.probe_ip =
 probe_ch_status.status_ip where probe_ch_status.status_ip is NULL";
$rs2=mysql_query($sql2,$netview) or die ("x");
    while($row = mysql_fetch_array($rs2)){
    $com=sprintf('/tool/netwatch/add host="%s"',$row["probe_ip"]);
    $client->sendSync(new RouterOS\Request($com));
    }
$responses2= $client->sendSync(new RouterOS\Request('/tool/netwatch/print'));
foreach ($responses2->getAllOfType(RouterOS\Response::TYPE_DATA) as $response) {
```

Figure 6 PHP API for RouterOS

Figure 5 and 6 are code fragments of our system that shows how to use PHP_API to communicate with RouterOS installed in MikroTik devices. To communicate with RouterOS, we first create an object Client to send a command to the target device via its IP Address using function **sendSync()** with the syntax **"new RouterOS\Request('command that we want to send for example: /tool/netwatch/print')".** The waiting for the response. Then, the application will send the object of measurement in order to be stored in the database.

We can use function **time_sleep_until()** (figure 7) to make the system repeat the service measurement in specific interval then save the test in system's database in instance test mode or timer test mode and we can use the function curl() to send testing's notification via an SMS.

```
15 if($t=="Now"){
16     $t="+5 seconds";
17 }
18 //repeat
19     while($rep!="")
20     {
21      $timestamp = strtotime($t);
22      $time_go=date('Y-m-d H:i',$timestamp+($rep*60));
23      if(time_sleep_until($timestamp)){
24      $sql2="UPDATE  `netview`.`service_schedule_logs` SET `sv_time_start` =  '$time_go'
   WHERE  `service_schedule_logs`.`sv_sla` = '$sla'";
25     $rs2=mysql_query($sql2,$netview) or die ("x");
26     $comm=sprintf("php canvas_json_db_sh.php %s",$sla);
27     passthru($comm);
28     $sql3="select * from service_schedule_logs where sv_sla='$sla'";
29     $rs3=mysql_query($sql3,$netview) or die ("x");
30     $t=mysql_result($rs3,0,7);
31     $sla=mysql_result($rs3,0,2);
32     $rep=mysql_result($rs3,0,11);
33      }
34     }
35 }
36 else{
37     if($t=="Now"){
38     $t="+5 seconds";
39 }
40     //in time
41      $timestamp = strtotime($t);
42      if(time_sleep_until($timestamp)){
43     $comm=sprintf("php canvas_json_db_sh.php %s",$sla);
44     passthru($comm);
45     }
46 }
47   $sql3="select * from sms_message where sms_type ='2'";
48     $rs3=mysql_query($sql3,$netview) or die (mysql_error());
49     $sms_into=mysql_result($rs3,0,1);
50
51    $sql4="select * from user where `user_login` = '$user_send'";
52     $rs4=mysql_query($sql4,$netview) or die (mysql_error());
53     $user_tel=mysql_result($rs4,0,7);
54 $sms=sprintf("[netview]%s[%s]successful",$sms_into,$sla);
55 //send sms
56 if($user_tel!="" and $sms!="")
57 {
58 $smsdata=sprintf(
   "http://203.113.6.37/user=totpayphone&password=pathumthani&phonenumber=%s&sender=0893005740
   &text=%s",$user_tel,$sms);
59  $ch = curl_init();
60         curl_setopt($ch, CURLOPT_URL, $smsdata);
61         //return the transfer as a string
62         curl_setopt($ch, CURLOPT_RETURNTRANSFER, 1);
63         // $output contains the output string
64         $output = curl_exec($ch);
65         // close curl resource to free up system resources
66         curl_close($ch);
67 }
68 ?>
```

Figure 7 Service Measurement Control and testing's notification

3. Results and discussion

3.1 Dashboard

The dashboard (figure 8) is design based on Kaplan & Norton's concept[7] that allows the user to explore and follow the result of service measurement. Our dashboard is divided into 5 sections:

1) Area Management: show Probe devices in different areas and their information such as IP Address, name and location

2) User Management: manage users in system, show list of all users, specify their access right and modify users' attributes

3) Probe Management: manage Probe devices, show list of devices that user has a right to access and specific information about devices

4) Service Measurement: measure the performance of service, and test network performance
5) Report: export the testing report into the calendar format.

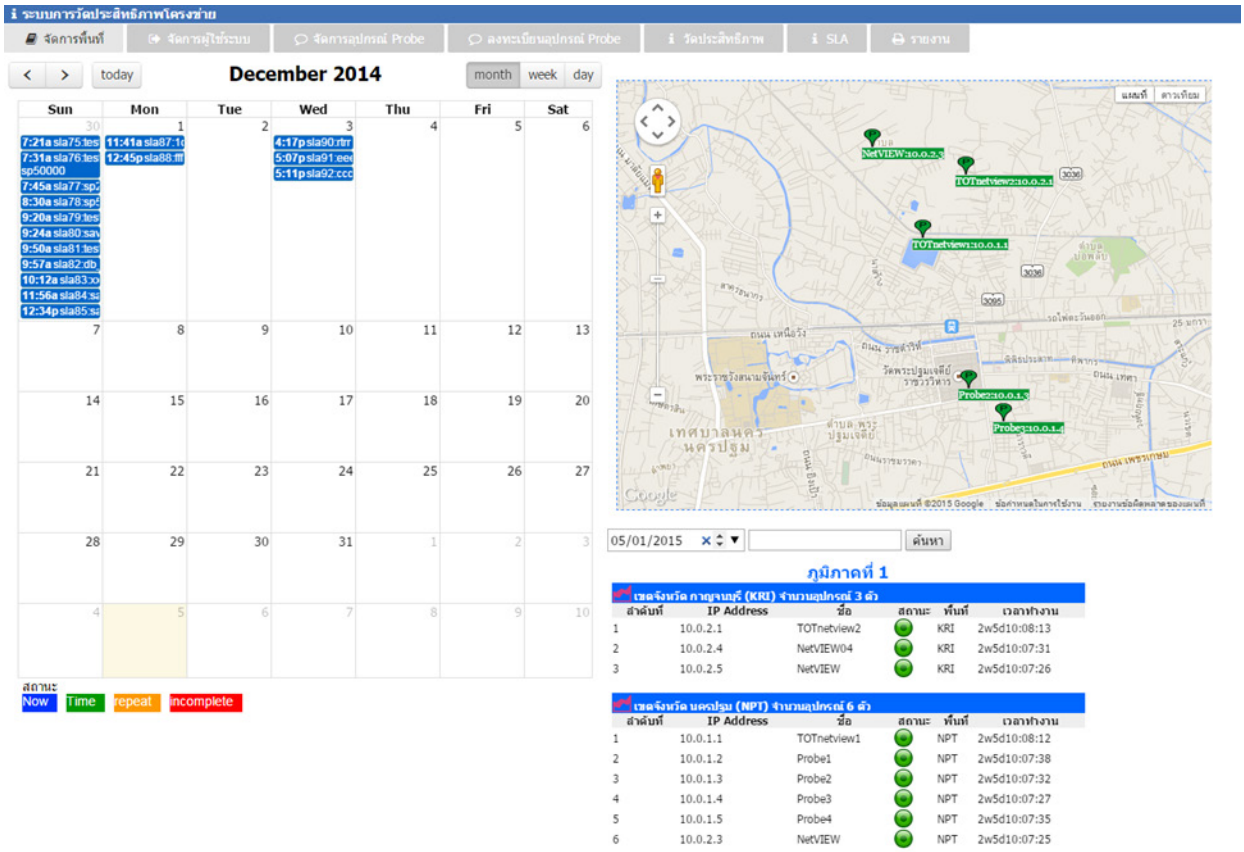


Figure 8 System Dashboard

3.2 Service measurement result

A Service Level Agreement (SLA)[10,11] is a contract between Service Providers and Customers that specifies what services the Service Provider will furnish, what transmission rate the Service Provider guarantee and what penalties the Service Provider will pay if he cannot meet the committed goals. The SLA will drive Service Provider to contribute to their customer's trust in terms of managed reliability and monitoring capabilities. To assure the availability and quality of their service, the Service Provider should verify in various aspect as shown in table 1.

Table 1 Service Measurement Testing aspects

Testing aspects	Result		Remark
	Correct	Incorrect	
Measurement in the same area	X		Depend on area
Measurement across areas	X		Depend on access right
Measurement with specific bandwidth	X		0.5-5 Mbps
Measurement with scheduled test	X		1-30 mins
Continuous measurement in different period	X		Starting from 1 mins
Repeat the measurement	X		every 5 mins
Measurement with many devices in the same time	X		More than 1 device

From Table 1, we implement our system as shown Figure 9 we have tested many times from 3 users in different areas with different access right as follows:

1) tko user at Nakhon Pathom (NPT) area as a maintenance officer
2) aue user at Kanchanaburi (KRI) area as a district chief
3) ana user at Bangkok (BKK) area as a central authority

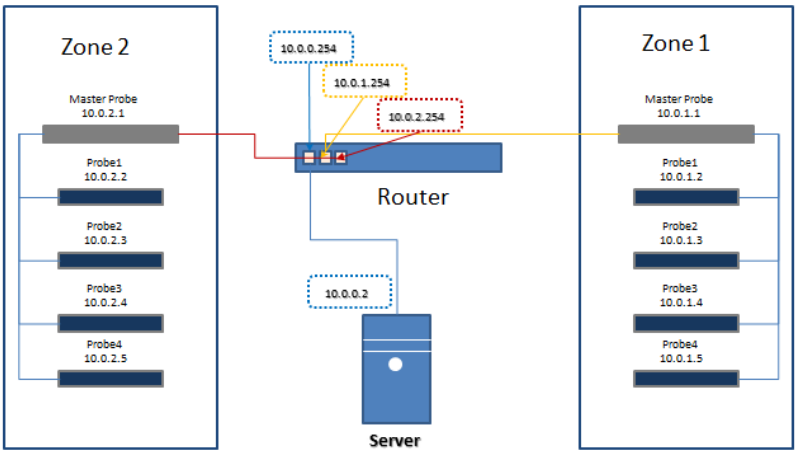


Figure 9 Overview of the network

The service measurement result is presented in the Table 1 that can show the correctness of different testing aspects.as shown in Figure 9. The result is presented in the Table 2 that show the service performance with different parameters.

Table 2 Service Measurement Result with specific bandwidth

Order	Source	Destination	Time	User	Area	Bandwidth	TX (Kbps)	RX (Kbps)
1	10.0.2.3	10.0.2.5,10.0.1.1	1 min	anan	BKK	1 Mbps	1019.53	1019.53
2	10.0.1.1	10.0.2.5	1 min	anan	BKK	1 Mbps	1019.33	1019.53
3	10.0.2.3	10.0.1.4	1 min	anan	BKK	1 Mbps	1019.33	1019.33
4	10.0.2.3	10.0.2.5	1 min	anan	BKK	1 Mbps	1019.73	1019.73
5	10.0.1.1	10.0.1.3	1 min	aue	KRI	5 Mbps	5110.99	5110.39
6	10.0.1.1	10.0.1.4	1 min	aue	KRI	6 Mbps	6142.04	6141.83
7	**10.0.1.1**	**10.0.1.4**	**1 min**	**aue**	**KRI**	**1 Mbps**	**1019.53**	**1019.53**
8	10.0.1.1	10.0.1.4,10.0.2.3	1 min	tko	NPT	1 Mbps	1019.33	1019.53
9	10.0.2.3	10.0.1.4	1 min	tko	NPT	2.5 Mbps	2554.48	2554.87

Figure 10 is the detail of the order 7 in Table 2. The source is 10.0.1.1 and the destination is 10.0.1.4. The output is shown in graph and in map location. In one minute of testing and bandwidth is 1 Mbps, the average value of Transmit Rate (Tx) is 1019.53 Kbps or 99.56%. The average value of Receive Rate (Rx) is 1019.53 Kbps or 99.56%.

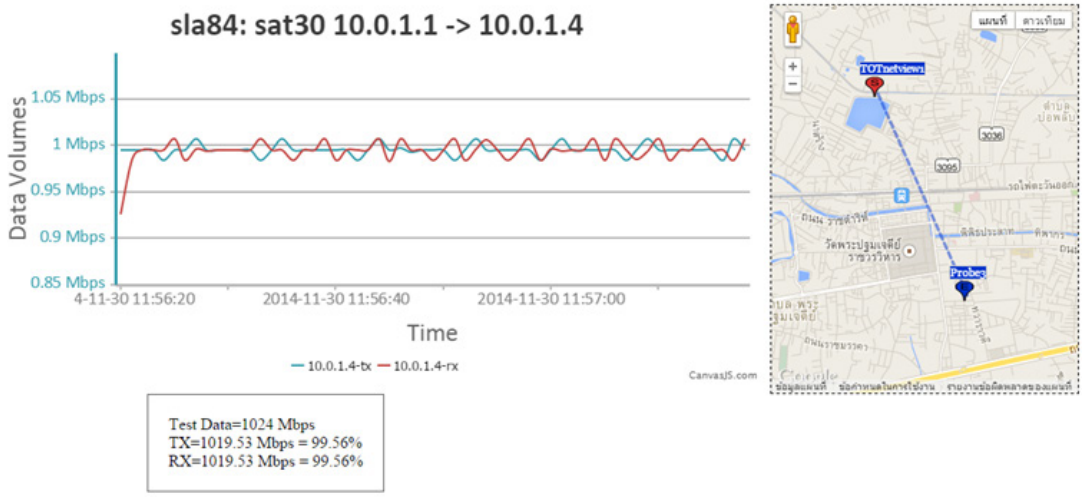


Figure 10 Measurement result Service Level Agreement

In order to evaluate tool, we have TOT Public Company Limited. TOT is a ISP, a Thai state-owned telecommunications company. TOT has applied our tool with TOT Netview within one year, the result has been shown that our tool can save the cost 133,261 baht per set of Probe and 13,0000,000 baht for the server needed for their own classic monitoring[9].

4. Conclusions & Future works

In this research, we develop a new service measurement tool for telecommunication networks using MikroTik devices and RouterOS and control these devices via PHP API that allows the user to manage the system, user, networks devices and allow users to measure the performance of the system.

In the future works, we can extend the expressivity of our tool by distributing the control to local control unit instead of using centralized control unit to share the workload and diffuse the risk of script working failures. We will try to use every functionality that came with the network device to improve the management of the system.

References

[1] Tiankantade K. Measurement, Analysis, Evaluation of universal primary education. Bangkok: Butterfly publisher, OPAC; 1993 [cited 2017 Oct 30]. Available from: http://library.montfort.ac.th/mylib/bookdetail.php?book_id=5881

[2] MRTG - The Multi Router Traffic Grapher. MRTG. [cited 2017 Oct 30]. Available from: http://www.mrtg.org/

[3] Burgess N. Rfc 2544 testing of ethernet services in telecom networks. White Pap. 2004;

[4] Boonchieng E. MVT Communication Public Company Limited. 2011 [cited 2017 Oct 30]. Available from: http://www.mvt.co.th/viewnews.php?nid=420

[5] MikroTik. [cited 2017 Oct 30]. Available from: https://mikrotik.com/

[6] Hasnain S. Design, Implementation and Monitoring of an ISP's Network Scenario [Thesis]. East West University; 2015 [cited 2017 Oct 31]. Available from: http://dspace.ewubd.edu/handle/123456789/1788

[7] Stoitsov G, Rangelov V. One implementation of API interface for RouterOS. TEM J. 2014;3(2).

[8] Welsh RC. GNS3 Network Simulation Guide. Packt Publishing; 2013. 154 p.

[9] TOT Public Company Limited (Thailand). TOT-netview. Network Performance Measurement Systems. (TOT-netview). [cited 2017 Oct 30]. Available from: http://www.sepo.go.th/tinymce/plugins/filemanager/thumbs/soe-2556.pdf

[10] Kaplan RS, Norton DP. The Strategy-Focused Organization: How Balanced Scorecard Companies Thrive in the New Business Environment. 1 edition. Boston, Mass: Harvard Business Review Press; 2000. 416 p.

[11] Iwata A, Fujita N. A hierarchical multilayer QoS routing system with dynamic SLA management. IEEE J Sel Areas Commun. 2000 Dec;18(12):2603–16.

[12] Marilly E, Martinot O, Betgé-Brezetz S, Delègue G. Requirements for service level agreement management. In: IP Operations and Management, 2002 IEEE Workshop on. IEEE; 2002. p. 57–62.

Semantic Web-based Approach for Economic Performance Indicators Based on Global Reporting Initiative (GRI) G4

Ilham S.Y. Yaldo[1,*] and Udsanee Pakdeetrakulwong[2]

[1]Accounting Tech. Dept., Institute of Administration /Al-Rusafa, Middle Technical University, Iraq
[2]Software Engineering Department, Nakhon Pathom Rajabhat University, Thailand

Abstract

The aim of this research is to fill the gap by developing ontology for Economic Performance Indicators based on the latest guidelines (GRI G4). The chief research question is: What is the best approach to developing an Ontological Model for the knowledge domain Economic Performance Indicators? The main objective of this research is to develop ontology for Economic Performance Indicators based on GRI G4. The methodology used in this research is a merger of several existing methodologies. The methodology adopted as a result of this applied research includes four phases: specification, conceptualization, formalization, and implementation. A requirement specification for Economic Performance Indicators ontology was created by identifying the intended scope and purpose of scenarios for each of the phases of ontology. The classes, properties, and relationships for Economic Performance Indicators based on GRI G4 were also identified. A conceptual model was formalized using UML. The implemented ontology is based on OWL language. And protégé tool to encode competency questions and subsequent SPARQL Queries. The resulting ontology was tested using instances data collected for four Australian companies listed on the Australian Securities Exchange (ASX), namely: Origin Energy Limited (ORG), Amcor Limited (AMC), Transurban Group (TCL), and BHP Billiton (BHP).

As mentioned, the ontology of content was evaluated to meet the criteria of completeness, consistency, and conciseness, and SPARQL Queries' answers were obtained establishing its utility and rationality. As a consequence, the developed ontology for Economic Performance Indicators was validated. There is clear evidence that few Australian companies have adopted either GRI or other initiatives and standards for reporting and that this position needs to be addressed. The ontology as proposed in this research could be applied to correct this concern. The four companies used to test the ontology are from different industries and sub-industry classifications and, as a result, the findings are not generalizable outside of these industries. However, the main finding of this research demonstrates that the majority of instances contained within the GRI4 Guidelines was validated suggesting that the ontology framework is effective as a standardized form of reporting.

Keywords: Economic Performance Indicators, GRI Sustainability Reporting Guidelines G4, Ontology, Stakeholders

1. Introduction

Reporting by corporations on economic, environmental and social dimensions, referred to as "Sustainability", is seen as a step towards a sustainable global economy that combines long-term profitability with social justice and environmental protection [1]. The history of sustainability reporting began at the beginning of the 20th century with employee reporting, social reporting, environmental reporting, triple bottom line reporting and sustainability reporting [2]. Some authors contend that there is currently no suitable definition for sustainability reporting [3]. Kolk and Herzig and Schaltegger claim that since the mid-1990s the number of companies reporting on sustainability has increased substantially and new forms of corporate sustainability reporting are being developed, resulting in reporting contents and formats being subject to change from year to year [4].

Several theoretical approaches that explain the motivation for sustainability reporting include: accountability theory, legitimacy theory, and political economy and stakeholder theory [5] [2]. There are several national and international bodies that promote sustainability reporting and provide guidance; these include: Global Reporting Initiative (GRI), the International Standards Organization (ISO), the World Business Council for Sustainable Development (WBCSD), AccountAbility, and the Sustainability Integrated Guidelines for Management (SIGMA) Project [2]. Christofi, Christofi, and Sisaye argued that it was important to have standardized sustainability reporting by corporations [6]. The GRI guidelines are generally accepted as "best practice" reporting and are widely used by organizations around the world as the basis for their environmental

* Corresponding author; e-mail: ilhamsy_ilhamsy@yahoo.com

and social reporting [5]. The guidelines provide guidance on how to write and what to write and present principles that guide report content and report quality [7]. An ontology methodology plays an important role in the design of information systems [8]. It provides a formal specification for the concepts within a domain and the relationship between those concepts [9]. There are many existing definitions of ontology, arguments about what the definition of ontology is or ought to be [10], and debates on what is the best definition [11]. Studer, Benjamins, and Fensel define ontology as a "formal, explicit specification of a shared conceptualisation" [12]. This is one of the most comprehensive definitions from those available in the literature [13]. A new information system for sustainability reporting is required as it has become an important source of monetary and non-monetary, quantitative and qualitative information [14]. There are several studies that develop ontologies in different aspects of accounting but little ontological research exists within the accounting domain. For example, Chou, Vassar, and Lin developed an ontology concept model for profit and loss accounts and implemented it for Microsoft's NET software [15]. Teller established ontology of accounting notions to represent the entire domain knowledge based on International Financial Reporting Standards (IFRS)[16]. Chou and Chi proposed an ontological model comprising Event, Principle and Account (EPA) for accounting principles [17]. Smeureanu et al. developed ontology for Corporate Social Responsibility based on the guidelines proposed by the 'ISO 26000 Standard for Social Responsibility' [18]. Weigand and Elsas introduced a model-based auditing approach as a design artefact that includes a corresponding business modelling language [19]. Weigand, Johannesson, and Bergholtz introduced a service accounting model based on a formal ontology approach and propose some adaptations to the Resource-Event Agent (REA) model [20]. From the literature review, ontology for economic performance indicators based on GRI G4 does not exist. Thus, the aim of this research is to fill the gap by developing an ontology for economic performance indicators based on GRI G4. The Economic performance indicators focus on the financial organization's performance and impacts on the stakeholders by clarifying the flow of capital among them; it does not focus on the financial status of the organization. In addition, they focuses on economic systems at local, national, and global levels [21].

In this research, the ontologies for Economic Performance Indicators based on the Global Reporting Initiative guidelines (GRI G4) are presented. This paper is structured in the following manner. In Section 2, Research objective is described and then followed by Materials and methods in Section 3. In Section 4, Results are presented. In Section 5, ontology evaluation is described and followed by discussion in Section 6. Section 7 is a conclusion and future work.

2. Research objective

The main objective of this research is to develop ontology for Economic Performance Indicators based on GRI G4, and this will be achieved through the following sub-objectives:

- Identifying the classes, data properties, object properties for Economic Performance Indicators based on GRI G4.
- Transforming a conceptual model into a formalized model by using the Unified Modelling Language (UML) to represent ontology for Economic Performance Indicators.
- Implementing ontology by using OWL language and Protégé tools to encode the competency questions. Subsequent SPARQL Queries will be created after implementing all classes, data properties, object properties identified within GRI G4 for Economic Performance Indicators. Data instances will be collected online for four Australian companies listed with the ASX, including Origin Energy Limited, BHP Billiton, Amcor Limited, and Transurban Group.
- Evaluating the developed ontology for Economic Performance Indicators by a process of verification and validation. Schema Metrics and Knowledgebase Metrics will be used to verify the ontology. To validate the ontology, the answers to SPARQL Queries are extracted and the ontology for an Economic Performance Indicators is validated.

3. Materials and methods

3.1 Background

3.1.1 Ontology

There are many existing definitions of ontology, arguments about what the definition of ontology is or ought to be [10], and debates regarding the best definition [11]. Studer, Benjamins, and Fensel definition of ontology as "a formal, explicit specification of a shared conceptualisation" is one

of the most comprehensive definitions available [12]. They define the terms: Explicit, Formal, and Shared as follows:

- Explicit: all elements of ontology are obviously defined.
- Formal: refers to the fact that the ontology should be machine readable, which excludes natural language.
- Shared: refers to consensual knowledge agreed on to be accepted by a group of people.

The definition introduced by Studer, Benjamins, and Fensel [12] is one of the most comprehensive forms available in the literature [13]. This research is based on this definition. The main uses of ontology are to share common understanding of terms for specific domain in the real world between people and computers, and to reuse it; if it is not reused, it provides limited benefits.

It should be noted that Ontological Engineering (OE) refers to any activities involved in the ontology building process and also include lifecycle, principles and methodologies used for its construction [13]. The main methodologies and methods used to build ontologies from scratch. These methodologies are related to its lifecycle. The lifecycle as a development process consists of different activities to design and evaluate ontologies. Until the mid-1990s this process was an "art rather an engineering activity" [13].

Scholars agree that concepts, relations, instances and axioms are the main components or basic and typical elements of ontology. Because of different ontology languages, the exact specification of these elements may vary according to the underlying knowledge model [22] [23]. Concepts are also known as classes of objects. Classes have been defined as "abstract or concrete, elementary or composite, real or fictitious"; in short, a concept can refer to just about anything including speech, actions or activities, strategies or plans, or cognitive processes, to name a few [23]. Relations represent a "type of association between concepts of the domain" [13]. Binary relationships refer to the relational links involving two concepts; roles describe binary relations between concepts; inverse relationships refer to binary relation links between two concepts in the opposite direction. There are three types of relationships: association relationship, inheritance relationship, and composition relationship are used in this reseach. Properties are also known as slots or roles or attributes of classes. Properties represent relationships that describe various features and attributes of the concept [24]. Object properties and datatype properties are two main types of properties. Object properties are relationships between two individuals and they use "vocabulary" and "semantic" to describe this relationship. Instances are also known as individuals. Instances represent "real-world individuals" or are used to represent elements or individuals in ontology [25]. Horridge stated that individuals, are also known as instances or "objects" in the interested domain. Individuals can be defined as being "instances of classes"[26]. Axioms refer to constraints used on values for classes or instances; the properties of relations are types of axioms and they include more general rules [24] [27].

3.1.2 Global Reporting Initiative

A comprehensive Sustainability Reporting Framework that is the most widely used around the world has been established and improved by the Global Reporting Initiative or GRI. The GRI is a leading organization in the sustainability field. The GRI Sustainability Report is a report issued by organizations (private, public, or non-profit) that reports their economic, environmental and social impacts, and the performance of their activities, products and services. Such reporting takes a Triple Bottom Line (TBL) approach. GRI considers an organization's impacts and performance not only on in terms of its local economy but also in terms of its sustainable global impact. Many organizations, regardless of their type, size, sector or location, voluntarily use the GRI Framework to measure and report on their performance according to specific principles and indicators. This framework is a reporting system which includes the Reporting Guidelines, "the core document" or the "cornerstone" of this framework providing guidance on how organizations can disclose their sustainability performance and increase accountability [28] in addition to Sector Guidance and other resources. G4 is the latest version of GRI's Sustainability Reporting Guidelines released in May 2013 after several previous versions of the Guidelines: the first version in 2000; the second generation (G2) in 2002; and the third generation (G3) in 2006. In 2011, the GRI updated and published the G3.1. [29]. Global Reporting Initiative, the Global Reporting Initiative logo, Sustainability Reporting Guidelines, and GRI are trademarks of the Global Reporting Initiative [30]-[33]. GRI includes sustainability reporting that principally applies to environmental issues as well as economic and social impacts. However, in Australia, GRI guidelines are for voluntary use by business firms for reporting on the three aforementioned dimensions of their activities, products, and services [32].

3.2 Conceptual framework

The scenario is illustrated in Figure 1. In a real-world use scenario of Sustainability Reporting, small, medium or large enterprises engage in this reporting process by following Sustainability Reporting Guidelines. Because of a lack of a standard application for the report generation, ontology is used to solve this problem by generating an Ontological Model for Sustainability Reporting including Economic Performance Indicators. This enables organizational sharing, communicating and reusing this Model for Economic Performance Indicators. The components of ontology are elicited from Sustainability Report that based on GRI G4 and they involved in ontology development process and resulted ontological model. The Ontology Development Process Model includes four phases: specification, conceptualization, formalization, and implementation [24] [34] [35] [36]. Through these steps, the purpose and the scope of the ontology are defined, the conceptual model is identified and formalized, and the formalized model is encoded. Then, to verify and validate the model, an outcome of this process is to create and assess an ontological model for Economic Performance Indicators based on GRI G4.

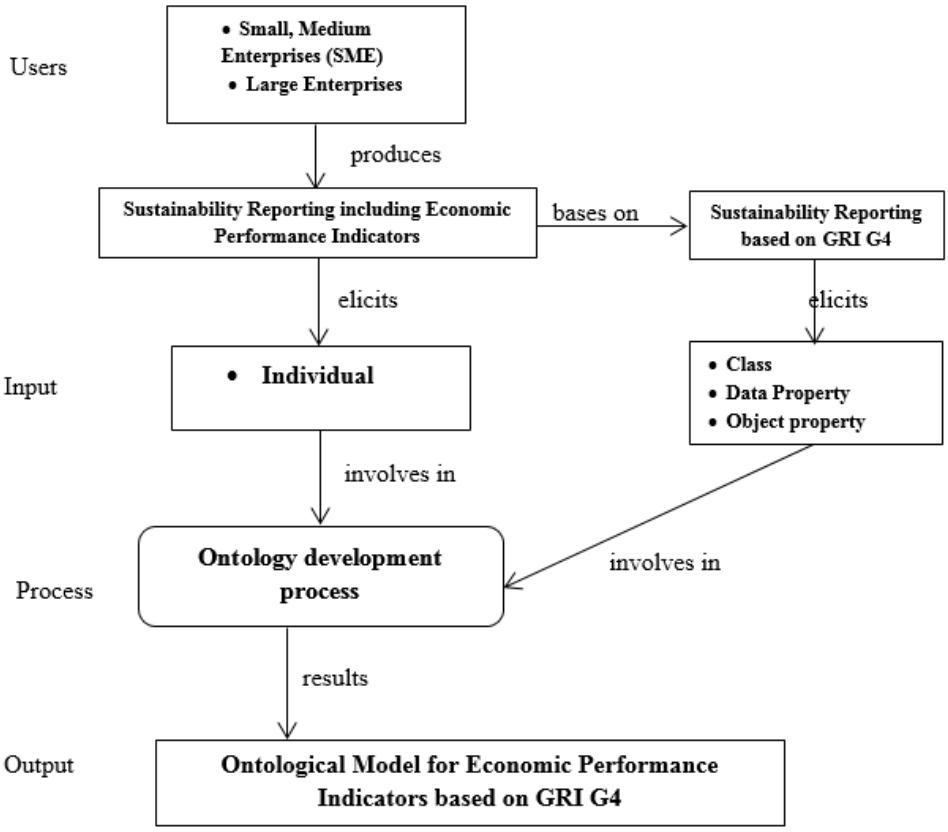


Figure 1 Conceptual framework

Figure 2 shows the contained tasks in each phase. In the specification phase, the motivation scenarios and competency questions need to be described. In the conceptualization phase, the conceptual models need to be defined. In the formalization phase, the conceptual models are required to be formalized. In the implementation phase, the ontology will be built by encoding [24] [34]-[38]. The following subsections will explain each phase.

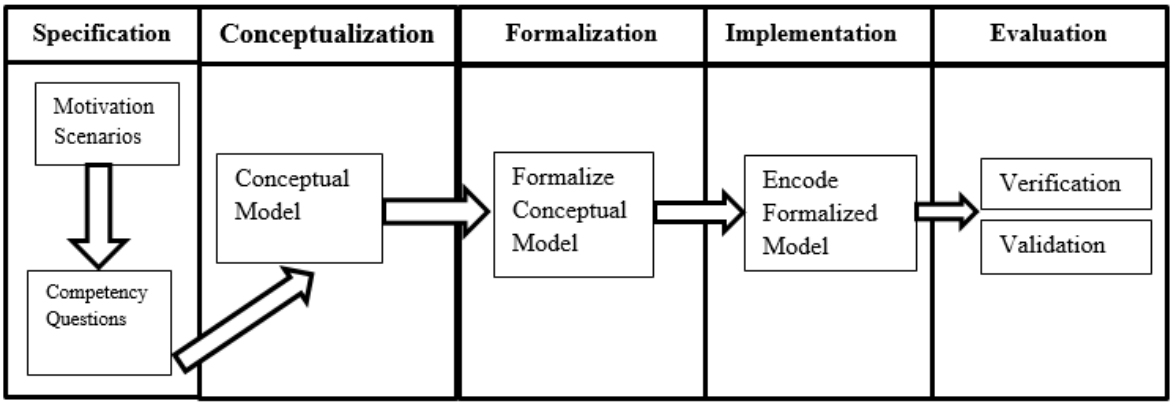


Figure 2 Tasks in each phase of the Economic Performance Indicator ontology development

3.2.1 Specification phase

The first development phase of ontology is the specification phase; this activity is ontology description (usually in natural language). The aim of this phase is to 'state why the ontology is being built, what is intended uses are, who the users are, and which requirements the ontology should fulfil' [39]. The first requirement is to describe the motivating scenario and present solutions to the problems arising in the scenario [40] as stated above. Uschold and Gruninger [36] and Uschold [37] identify the purpose and scope of ontology. Fernández-López, Gómez- Pérez, and Juristo [41] and Lopez et al. [35] show a brief example of ontology requirements specification document in the chemicals domain. The following information should be included in the specification phase. A detailed ontology requirements specification document (ORSD) is required in this phase as proposed by (Uschold 1996) [37]. The specifications of the Sustainability Reporting ontology are defined as follows:

Domain: Sustainability Reporting based on GRI Guidelines G4.

Purpose: Developing a Sustainability Reporting ontology-based knowledge base for software to automatically create GRI reports for the following reasons:

1) Enabling knowledge sharing among people, organizations, and software systems [24] [36] [42] [43] [44].

2) Reusing knowledge. The proposed ontology can be reused by organizations and can also be updated to adapt to new generations of GRI.

End users: Engaged stakeholder groups, for example, civil society, customers, employees, other workers and their trade unions, local communities, shareholders and providers of capital, and suppliers.

Level of formality of the implemented ontology: Semi-formal. This is the level of formality that will be used to codify the terms and their meanings in a language somewhere between natural language and a rigorous formal language [41]. Uschold and Gruninger [36] classify the level of formality into: highly informal, semi-informal, semi-formal or rigorously formal ontologies.

Scope: All components of Economic Performance Indicators defined according to GRI Guidelines G4.

Sources of knowledge:

1) Interviews with the experts in GRI Sustainability Reporting Guidelines because the ontologists and the GRI reporters are different jobs. However, in this research the ontology is used as a tool to design Economic Performance Indicators according to GRI G4. So, the reporters are the professionals experienced in the content of GRI reporting and the ontologists will structure the information of GRI G4 into: classes, properties, relationships, axioms and individual. Then Protégé is used to implement this ontology development process.

2) GRI Sustainability Reporting Guidelines G4: Reporting Principles and Standard Disclosures [21] and GRI Sustainability Reporting Guidelines G4: Implementation Manual [33].

The second requirement is to create 'competency questions' 'CQ' as the technique for establishing the ontology requirements [40]. Competency questions are queries written in natural language and the ontology to be built should be able to answer all questions raised by stakeholders and can be used to verify the correctness of the ontology with the ontology requirements identified (scope of the ontology) [39]. The main concepts and their properties, relations and formal axioms of the ontology are used to extract these questions and answers [45]. In this research, competency questions are created for data instances found in four Australian companies to implement ontology as can be seen two examples in this research.

3.2.2 Conceptualizations phase

The second step in the ontology lifecycle is conceptualization. The output of the first phase will be transformed into a conceptual model by means of conceptualization [46]. The aim of this activity is to structure the domain knowledge in a conceptual model in terms of the domain vocabulary identified in the ontology specification activity [41]. Weber [47] defines 'Conceptual modelling' as an 'activity undertaken during information systems development to build a representation of selected semantics about some real-world domain'. According to Noy and McGuinness [24], the requirements for the conceptualization phase are:

1. Identify terminologies for Economic Performance Indicators in the GRI G4 Guidelines; and
2. Identify the classes, their properties, and the relationships between them as defined in GRI G4 Guidelines and create instances from actual sustainability report.

3.2.3 Formalization phase

The formalization phase is the core of an ontology development process. It involves transforming a conceptual model into a formalized model or semi-computable model [22] [46] [25]. Colomb [48] explained that a formal ontology is an "advanced knowledge representation system". Guebitz, Schnedl, and Khinast [49] stated that creating a neutral ontology formulation, independent of implementation languages is the goal of this phase. There are different levels of the transformative process in relation to the conceptual model ranging from semi-formal to rigorously formal. The greater the formality, the greater is the amount of automation required to support ontology [37]. It depends on the implementation requirements of the ontology. Guebitz, Schnedl, and Khinast [49] presented the object-oriented modelling language as an appropriate formalism to represent ontology by using the Unified Modelling Language (UML). Thus, for the development of the sustainability report ontology, the formalization requires a notation system to formalize the sustainability report ontology conceptual model.

To create a formal ontology, all main structural components and their constraints must be explicitly described [49]. The object oriented modelling language can be used for ontology modelling. Cranefield and Purvis [50] suggested that UML as a static modelling notation can be used to model the "formal semantics" of ontologies.

In this research, three types of relationships are identified between classes, which are: Association relationship, Inheritance relationship, and Composition relationship.

3.2.4 Implementation phase

This activity builds computable models in a formal language or representation of conceptual models by using an ontology language [46]. To implement computable models, there are tools used in different ontology languages as ontology editors. There are several languages: XML, RDF, OIL, DAML+OIL, OWL, CARIN, FLogic, Jess, and Prolog [25]. The requirements of the implementation phase are:

1. A formal language that can be used to encode the ontology; and
2. A tool that supports the ontology development activities.

In this research, Web Ontology Language OWL is used as a standard and broadly acceptable ontology language, which provides classes, data properties, object properties and individuals [51]. Protégé Onto Edit (protégé.standford.edu) is used as a tool to represent ontology in a machine readable format. Ontologies are stored as Semantic Web documents (W3C OWL Working Group)[1]. The full ontology coding is available at http://www.semanticweb.org/14174782/ontologies/2014/6/csr#.

3.2.5 Evaluation phase

Evaluation is a 'technical judgment of the content of the ontology with respect to a frame of which can be requirements specifications, competency questions or the real world during each phase and between phases of their lifecycle to guarantee to end users the consistency, completeness and conciseness of the ontologies definitions, documentations, and software' [52] – [55]. Ontology evaluation includes:

Ontology verification and
Ontology validation

[1] http://www.w3.org/TR/2012/REC-ow12-overview-20121211

In this research, all classes, data properties, object properties identified for Economic Performance Indicators according to GRI G4. All instances data as identified from actual sustainability report for 4 Australian companies. Most definitions of classes can be found in [33].

4. Results and discussion

There are four Aspects as classes within the 'Economic Category' class – the 'Economic Performance Aspect' class, the 'Market Presence Aspect' class, the 'Indirect Economic Impact Aspect' class, and the 'Procurement Practice Aspect' class. The following subsection explains the ontology for each Aspect class.

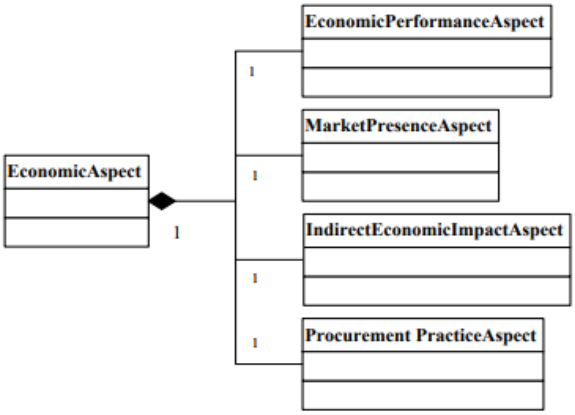


Figure 3 Ontology formalization for 'Economic Aspect' class

4.1 Ontology for Economic Aspect class

This is the first aspect which addresses the "direct value generated" [3] of the organization's activities and immediate consequences of monetary flows to stakeholders. There is a generic DMA and four indicators related to this indicator class as shown in Figure 4. In the following subsections, the ontologies for the four indicators of the class 'Economic Performance Aspect' are presented.

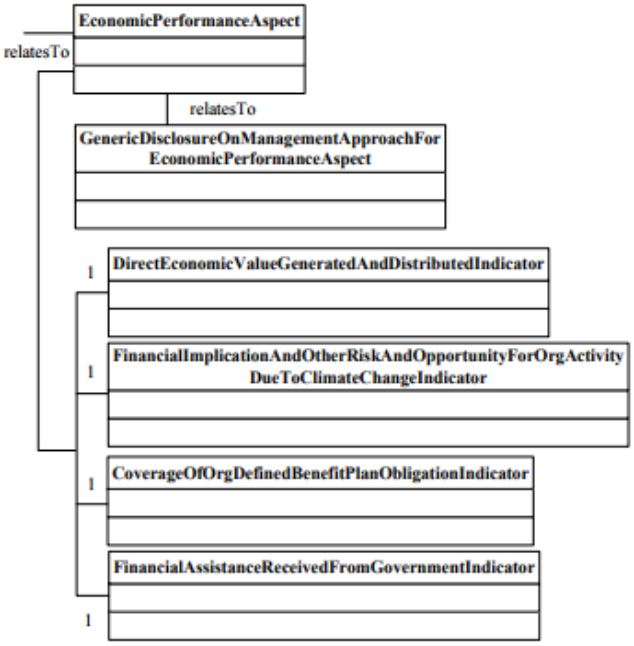


Figure 4 Ontology formalization for 'Economic Performance Aspect' class

4.1.1 Ontology for 'Direct Economic Value Generated and Distributed Indicator' class/ EC1

This indicator class concerns the economic value generated and distributed (EVG&D) (Figure 5). The concept that is related to this indicator is 'Economic Value Retained' class. The class 'Organization' retains

'Economic Value Retained'. This class is obtained from the 'Direct Economic Value Generated' class and 'Economic Value Distributed' class. The class 'Organization' generates the 'Direct Economic Value Generated' class. In addition, the class 'Organization' distributes 'Economic Value Distributed' class. The class 'Direct Economic Value Generated' is generated from 'Revenue' class. The class 'Economic Value Distributed' is distributed to: 'Operation Cost' class; 'Employee Wage and Benefit' class; 'Payment To providers of Capital' class; 'Payment To Government' class; and 'Community Investment' class [33].

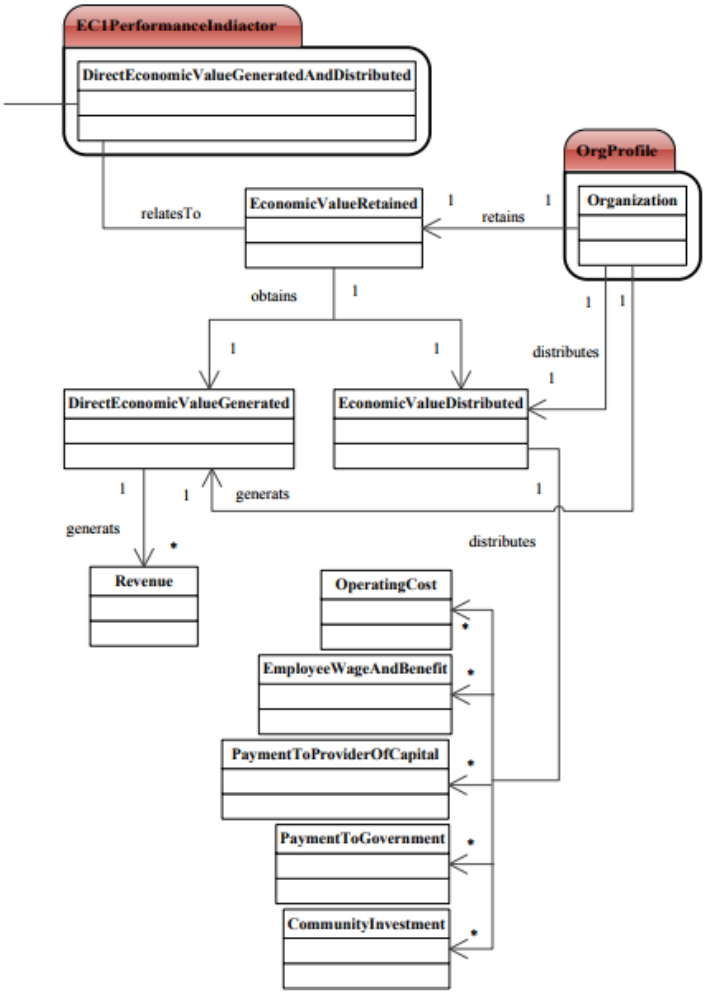


Figure 5 Ontology formalization for 'Direct Economic Value Generated And Distributed Indicator' class

4.1.2 Ontology for 'Financial Implication And Other Risk And Opportunity For Org Activity Due To Climate Change Indicator' class/ EC2

This indicator centres on how climate change affects economic performance. It is required to identify 'Climate Change Risk' class and 'Climate Change Opportunity' class that posed by 'Climate Change' class. The class 'Climate Change Risk' categorizes risk according to 'Physical Risk' class, 'Regular Risk' class, and 'Other Risk' class. The class 'Climate Change Opportunity' categorizes opportunity according to 'Physical Opportunity' class, 'Regular Opportunity' class and 'Other Opportunity' class [33].

4.1.3 Ontology for 'Coverage Of Org Defined Benefit Plan Obligation Indicator' class/ EC3

This indicator class focuses on structure of retirement plan offered to employee. The concept that is related to this indicator is 'Structure Of Retirement Plan Offered To Employee' class whether is based on 'Defined Benefit Plan' class; 'Defined Contribution Plan' class; and 'Other Type Of Retirement Benefit' class. For class 'Defined Benefit Plan' whether is funded by 'Org General Resource' class or by the class 'Separate Fund' which is used to pay to 'Pension Liability' class which is kind of 'Liability' class. For class 'Defined Contribution Plan' is required to report 'Percentage Of Salary' class and 'Level Of Participation' class. The

'Percentage Of Salary' class which is contributed by employee and employer as 'Contribution Of Employee' class and 'Contribution Of Employer' class. For the class 'Other Type Of Retirement Benefit' is specified where not fully covered by general resource and separate fund. In addition, the class 'Jurisdiction Regarding Calculation Plan Coverage' is required to identify calculations used to determine plan coverage [33].

4.1.4 Ontology for 'Financial Assistance Received From Government Indicator' class/ EC4

This indicator concerns the financial support received from government. The 'Financial Assistance' class is related to this indicator. The class 'Organization' receives 'Financial Assistance' class. It is received from the class 'Government' which is part of 'Stakeholder Group Engaged By Org' class. It is received in 'Reporting Period' class. The data properties can be found in [33].

4.2 Ontology for 'Market Presence Aspect' class

This is the second Aspect that focusses on "entry-level wage by gender compared to local minimum wage" [3]. This Aspect comprises generic DMA and two indicators as following.

4.2.1 Ontology for 'Ratio Of Standard Entry Level Wage By Gender Compared To Local Minimum Wage At Significant Locations Of Operation Indicator' class/EC5

This indicator concentrates on entry level wage by gender compared to local minimum wage. The classes that are related to this indicator are: 'Local Minimum Wage'; 'Entry Level Wage'; and 'Ratio Of Standard Entry Level Wage' class which are presented at 'Location Of Operation'. The fourth class is 'Salaried Employment' which is offered by the class 'Organization' [33].

4.2.2 Ontology for 'Proportion Of Senior Management Hired From Local Community At Significant Location Of Operation Indicator' class/ EC6

This indicator concentrates on percentage of senior management at significant locations of operation that hired from the local community. So, the concept of 'Proportion Of Senior Management' class is related to this indicator class. It is required to report the 'Percentage Of Senior Management' class that is hired at 'Location Of Operation' class which is hired from 'Local Community' class [33].

4.3 Ontology for 'Indirect Economic Impact Aspect' class

This is the third Aspect that emphasizes "impact of infrastructure investments" in relation to local communities and regional economies [3]. There are generic and specific DMA classes and two indicators:

4.3.1 Ontology for 'Development and Impact of Infrastructure Investment and Service Supported Indicator' class/ EC7

This indicator focuses on significant infrestructure investment in terms of its development and impact or service supported. The concept related to this indictor is the 'Infrastructure Investment and Service Supported' class that has an impact on 'Community and Local Economy' class [33].

4.3.2 Ontology for 'Significant Indirect Economic Impact Including Extent Of Impact Indicator' class / EC8

The additional impacts that are generated by an organization through the economy in terms of financial flow are included in this indicator. It has indirect impacts as a participant or agent in socio-economic change, and in developing economies in terms of local communities and regional economies [33]. So, this indicator has significant positive and negative indirect economic impacts on 'Local Community and Regional Economy' class.

4.4 Ontology for 'Procurement Practice Aspect' class

This is the final aspect, the essence of which is "spending on local suppliers" [3]. There are generic and specific DMA classes associated with this aspect and only one indicator which is the Ontology for 'Proportion Of Spending On Local Supplier At Significant Location Of Operation indicator' class/ EC9. This indicator concentrates on ratio of local spending at significant locations of operation. The concept that relates to this indicator is 'Percentage of Procurement Budget Spent On Local Supplier' which is used for the class 'Location of Operation' [33].

In implementation phase, Web Ontology Language (OWL) is used as a standard and broadly acceptable ontology language which defines classes, data properties, object properties, and individuals. Protégé_5.0_beta (protégé.standford.edu) is used as a tool to create ontologies. Ontologies are stored as Semantic Web documents

(W3C OWL Working Group)[2]. The full ontology coding is available at http://www.semanticweb.org/14174782/ontologies/2014/6/csr#.
In addition, only the following language elements are used: Owl:Ontology, owl:Class, owl: ObjectProperty, owl:DatatypeProperty, rdfs:subClassOf, rdf:datatype, rdfs:domain, and rdf:range [56].
Therefore, all classes' object properties, and data properties identified and formalized are created in Protégé_5.0_beta. The instances of classes are referenced from the four Australian companies mentioned before.
According to the scope and purpose of ontology for a Economic Performance Indicators specified in phase 1, stakeholders need information about an Economic Performance Indicators disclosures, and therefore they raise questions. Competency questions are prepared as a standard technique in ontology engineering methodologies [36]. Grüninger and M.S.Fox [57] proposed competency questions as a methodology for evaluating ontologies. The query language is required to encode the competency questions appropriately [58].

4.5 Competency questions and SPARQL queries for 'Economic Performance indicator' class

In this section, questions in natural language are detailed and covered all the instances in the ontology. All these questions are correct and complete. They are then transformed to SPARQL queries for inquiring the 'Economic Performance indicator'' class as shown for example in Table 1 and Table 2.

Table 1 Competency questions and SPARQL query for 'Direct Economic Value Generated' class

CQ60: What is the total value of direct economic value generated, by region, basis, and measurement unit currency for this company?
SPARQL query SELECT ?subject ?object WHERE { ?subject csr:directEconomicValueGeneratedBasis ?object } csr:regionNameForDirectEconomicValueGenerated ?object } csr:totalValueOfDirectEconomicValueGenerated ?object } csr:totalValueOfDirectEconomicValueGeneratedByRegion ?object } csr:measurementUnitCurrency ?object }

Table 2 Competency questions and SPARQL query for 'Revenue' class

CQ61: What is the total value of revenue by region, basis, and measurement unit currency for this company?
SPARQL query SELECT ?subject ?object WHERE { ?subject csr:revenueName csr:revenueandOtherIncomeBasis ?object } csr:regionNameForRevenueandOtherIncome ?object } csr:totalValueOfRevenueandOtherIncome ?object } csr:totalValueOfRevenueandOtherIncomeByRegion ?object } csr:measurementUnitCurrency ?object }

5. Ontology evaluation

Weller [22] considered the evaluation of ontology as an additional process. It incorporates verification and validation. It refers to "judging the quality of the content of the ontology" [22] [54]. To evaluate the ontology, there are many approaches based on the level of evaluation [59] and relevant criteria identified [54]. It is performed differently depending on the methodologies used to build ontology [54]. Grüninger and Fox [40] propose to evaluate ontology by identifying a set of competency questions. These questions need to be formalized in a query language to encode the competency questions using an appropriate tool [58]. The form of questions is used in this evaluation.

[2] http://www.w3.org/TR/2012/REC-ow12-overview-20121211/

Ontology evaluation includes technical evaluation. The core of technical evaluation is the evaluation of the definitions that consider different aspects of ontology in terms of vocabulary, structure, content, syntax, semantic and representation that satisfy the criteria of completeness, consistency, and conciseness of definitions [58][54]. To assess specific features of ontology, technical evaluation methods are required.

Verification is the process whereby the correctness of ontology is ascertained. The process involves the creation of an ontology whose definitions adequately meets its requirements and competency questions, and function correctly in the real world [52] – [55]. Ontology verification is quite distinct from ontology validation. Ontology verification ensures that the ontology was created correctly, whereas ontology validation determines whether the right ontology was created [58]. It deals with the problem of the three Cs: (consistency, completeness, and conciseness) [55] [53] [52]. Gómez-Pérez [55] defines the three Cs as follows:

Consistency refers to definitions in the ontology that are semantically consistent;

Completeness refers to the extension, degree, amount of or coverage of the information about the real world in the ontology;

Conciseness refers to the usefulness and precision of all the information gathered in the ontology.

It requires a common understanding between the domain knowledge experts and ontology engineering experts. For this purpose, SPARQL queries are used to extract answers for the competency questions after SPARQL queries are created as shown in Table 1 and Table 2. The extracted answers for the competency questions as shown in Figure 6 and Figure 7 are the correct answers that confirm that the reported data are instantiated and correctly describe all relationships between the data. Therefore, the developed ontology for the Economic Performance Indicators is valid.

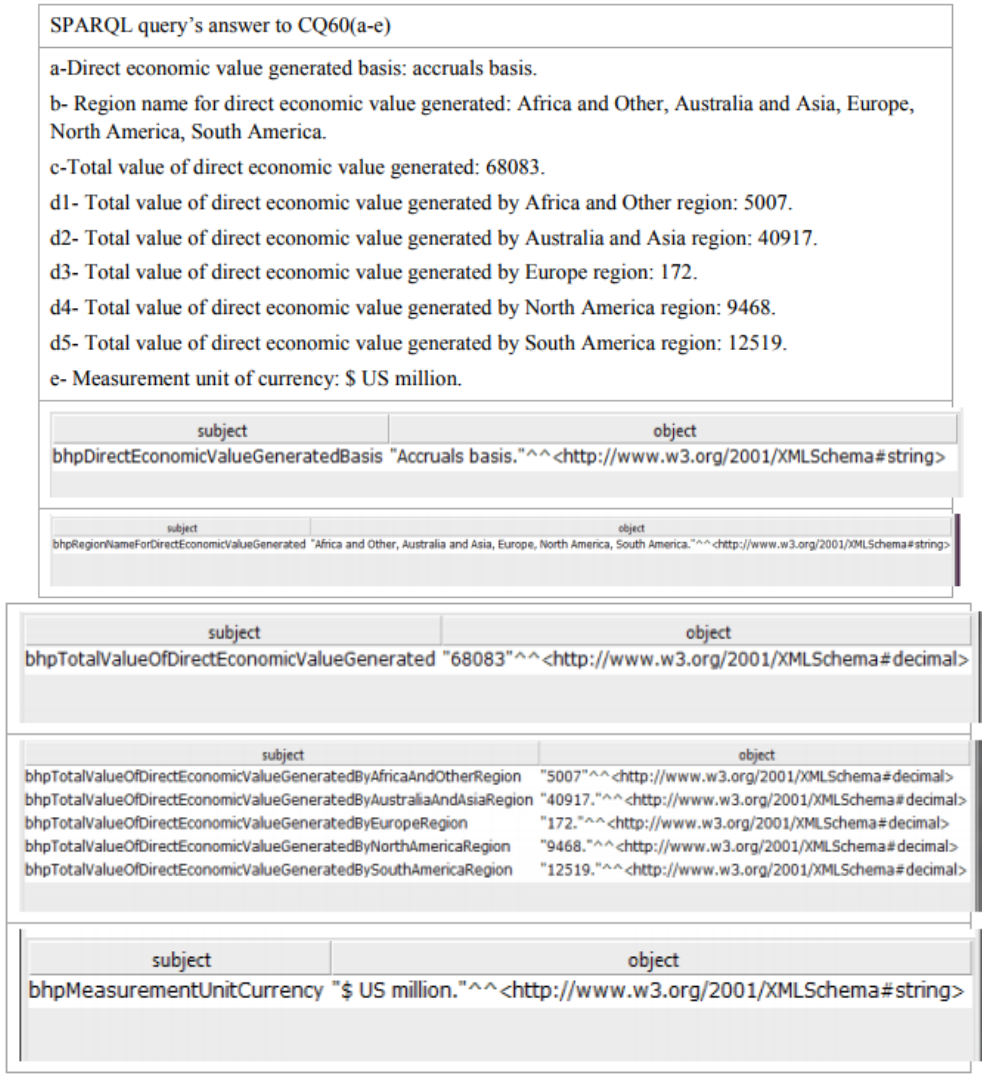
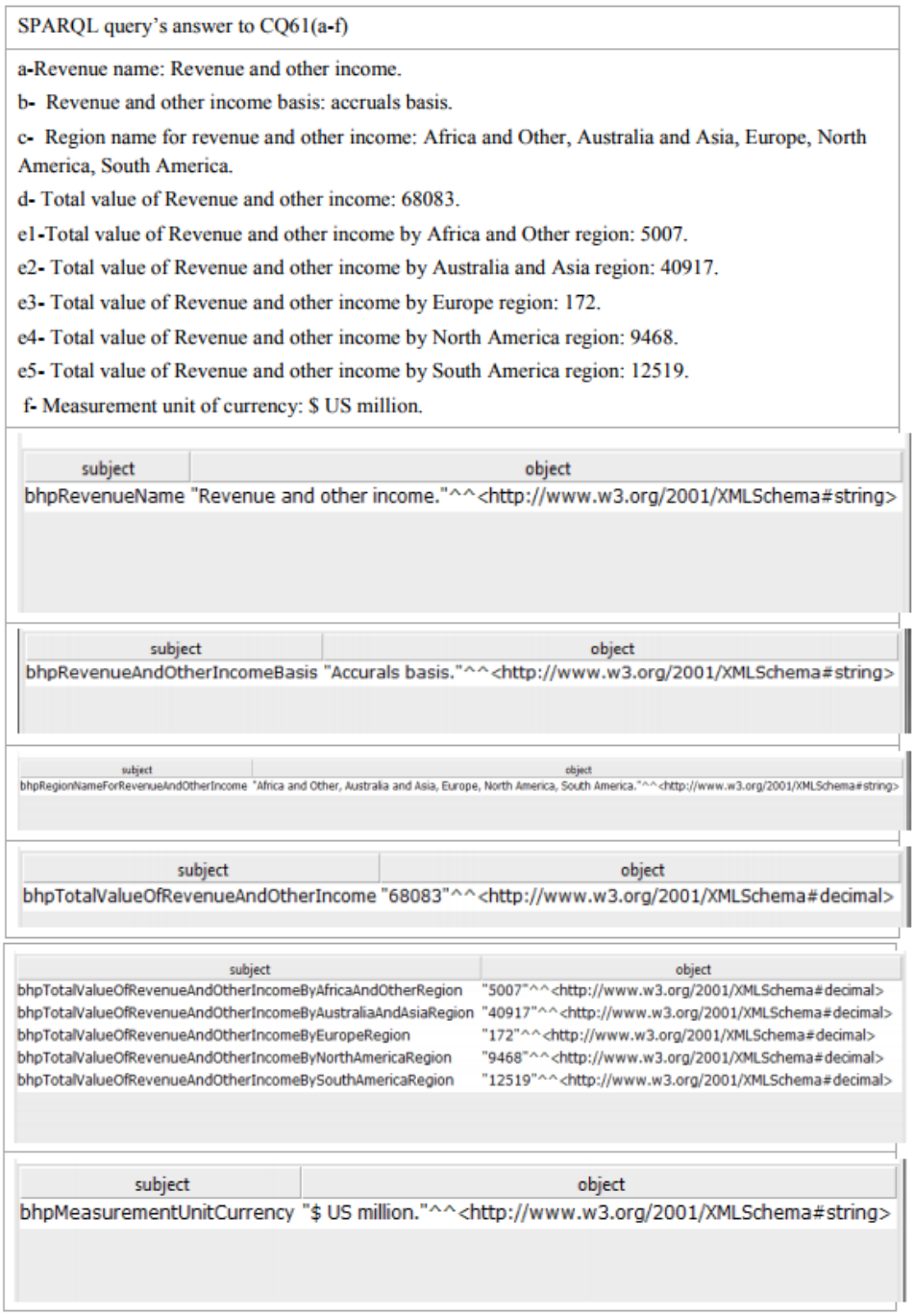


Figure 6 SPARQL query result for CQ60 in Table 1 related to 'Direct Economic Value Generated' class



SPARQL query's answer to CQ61(a-f)

a-Revenue name: Revenue and other income.

b- Revenue and other income basis: accruals basis.

c- Region name for revenue and other income: Africa and Other, Australia and Asia, Europe, North America, South America.

d- Total value of Revenue and other income: 68083.

e1-Total value of Revenue and other income by Africa and Other region: 5007.

e2- Total value of Revenue and other income by Australia and Asia region: 40917.

e3- Total value of Revenue and other income by Europe region: 172.

e4- Total value of Revenue and other income by North America region: 9468.

e5- Total value of Revenue and other income by South America region: 12519.

f- Measurement unit of currency: $ US million.

subject	object
bhpRevenueName	"Revenue and other income."^^<http://www.w3.org/2001/XMLSchema#string>

subject	object
bhpRevenueAndOtherIncomeBasis	"Accurals basis."^^<http://www.w3.org/2001/XMLSchema#string>

subject	object
bhpRegionNameForRevenueAndOtherIncome	"Africa and Other, Australia and Asia, Europe, North America, South America."^^<http://www.w3.org/2001/XMLSchema#string>

subject	object
bhpTotalValueOfRevenueAndOtherIncome	"68083"^^<http://www.w3.org/2001/XMLSchema#decimal>

subject	object
bhpTotalValueOfRevenueAndOtherIncomeByAfricaAndOtherRegion	"5007"^^<http://www.w3.org/2001/XMLSchema#decimal>
bhpTotalValueOfRevenueAndOtherIncomeByAustraliaAndAsiaRegion	"40917"^^<http://www.w3.org/2001/XMLSchema#decimal>
bhpTotalValueOfRevenueAndOtherIncomeByEuropeRegion	"172"^^<http://www.w3.org/2001/XMLSchema#decimal>
bhpTotalValueOfRevenueAndOtherIncomeByNorthAmericaRegion	"9468"^^<http://www.w3.org/2001/XMLSchema#decimal>
bhpTotalValueOfRevenueAndOtherIncomeBySouthAmericaRegion	"12519"^^<http://www.w3.org/2001/XMLSchema#decimal>

subject	object
bhpMeasurementUnitCurrency	"$ US million."^^<http://www.w3.org/2001/XMLSchema#string>

Figure 7 SPARQL query result for CQ61 in Table 2 related to 'Revenue' class

Moreover, Schema Metrics and Knowledgebase Metrics were the means used to verify the ontology for this research, [60] [61]. These metrics include:
Relationship Richness (RR)
Attribute Richness (AR)
Inheritance Richness (IR)
Class Richness (CR)
Average Population (P)

According to Table 3, the total number of classes, data properties, object properties, instances, sub-classes, and non-empty classes of Economic Aspects are 64, 193, 59, 173, 0, and 29 respectively. Therefore, the RR is 1.00 because the number of SC is 0. Each class on average has data properties of 3.02. In addition, the CR

is 0.45. Besides, each class has an average instance of 2.70 which shows the richness of instances in particular for EC1, EC2, EC9, EC3, EC7, and EC6.

Table 3 Schema Metrics and Knowledgebase Metrics for Economic (EC) Aspects

Definition of class	Class (C)	Data property (att)	Object property (P)	Instance (I)	Number of Sub-class (SC)	C`	RR	AR	IR	CR	Average Population (P)
EC Category	1.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
EC Aspect	4.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
Economic Performance Aspect	5.00	6.00	3.00	0.00	0.00	0.00	1.00	1.20	0.00	0.00	0.00
EC1	9.00	54.00	8.00	89.00	0.00	9.00	1.00	6.00	0.00	1.00	9.89
EC2	9.00	60.00	5.00	60.00	0.00	9.00	1.00	6.67	0.00	1.00	6.67
EC3	13.00	23.00	9.00	18.00	0.00	5.00	1.00	1.77	0.00	0.38	1.38
EC4	2.00	4.00	6.00	0.00	0.00	0.00	1.00	2.00	0.00	0.00	0.00
Market Presence Aspect	3.00	6.00	3.00	0.00	0.00	0.00	1.00	2.00	0.00	0.00	0.00
EC5	5.00	5.00	6.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00
EC6	2.00	4.00	4.00	1.00	0.00	2.00	1.00	2.00	0.00	1.00	0.50
Indirect Economic Impact	4.00	10.00	3.00	0.00	0.00	0.00	1.00	2.50	0.00	0.00	0.00
EC7	2.00	5.00	3.00	2.00	0.00	2.00	1.00	2.50	0.00	1.00	1.00
EC8	1.00	2.00	2.00	0.00	0.00	0.00	1.00	2.00	0.00	0.00	0.00
Procurement Practice	3.00	11.00	2.00	0.00	0.00	0.00	1.00	3.67	0.00	0.00	0.00
EC9	1.00	3.00	3.00	3.00	0.00	2.00	1.00	3.00	0.00	2.00	3.00
Total	**64.00**	**193.00**	**59.00**	**173.00**	**0.00**	**29.00**	**1.00**	**3.02**	**0.00**	**0.45**	**2.70**

6. Discussion

In this paper, the implemented ontology using OWL language and the Protégé tool is validated through the competency questions written in SPARQL Queries as shown in Table 1 and Table 2. Instances data were collected online for four Australian companies listed within the ASX for FY 2014; these are ORG, AMC, TCL, and BHP. The evaluation ontology of content to meet the 3Cs criteria of completeness, consistency, and conciseness was verified and the answers to the SPARQL Queries were obtained. These answers show that the reported data are instantiated and correctly describe all relationships between the data. Hence, the developed ontology for 'Economic Performance Indicator' is valid. Thus, the fourth objective of this research, which is to develop ontology for 'Economic Performance Indicator' class, was achieved. The main contribution of the

research is that it provides a formal framework for concepts, properties, and relationships for 'Economic Performance Indicator' class based on GRI G4 guidelines. The framework facilitates knowledge-sharing among stakeholders and computer software through a shared and common understanding of terms and vocabulary for 'Economic Performance Indicator' class. It also helps to store knowledge in a repository which can be automatically renewed to be compatible with the new generation of GRI.

The majority of instances relating to economic indicators' data instances was extracted from BHP, in particular for EC1, EC2, and EC9 (full disclosures), EC3 and EC6 (partial disclosures). This company is unique in terms of the quantity and quality of information disclosed. Whereas, the ORG data instances disclosure for EC7 was found to be optimal. There was a dearth of disclosure for EC4, EC5, and EC8 by any company in the sample. The valid answers are appeared. The summary of Schema Metrics and Knowledgebase Metrics for 'Economic Performance Indicator' class in terms of total number of classes, data properties, object properties, instances, number of sub-classes and non-empty classes were 64, 193, 59, 173, 0, and 29 respectively. Therefore, the RR is 1.00 because the number of SC is 0. Each class on average has data properties of 3.02. In addition, the CR is 0.45. Besides, each class has an average instance of 2.70 which shows the richness of instances in particular for EC1, EC2, EC9, EC3, EC7, and EC6. The content of the ontology was thereby validated. SPARQL queries were used to extract answers for the competency questions and correctly describe all relationships between the data within the inclusive set. Therefore, the developed ontology for the Economic Performance Indicator is active.

7. Conclusion and future work

This paper is aimed at formally modelling the real world of Economic Performance Indicators within Sustainability Reporting. Ontology has provided a shared and common understanding of terms and vocabulary that can be communicated among stakeholders in an organization, and computer software to facilitate the sharing and reutilization of knowledge. The methodology adopted included four phases: specification, conceptualization, formalization, and implementation. A requirement specification for Economic Performance Indicators ontology was created by identifying the intended scope and the purpose to address the various ontology scenarios. The classes, properties, and relationships for Economic Performance Indicators based on the GRI G4 were identified. A conceptual model was transformed into a formalized model using UML to represent the ontology formalization for 'Economic Performance Indicator' class. However, using SPARQL to access information in the ontology is sometimes too complicated for end users who have little knowledge of the language. Therefore, in the future work, we plan to develop an application that can support end users to effectively access and manage knowledge captured in the Ontology for Economic Performance Indicators Based on Global Reporting Initiative (GRI) G4.In addition, an inference and logic reasoning ability will be applied for this research in the future.

Acknowledgement

We would like to thank Dr. Alina Lee, Dr. Gordon Woodbine, and Dr. Hai Dong for their insightful vision, support and valuable comments on this study.

References

[1] UMEP, KPMG, Global Reporting Initiative, and Centre for Corporate Governance in Africa. 2013. Carrots and Sticks: Sustainability Reporting Policies Worldwide - Today's Best Practice, Tomorrow's Trends. https://www.globalreporting.org/resourcelibrary/Carrots-and-Sticks.pdf.

[2] Buhr, Nola. 2010. "Histories of and Rationales for Sustainability Reporting." In Sustainability Accounting and Accountability, eds Jeffrey Unerman, Jan Bebbington and Brendan O'Dwyer, 57-69. London Routledge.

[3] English, Denise M., and Diane K.Schooley. 2014. "The Evolution of Sustainability Reporting." CPA Journal84(3):26-35. http://search.ebscohost.com.dbgw.lis.curtin.edu.au/login.aspx?direct=true&db=bth&AN=94811193&site=ehost-live.

[4] Kolk, Ans. 2004. "A Decade of Sustainability Reporting: Developments and Significance." International Journal of Environment and Sustainable Development 3 (1): 51-64.

[5] Deegan, Craig. 2014. Financial Accounting Theory. 4E ed. Australia: McGraw-Hill Education (Australia) Pty Ltd.

[6] Christofi, Andreas, Petros Christofi, and Seleshi Sisaye. 2012. "Corporate Sustainability: Historical Development and Reporting Practices." Management Research Review 35 (2): 157-172.

[7] Joseph, George. 2012. "Ambiguous but Tethered: An Accounting Basis for Sustainability Reporting." Critical Perspectives on Accounting 23 (2): 93-106. doi: http://dx.doi.org/10.1016/j.cpa.2011.11.011.

[8] Church, Kim S., and Rod E. Smith. 2007. "An Extension of the REA Framework to Support Balanced Scorecard Information Requirements." Journal of Information Systems 21 (1): 1-25. http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=24496336&site=ehost-live.

[9] Gruber, T. 2009. "Ontology." In Encyclopedia of Database Systems, eds L. Liu and M. T. Ozsu, 1963-1965. Berlin: Springer.

[10] Uschold, Mike, and Austin Tate. 1998. "Putting Ontologies to Use." The Knowledge Engineering Review 13 (01): 1-3. doi: doi:null.

[11] Borst, Willem Nico. 1997. "Construction of Engineering Ontologies for Knowledge Sharing and Reuse." Universiteit Twente. http://doc.utwente.nl/17864/.

[12] Studer, Rudi, V. Richard Benjamins, and Dieter Fensel. 1998. "Knowledge Engineering: Principles and Methods." Data & Knowledge Engineering 25 (1–2): 184. doi: http://dx.doi.org/10.1016/S0169-023X(97)00056-6.

[13] Corcho, Oscar, Mariano Fernandez-Lopez, and Asuncion Gomez-perez. 2007. "Ontological Engineering: What Are Ontologies and How Can We Build Them?" In Handbook on Ontologies, eds Steffen Staab and Rudi Studer, 44-70. Springer.

[14] Herzig, Christian, and Stefan Schaltegger. 2006. "Corporate Sustainability Reporting: An Overview." In Sustainability Accounting and Reporting, eds Stefan Schaltegger, Martin Bennett and Roger Burritt, 301-324. Springer Netherlands.

[15] Chou, T.H., J.A. Vassar, and B. Lin. 2008. "Knowledge Management Via Ontology Development in Accounting." Kybernetes 37 (1): 36-48.

[16] Teller, Pierre. 2008. "The Use of a Formal Representation of Accounting Standards." International Journal of Computer Science and Applications 5 (3b): 93-116.

[17] Chou, Chi-Chun, and Yu-Liang Chi. 2010. "Developing Ontology-Based Epa for Representing Accounting Principles in a Reusable Knowledge Component." Expert Systems with Applications 37 (3): 2316-2323. doi: doi:10.1016/j.eswa.2009.07.058.

[18] Smeureanu, I., A. Dio teanu, C. Delcea, and L. Cotfas. 2011. "Business Ontology for Evaluating Corporate Social Responsibility." The Amfiteatru Economic Journal 13 (29): 28-42.

[19] Weigand, Hans, and Philip Elsas. 2012. "Model-Based Auditing Using REA." International Journal of Accounting Information Systems 13 (3): 287-310. doi: http://dx.doi.org/10.1016/j.accinf.2012.06.013.

[20] Weigand, H., P. Johannesson, and M. Bergholtz. 2015. "Accounting for Service Value - an Ontological Approach" Research Challenges in Information Science (RCIS), 2015 IEEE 9th International Conference on, doi: 10.1109/RCIS.2015.7128876.

[21] Global Reporting Initiative. 2013a. G4 Sustainability Reporting Guidelines: Implementation Manual. Amsterdam. www.globalreporting.org.

[22] Weller, Katrin. 2010. Knowledge Representation in the Social Semantic Web. Germany: Walter de Gruyter GmbH & Co. KG.

[23] Gomez-Perez, A., and O. Corcho. 2002. "Ontology Languages for the Semantic Web." Intelligent Systems, IEEE 17 (1): 54-60. doi: 10.1109/5254.988453.

[24] Noy, Natalya F., and Deborah L. McGuinness. 2001. "Ontology Development 101: A Guide to Creating Your First Ontology." Stanford knowledge systems laboratory technical report KSL-01-05 and Stanford Medical Informatics Technical Report SMI-2001-0880.

[25] Corcho, Oscar, Mariano Fernández-López, Asunción Gómez-Pérez, and Angel López-Cima. 2005. "Building Legal Ontologies with Methontology and Webode." In Law and the Semantic Web, eds V. Richard Benjamins, Pompeu Casanovas, Joost Breuker and Aldo Gangemi, 145. Springer.

[26] Horridge, Matthew. 2011. A Practical Guide to Building OWL Ontologies Using Protege 4 and Co-Ode Tools 1.3 ed: University of Manchester.

[27] Stevens, Robert, Carole A. Goble, and Sean Bechhofer. 2000. "Ontology-Based Knowledge Representation for Bioinformatics." Oxford Journals Life Sciences & Mathematics & Physical Sciences 1 (4): 398-414.

[28] Moneva, J. M, Pablo Archel, and Carmen Corra. 2006. "GRI and the Camouflaging of Corporate Unsustainability." Accounting Forum 30 (2): 121-137. doi: www.elsevier.com/locate/accfor.

[29] Global Reporting Initiative. 2015. What Is GRI? Accessed October 15, www.globalreporting.org/information/about-gri/what-is-GRI/Pages/default.aspx.

[30] _____. 2000. Sustainability Reporting Guidelines http://www.globalreporting.org.
[31] _____. 2000-2006 GRI Version 3.0a. Economic Performance Indicators. http://www.globalreporting.org.
[32] _____. 2002. GRI: Sustainability Reporting Guidelines. http://www.globalreporting.org.
[33] ———. 2013b. G4 Sustainability Reporting Guidelines: Implementation Manual. Amsterdam. www.globalreporting.org.
[34] Fernández-López, Mariano, Asunción Gómez-Pérez, and Natalia Juristo. 1997a. "Methontology: From Ontological Art Towards Ontological Engineering" Proceedings of the Ontological Engineering AAAI-97 Spring Symposium held in 24-26 March, Stanford University, California: www.aaai.org.
[35] Lopez, M. F., A. Gomez-Perez, J. P. Sierra, and A. P. Sierra. 1999. "Building a Chemical Ontology Using Methontology and the Ontology Design Environment." Intelligent Systems and their Applications, IEEE 14 (1): 37-46. doi: 10.1109/5254.747904.
[36] Uschold, Mike, and Michael Gruninger. 1996. "Ontologies: Principles, Methods and Applications." The Knowledge Engineering Review 11 (02): 93-136. doi: doi:10.1017/S0269888900007797.
[37] Uschold, Mike. 1996. "Building Ontologies: Towards a Unified Methodology" In 16th Annual Conference of the British Computer Society Specialist Group on Expert Systems, Cambridge, UK: .
[38] Staab, Steffen, Rudi Studer, H-P Schnurr, and York Sure. 2001. "Knowledge Processes and Ontologies." Intelligent Systems, IEEE 16 (1): 26-34.
[39] Suárez-Figueroa, MariCarmen, Asunción Gómez-Pérez, and Boris Villazón-Terrazas. 2009. "How to Write and Use the Ontology Requirements Specification Document." In On the Move to Meaningful Internet Systems: Otm 2009, eds Robert Meersman, Tharam Dillon and Pilar Herrero, 966-982. Springer Berlin Heidelberg.
[40] Grüninger, Michael, and Mark S Fox. 1995. "Methodology for the Design and Evaluation of Ontologies" Workshop on Basic Ontological Issues in Knowledge Sharing, IJCAI-95 held in Montreal, Quebec Canada: www.ijcai.org/past/ijcai-95.
[41] Fernández-López, Mariano, Asunción Gómez-Pérez, and Natalia Juristo. 1997b. "Methontology: From Ontological Art Towards Ontological Engineering" In Proceedings of the Ontological Engineering AAAI-97 Spring Symposium held in 24-26 March, Stanford University, California: www.aaai.org.
[42] Duineveld, A. J., R. Stoter, M. R. Weiden, B. Kenepa, and V. R. Benjamins. 2000. "Wondertools? A Comparative Study of Ontological Engineering Tools." International Journal of Human-Computer Studies 52 (6): 1111-1133. doi: http://dx.doi.org/10.1006/ijhc.1999.0366.
[43] Chandrasekaran, Balakrishnan, John R Josephson, and V Richard Benjamins. 1998. "Ontology of Tasks and Methods" Knowledge Acquisition Workshop, Banff: http://ksi.cpsc.ucalgary.ca/KAW/KAW98/ chandra/ index. html.
[44] Gruninger, Michael, and Jintae Lee. 2002. "Ontology Applications and Design." Communications of the ACM 45 (2): 39-41.
[45] Gomez-Perez, Asuncion, Mariano Fernandez-Lopez, and Oscar Corcho. 2004. Ontological Engineering with Examples from the Areas of Knowledge Management, E-Commerce and the Semantic Web. London: springer.
[46] Corcho, Oscar, Mariano Fernandez-Lopez, and Asuncion Gomez-perez. 2007. "Ontological Engineering: What Are Ontologies and How Can We Build Them?" In Handbook on Ontologies, eds Steffen Staab and Rudi Studer, 44-70. Springer.
[47] Weber, Ron. 2003. " Conceptual Modelling and Ontology: Possibilities and Pitfalls " Journal of Database Management 14 (3): P.1.
[48] Colomb, Robert M. 2007. Ontology and the Semantic Web. Vol. 156. Netherlands: IOS Press.
[49] Guebitz, Brigitte, Hubert Schnedl, and Johannes G Khinast. 2012. "A Risk Management Ontology for Quality-by-Design Based on a New Development Approach According Gamp 5.0." Expert Systems with Applications 39 (8): 7291-7301.
[50] Cranefield, Stephen, and Martin Purvis. 1999. UML as an Ontology Modelling Language.
[51] Horridge, Matthew. 2011. A Practical Guide to Building OWL Ontologies Using Protege 4 and Co-Ode Tools 1.3 ed: University of Manchester.
[52] Gómez-Pérez, Asunción. 1995. "Some Ideas and Examples to Evaluate Ontologies" Artificial Intelligence for Applications, 1995. Proceedings., 11th Conference on: IEEE.
[53] ———. 1996. "Towards a Framework to Verify Knowledge Sharing Technology." Expert Systems with Applications 11 (4): 519-529. doi: http://dx.doi.org/10.1016/S0957-4174(96)00067-X.

[54] ———. 2001. "Evaluation of Ontologies." International Journal of Intelligent Systems 16 (3): 391-409. doi: 10.1002/1098-111x(200103)16:3<391::aid-int1014>3.0.co;2-2.

[55] ———. 2004. "Ontology Evaluation." In Handbook on Ontologies, 251-273. Springer.

[56] Hepp, Martin. 2008. "Goodrelations: An Ontology for Describing Products and Services Offers on the Web." In Knowledge Engineering: Practice and Patterns, 329-346. Springer.

[57] Grüninger, Michael, and M.S.Fox. 1994. "The Role of Competency Questions in Enterprise Engineering" In proceedings IFIP WG5.7 Workshop on Benchmarking—Theory and Practice, Trondheim, Norway: Springer.

[58] Vrandecic, Denny. 2010. "Ontology Evaluation." KIT Karlsruhe Institute of Technology, Karlsruhe, Germany.

[59] Brank, Janez, Marko Grobelnik, and Dunja Mladenić. 2005. "A Survey of Ontology Evaluation Techniques" In Proceedings of the Conference on data mining and data warehouse (SiKDD2005), Ljubljan, Slovenia: ailab.ijs.si/dunja/SiKDD2005.

[60] Tartir, Samir, I. Budak Arpinar, and AmitP Sheth. 2010. "Ontological Evaluation and Validation." In Theory and Applications of Ontology: Computer Applications, eds Roberto Poli, Michael Healy and Achilles Kameas, 115-130. Springer Netherlands.

[61] Tartir, Samir, I Budak Arpinar, Michael Moore, Amit P Sheth, and Boanerges Aleman-Meza. 2005. "Ontoqa: Metric-Based Ontology Quality Analysis" Knowledge Acquisition from Distributed, Autonomous, Semantically Heterogeneous Data and Knowledge Sources (KADASH), Houston, USA: www.cild.iastate.edu/events/KADASH.

\

Session of Medical Health Sciences and Laws

Stress Relieving of Thai Traditional Medicine Students by using Thai Traditional Medicine

Pitchayapa Attanoruk[1,*], Pitchayapha Inphrom[1], Jatuporn Panusnothai[1], Nantiya Manhmay[1], Sittipong Pornprasit[1]

[1]Thai Traditional Medicine Program, Faculty of Science and Technology, Bansomdejchaopraya Rajabhat University, Bangkok, Thailand

Abstract

The objective was to decrease stress level in Thai Traditional Medicine students of Bansomdejchaopraya Rajabhat University. Study design was Pretest-posttest and one week follow up one group design. The Thai traditional relaxation activities (Thai Hermit Exercise, Thai self-massage and psychotherapy art meditation) were implemented and 61 respondents to the questionnaires (ST5). Descriptive Statistics, t-test at 95% CI were using for data analysis.

The research results revealed that the most of Thai Traditional Medicine students before implement have moderate stress (5-7 scores) 37.8 percent, the most of Thai Traditional Medicine students after implement have less stress (0-4 scores) 47.5 percent, The stress level was decreased (p-value < 0.001). When follow up after implement 1 week the stress level in Thai Traditional Medicine students was decreased (p-value < 0.001). Developing ideas and methods for continuing organize this activity and expand the results to other agencies were recommended.

Keywords: Stress relieving, Student, Thai Traditional Medicine

1. Introduction

Stress is the mental imbalance. It can occur with all groups of people regardless of their genders; ages or occupations. Each individual will experience different levels of stress, which largely depended on his or her lifestyles. Nowadays technology is rapidly advancing, the lifestyle of urban people is always in a hurry with greater competition and the shortage of resting. The absence of relaxation caused the accumulation of stress which might result in the mental illness.

The study with higher education participants by Nitipun Boonpume [1] indicated that the students required to improve their perceptions as well as to be suitably adaptive toward their learning life which changes constantly occurred and thus affected the individual's stress. These changes including the orientation; adjustment to the learning style of the university; change in the dwelling; entering the new society; preparation for the career life and family life. Furthermore, the environment surrounding a student including the economy; family; and colleagues as well as his or her personal relationship; expectations toward himself or herself; family and others. These may be considered as the supplemental factors causing the stress in students.

Suwanna Sisomprasong [2] has identified the causes associated with the medical students' stress include that learning; Academy's regulations; colleagues; lecturers and medical personnel; causes relating with the future; time allocation; and their responsibilities as mature individuals.

Khanuengnut Thumpharak, *et. al.* [3] reported that the students who were unable to cope with these problems are likely to experience the mental anxiety and frustration. These problems have affected the learning performances and the living of students which they have been planning and resulted in frequent stress.

S Mohapatra , *et. al.* [4] said that the extremely high prevalence of mental health problems in university students provides evidence for this being an at-risk population. The results highlight the need for universal early interventions to prevent the development of severe mental illness in university students.

Emma Warnecke, *et. al.* [5] concluded that mindfulness practice reduced stress and anxiety in senior medical students. Stress is prevalent in medical students and can have adverse effects on both student health and patients

* Corresponding author; e-mail: amjoke51@gmail.com

Therefore, the author has interested in the stress relieving approach using the principles of Thai traditional medicine and applying the results to improve the procedures in various aspects for the prevention of stress problems among the students and shall implement the preliminary results as the advice for the students.

2. Objectives

To compare Pretest-posttest and one week follow-up the stress' Thai traditional medicine undergraduate student of Bansomdejchaopraya Rajabhat University by using the Thai traditional relaxation activities (Thai Hermit Exercise, Thai self-massage, psychotherapy art meditation)

3. Methods

3.1 The study was the action research with the one group pretest - posttest and one week follow up. The participants were the Thai traditional medicine undergraduate students, Faculty of Science and Technology, Bansomdejchaopraya Rajabhat University

3.2 The research instrument was three stress relieving activities consisting of;

1) 15 steps of Thai Hermit Exercise training. These steps were modified from the Digital Version of 15 steps Thai Traditional Exercise published by the Thai Traditional Medicine institution, Department of Thai Traditional and Alternative Medicine, Ministry of Public Health [6].

2) Self - training Thai massage for stress relieving has been modified from the "the art of self-massage 41 postures" (41 arts of massage styles for healthy life) by the public health and development foundation[7]

3) The psychotherapy art meditation training by the expert lecturer.

The instruments used for collecting data was the stress appraisal and analytic modified from ST5 of the Department of Mental Health. This questionnaire composing with five items (closed questions) and four scale points for each item. Each level of the measurement scale is determined as follows;

Almost no stress	= 0
Occasionally stress	= 1
Regularly stress	= 2
Always stress	= 3

These scales have been verified and amended according to the expert's suggestion. The calculated reliability using the Cronbach's Coefficient Alpha was 0.764

The scores from the questionnaires of all applicants have been combined together and analyzed using the frequency distribution and percentage calculation and compared to the score interpretation criterion specified by the Bureau of Mental Health Development, Department of Mental Health, Ministry of Public Health as shown as follows;

0-4 scores	= low stress
5-7 scores	= moderate stress
8-9 scores	= high stress
10-15 scores	= maximum stress

The general data were analyzed using descriptive statistics. Data distribution testing by using Kolmogorov-Smirnov Test (K-S Test). The comparison of students' stress scores pretest - posttest and posttest – follow up 1 week have been performed using t-test with 95% confidence interval.

4. Results and discussion

In this study, there were 61 participants, consisting of 53 females (87%), 8 males (13%). Of this, 28 students (46%) are from the 1st year, 23 students (38%) from the 2nd year, 7 students (11%) from the 3rd year and 3 students (5%) from the 4th year.

Before the participation in the activity, the most of the students have moderate stress (5-7 scores) which accounted for 37.8% as described in Table 1.

Table 1 The quantities of students categorized by the level of stress prior to the participation in the activity

Indication	Quantities	Percentage
0-4 scores (low stress)	6	9.8
5-7 scores (moderate stress)	23	37.8
8-9 scores (high stress)	19	31.1
10-15 scores (maximum stress)	13	21.3

After participating in the activity, the students were requested to make the stress appraisal again. It has been found that the most of students have low stress (0 - 4 scores), accounted for 47.5% as described in Table 2.

Table 2 The quantities of students categorized by the level of stress after the participation in the activity

Indication	Quantities	Percentage
0-4 scores (low stress)	29	47.5
5-7 scores (moderate stress)	25	41.0
8-9 scores (high stress)	3	4.9
10-15 scores (maximum stress)	4	6.5

From the monitoring of results for the next following week after the participation in the activity, the students were requested to make the stress appraisal again. It has been found that the most of students have low stress (0 - 4 scores), accounted for 59.0% as described in Table 3.

Table 3 The quantities of students categorized by the level of stress a week after the participation in the activity

Indication	Quantities	Percentage
0-4 scores (low stress)	36	59.0
5-7 scores (moderate stress)	23	37.7
8-9 scores (high stress)	2	3.3
10-15 scores (maximum stress)	0	0

Data distribution testing by using Kolmogorov-Smirnov Test (K-S Test) found that the scores (before the Participation *p*-value at 0.978, After the participation *p*-value at 1.119, and One week follow-up *p*-value at 1.103) were normal Distribution (*p*-value > 0.05)

The comparison of student's stress levels prior and after the participation in the activity revealed that the average stress levels have been diminished with the statistical significance (*p*-value < 0.001) as described in Table 4.

Table 4 Comparison of students' stress scores prior and after the participation in the stress relieve activity using t-test with 95% CI (n=61)

Groups of participating students	**Mean**	**S.D.**	***p*-value**
Before the participation	7.59	0.33	<0.001
After the participation	4.56	0.34	

The comparison of student's stress levels after the participation and one-week follow-up has revealed that the average stress levels have been diminished with the statistical significance (*p*-value < 0.001) as described in Table 5

Table 5 Comparison of students' stress scores after the participation and one-week follow-up using t-test with 95% CI (n=61)

Groups of participating students	**Mean**	**S.D.**	***p*-value**
After the participation	4.56	0.34	<0.001
One week follow-up	4.05	0.22	

The most of traditional Thai medicine undergraduate students of the academic year 2016 has moderate stress (5-7 scores) before the participation in the activity. This indicated that the participants are disturbed with unresolved anxiety which required a certain amount of times in making the adjustment or copes with the problems which is consistent with the findings of Helen M Stallman [8] which is excessive stress and poor coping skills can put university students at risk for mental health problems. They should be provided with advice or suggestions regarding the stress relieving to unravel the causes of problem consistent with the findings of Department of Mental Health [9] which is in accordance with the stress relieving activity using the Thai traditional medicine to lessen down the students' stress level that resulted in the overall diminishment with the statistical significance (p-value <0 .001).

After the students have been participated in the stress relieving activity, the scores from the ST5 appraisal were compared to identify the stress levels before and after the participation. It has been found that the stress scores have been decreased with statistical significance (p-value < 0.001). This indicated that the stress relieving activity is effective and able to practically lessen down the students' stress level is consistent with the findings of Sasithorn Charoenwoodhipong [10] which reported the efficiency of stress relieving program that resulted in the overall decreased stress level of the volunteers with the statistical significance (p-value < .01) and Cheryl Regeh, *et.al* [11] which reported cognitive, behavioral, and mindfulness interventions are effective in reducing stress in university students.

The follow up of the implementation of stress relieving approaches after one week of the participation in the activity revealed that the students are able to constantly implement the stress relieving approaches. Each of the students will adopt the stress relieving methods learned from the activity and applied to their own personalities which has lessen down the level of stress with statistical significance (p-value < 0.001) as shown in Table 5. The result is consistent with Sunisa Tasai, *et.al* [12] which reported that the most of students have appropriate coping methods with the stress and Kuem Sun Han [13] suggests that self-efficacy and health promoting behaviors are significant influencing factors on symptoms of stress among university students.

5. Conclusions

The stress relieving activity was an effective and able to practically lessen down the students' stress level respective maximum and high score**.** Suggestions for further work as shown as follows;

5.1 More stress relieving activities should be provided with various methods.

5.2 This kind of activity should be provided at least once a year for stress relieving and establishing the relationships between the students of different years.

5.3 The stress relieving activities should be provided to other organizations.

Acknowledgements

The authors wish to thank students of Thai traditional medicine program, Bansomdejchaopraya Rajabhat University and all staffs members for necessary assistance and instrument supports

References

[1] Nitipun Boonpume. Stress and coping of Thai traditional medicine students of Rajamangala University of Technology Thanyburi [dissertation]. Bangkok, Thailand: Silpakorn University; 2010.

[2] Suwanna Sisomprasong. A Stress of the Fourth-Year to the Sixth-Year Medical Students. Independent Study in Psychology Guidande [dissertation]. Bangkok, Thailand: Srinakharinwirot University; 2009.

[3] Khanuengnut Thumpharak et.al. A Stress of the First-Year students of Suranaree University of Technology [dissertation]. Nakhon Ratchasima, Thailand: Suranaree University of Technology; 2007.

[4] S Mohapatra , et. al. Medical student perceptions of academic stress and satisfaction with the revised curriculum quality at iau saudi Arabia. International Journal for Quality in Health Care. 2017; 29 (1): 43.

[5] Emma Warnecke, et. al. A randomised controlled trial of the effects of mindfulness practice on medical student stress levels. Journal of Medical Education. 2011; 45 (4): 381–388.

[6] The Institute of Thai Traditional Medicine, Department of Thai Traditional and Alternative Medicine, Ministry of Public Health. Hermit Thai Yoga Exercises [Video file]. Nonthaburi Thailand; 2009 [cite 8 May 2017]. Available from: https://www.youtube.com/watch?v=s2if1Lp2jmU

[7] Public Health and Development Foundation. the art of self-massage 41 postures. Bangkok: Public Health and Development Foundation; 2005.

[8] Helen M Stallman. The University Stress Scale: Measuring Domains and Extent of Stress in University Students. Journal of Australian Psychologist. 2016; 11 (2): 128-134.

[9] Department of Mental Health, Ministry of Public Health. Guidelines for using mental health tools for community health workers. (Chronic Disease Clinic). Nonthaburi: Mental Health Publishing House; 2015.

[10] Sasithorn Charoenwoodhipong. The Effect of Stress Management Program on Stress Levels of Nursing Instructors, Staff Members and Nursing Students. Journal of Public Health Nursing. 2011; 25 (1): 46-60.
[11] Cheryl Regeh, et.al. Interventions to reduce stress in university students: A review and meta-analysis. Journal of Affective Disorders.2013; 148 (1): 1-11.
[12] Sunisa Tasai et.al. Stress and stress coping of the high school students in Changwat Songkhla. Journal of Education, Prince of Songkla University Pattani Campus. 2008; 19 (2): 101-114.
[13] Kuem Sun Han. Self-Efficacy, Health Promoting Behaviors, and Symptoms of Stress among University Students. Journal of Korean Academy of Nursing. 2005; 35 (3): 585-592.

Factors Related to Mosquito-Borne Diseases in China-Laos Border Areas: Results from Multiple Correspondence Analysis

Chao Wu[1, 2], Hongning Zhou[1], Jun Zhao[2, 3], Xiaofang Guo[1], Quan Lv[1], Hongbin Li[4], Edward B McNeil[2] and Virasakdi Chongsuvivatwong[2,*]

[1]Yunnan Institute of Parasitic Diseases, Puer, Yunnan, P.R.China
[2]Epidemiology Unit, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla, Thailand
[3]Hubei University of Medicine, Shiyan, Hubei, P.R.China
[4]Xishuangbanna Prefecture Center of Disease prevention and Control, Jinghong, Yunnan, P.R.China

Abstract

Background: In China-Lao border areas of Yunnan province, mosquito-borne diseases are most common. The objective of the study was to group several risk factors related to mosquito-borne diseases.
Methods: A survey was conducted in 12 randomly selected villages and eight schools. A structured questionnaire on behaviors and environment variables related to mosquito-borne diseases and demographics was devised.

Results: 1295 participants were recruited. Twenty variables on risk behaviors related to mosquito-borne diseases were put into multiple correspondence analysis (MCA). Ten variables contributed in three pertinent dimensions: 1) pig rearing environment, 2) bed-net using behaviors and 3) repellent using behaviors.

Conclusion: The control programme should focus on these three groups of risk factors as they significantly explain several items of variables under the investigation.

Keywords: behaviors, mosquito-borne diseases, bed-net, repellent, pig rearing, multiple correspondence analysis

1. Introduction

Mosquito-borne diseases are increasing a serious global health concern, including-malaria, dengue, ZIKV, Japanese encephalitis, Banna virus fever, chikungunya fever, yellow fever etc. [1]. Yunnan Province, China, located at the southwest border of mainland China with an area of 394,000 km2 shares international borders with Myanmar, Vietnam, and Laos. The region favors the spread of these diseases. From 2008 to 2016, more dengue outbreaks were reported in this area. [2, 3].
Multiple correspondence analysis (MCA) is a data analysis technique for nominal categorical data, used to detect and represent underlying structures in a data set. It does this by representing data as points in a low-dimensional Euclidean space [4-6]. This fits well with our questionnaires.
In behaviors survey, most of questions are binary (yes vs no). As there are many questions, it is important to group into dimension. Exploratory factor analysis (EFA) is not appropriate because it assumes normality of the item variables.

2. Objective

The objective of the study was to group behaviors related to mosquito-borne diseases using MCA and to explore the nature of risk factors related to mosquito-borne diseases. The information from this study would be used in planning of various mosquito-borne diseases prevention and control in this area.

3. Methods

Ethical consideration

Ethical approval was obtained from Institution Ethical Review Committee of Prince of Songkla University on 2 November, 2016 (project code REC 59-244-18-5) and that of Yunnan institute of Parasitic Diseases (YIPD). Informed consent was obtained from all subjects and related authority including guardians of subjects under 16 years of age.

* Corresponding author; email: cvirasak@gmail.com

Study site and study design

The research was conducted in Mengla County, Xishuangbanna Prefecture, Yunnan Province, which holds a 677.8 km border with Laos. A cross-sectional survey was preformed among the selected study sites from 12 to 30 September 2016.

Sampling technique

The sample was drawn by using two-stage cluster sampling technique probability proportional to size.

Study participants

In each cluster, participants were randomly recruited from the list of adults in village or list of 6- 18 years old students in the selected schools. Inclusion criteria included being a resident of the study village for more than 6 months.

Questionnaire and measures

A structured questionnaire was developed to get the information from each participant and piloted in a village and a school, not included in the main study before being used in the field. We developed the same questionnaire for adults and children for the reasons of comparability and possible data pooling in the analysis. Collected data had 4 sections: 1) social-demographics variables such as age, gender, ethnicity, education level, occupation, 2) environmental variables such as pig rearing by family, distance from house to pig farm, with pig farm near the house, distance of the nearest pig farm, with paddy field, near to the forest, with rubber planting, with wasted tires, with aquatic plants, with Pickled jars, with running water and with tanks for water storage, 3) behavioral bed-net using including possess bed-net，often use bed-net, and sleeping in bed-net in daytime, 4) behavioral insect repellent using including using mosquito coil, floral water , and DEET (diethyltoluamide)working or activities outside the house.

Data management and analysis

Data were recorded by using EpiData (version 3.1). All analysis was performed using R (version 3.4.0).Most of variables in the current study were categorical factors. Multiple correspondence analysis (MCA) was used to display relationships among the individual variables and structural factors using the "FactoMineR" package [5, 6]. The scores of each dimension were extracted and dichotomized as below factor mean (low score for that dimension) and high score otherwise.

Sample size calculation

To estimate the prevalence of a risk behavior we assume 50% prevalence, with 95% confidence interval of the prevalence deviated 6% from the estimate and a design effect of 2, the sample size required for each age group was 534. In practice, we more than doubled this sample size to allow for other variables with smaller prevalence.

4. Results and discussion

4.1 Results

A total of 1295 participants were included the study. They came from 5 towns and 20 clusters (8 schools contributing 730 students and 12 villages contributing 565 adults. Table 1 showed the different distribution among the **S**ocial-demographic factors. Children group occupied 56.4%. On ethnicity, ethnic Yi group was the biggest group (23.2%), and Han group was the smallest group (11.4%). The majority occupation was student (56%).

Table1 Social-demographic characteristics Social-demographic factors	**Frequency**	**Percent**
Gender		
Male	582	44.9
Female	713	55.1
Age group		
<= 18 year-old	730	56.4
>18 Year-old	565	43.6
Education level		
less than primary school	228	17.6
Primary school	535	42.3

Secondary school or above	532	41.1
Ethnicity		
Han	148	11.4
Dai	187	14.4
Aini	227	17.5
Yi	301	23.2
Yao	256	19.8
Other	176	13.6
Occupation		
Farmer	461	35.6
Student	725	56.0
Other	109	8.4

Table2 Levels of correlation (R2) between the item variables and the underlying dimension	**Abbreviation**	**Dimension 1**	**Dimension 2**	**Dimension 3**
Variables items				
R2				
Pig rearing by family	pr	0.505	0.001	0.221
Distance from house to pig farm	ds	0.505	0.057	0.23
With pig farm near the house	wpfh	0.525	0.041	0.075
Distance of the nearest pig farm	dsh	0.542	0.078	0.084
Housing structure	hs	0.006	0.184	0.058
Paddy field	pf	0.001	0.032	0.009
Near to the forest	nf	0	0.036	0.005
Rubber planting	wrp	0	0.125	0.019
Discarded tires	d	0.007	0.024	0.01
Aquatic plants	wap	0.012	0.018	0.012
Pickle jars	wpc	0.045	0	0.003
Running water	rw	0.003	0	0
Tanks for water storage	tk	0.007	0.051	0.004
Family possess bed-net	fpbn	0.001	0.588	0.017
Using bed-net	ubdn	0	0.671	0.01
Sleeping in bed-net on daytime	sbnd	0.003	0.54	0.011
Using insect repellent working outside	urwo	0.35	0.02	0.525
Using mosquito coils	umc	0.331	0.016	0.472
Using floral water working/playing outside	utw	0.16	0.04	0.363
Using DEET	ude	0.065	0.031	0.017

working/playing
outside

(R2 the squared correlation between each categorical variable and the dimensions)

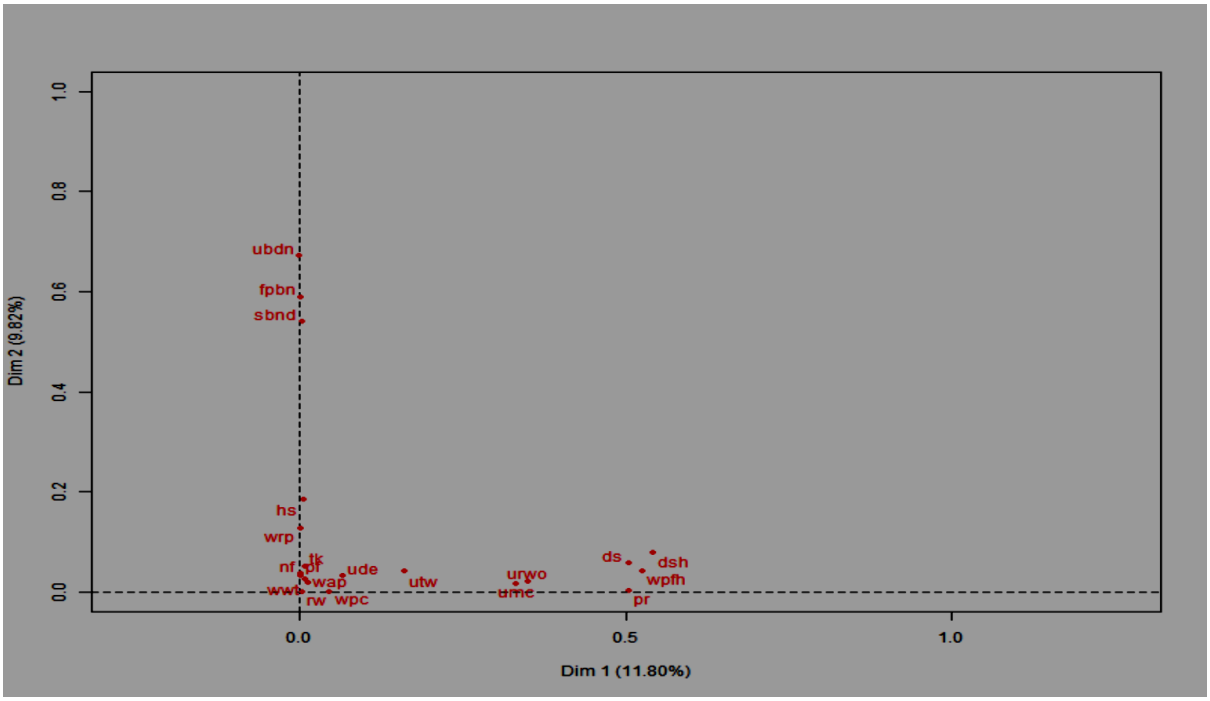
Other behaviors related to mosquito-borne diseases but were not taken into MCA, including travel history, Disease history of dengue and Japanese encephalitis, history of Japanese encephalitis vaccination and history of admitted in hospital in 2016.

Result of Multiple correspondence analysis (MCA)

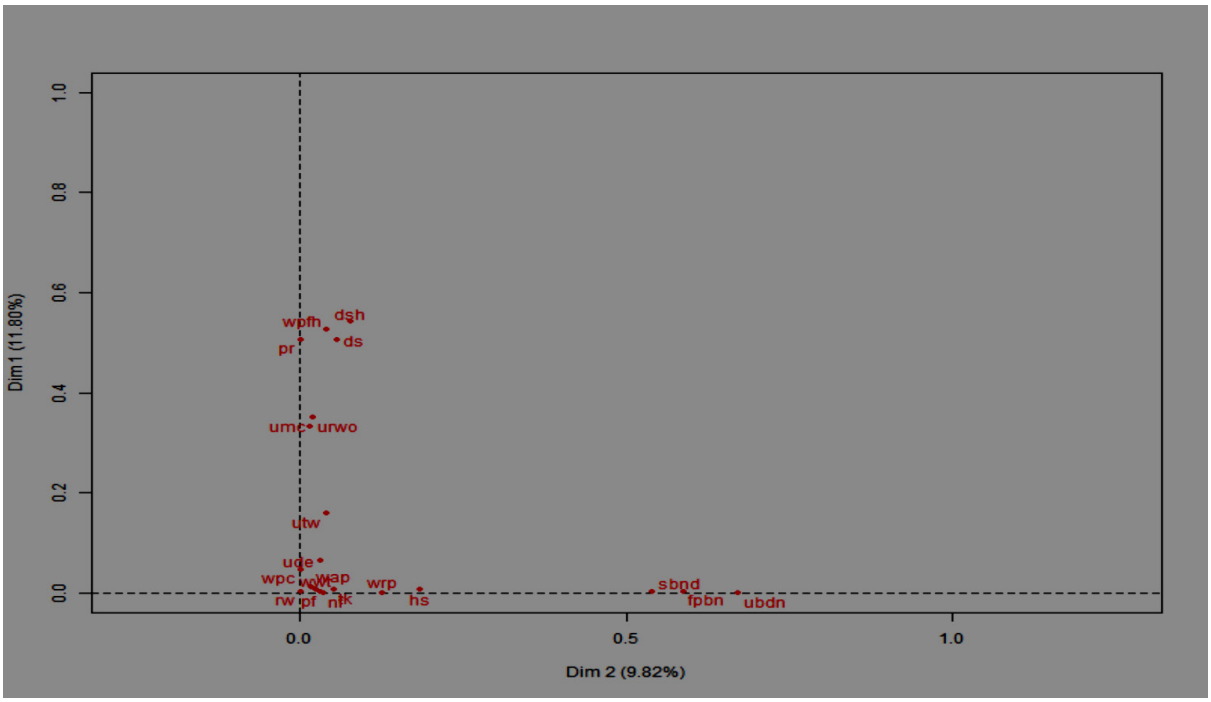
Table 2 indicated the levels of squared correlation between each categorical variable and three dimensions. Twenty active variables were selected into MCA. The abbreviations in the second column are used in subsequent graphic exploration. Ten variables contributed most among 3 dimensions. Based on the nature of correlation between item and dimension. The dimensions were identified: (1) pig rearing environment; (2) bed-net using behavior; (3) repellent using behaviors, respectively. Other variables including near to forest, running water, they did not correlate to one and other. They were not contributing by these three dimensions. Since MCA always use 2-3 dimensions to explain the results; and those three dimensions could explain about 30 percent of total variance of behaviors and environments, our analysis was thus confined to only three dimensions.

Figure 1 shows that various variables (abbreviation in Table 2) very well align along the axes of the three dimensions. A series two-dimension spaces displayed the mapping of environmental factors and personal behaviors on bet-net using and usage of repellent in Figure 2 to Figure 4. Different colors of the dots (denoting individuals with different subgroups of behavior variables) are well separated. Thus the dimensions well classify the individual by their behaviors.

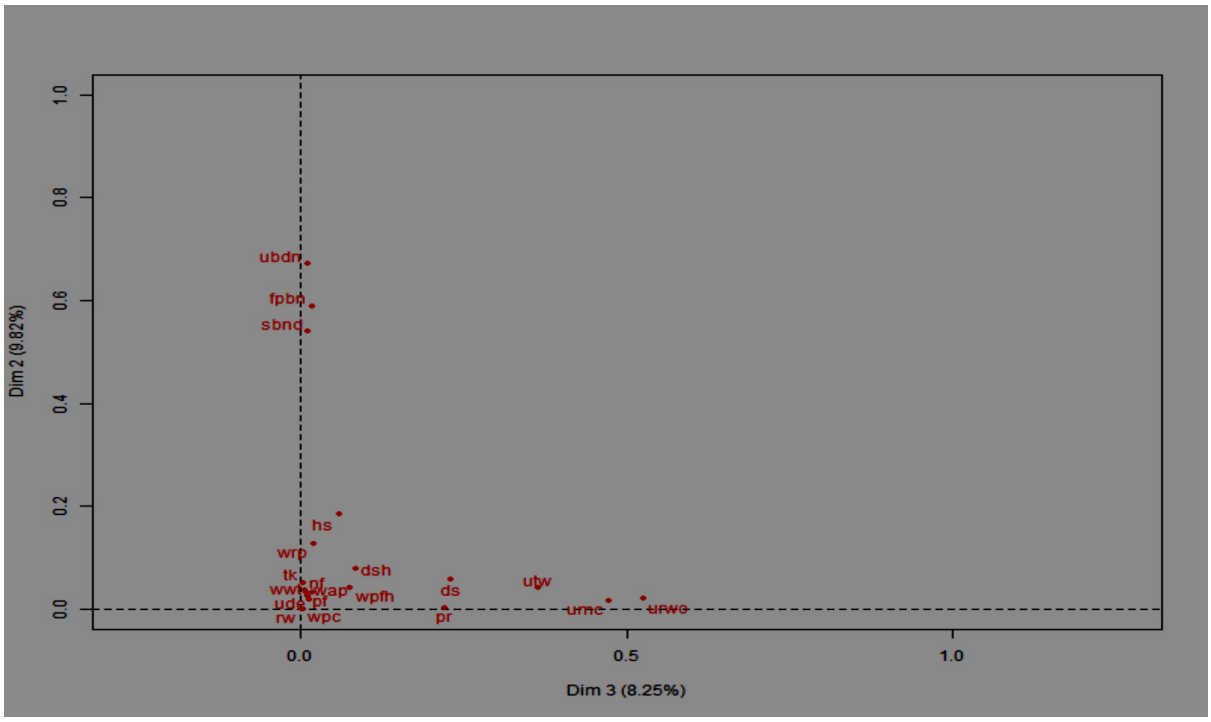
Dimension 1 by Dimension 2



Dimension2 by Dimension 1



Dimension3 by Dimension2



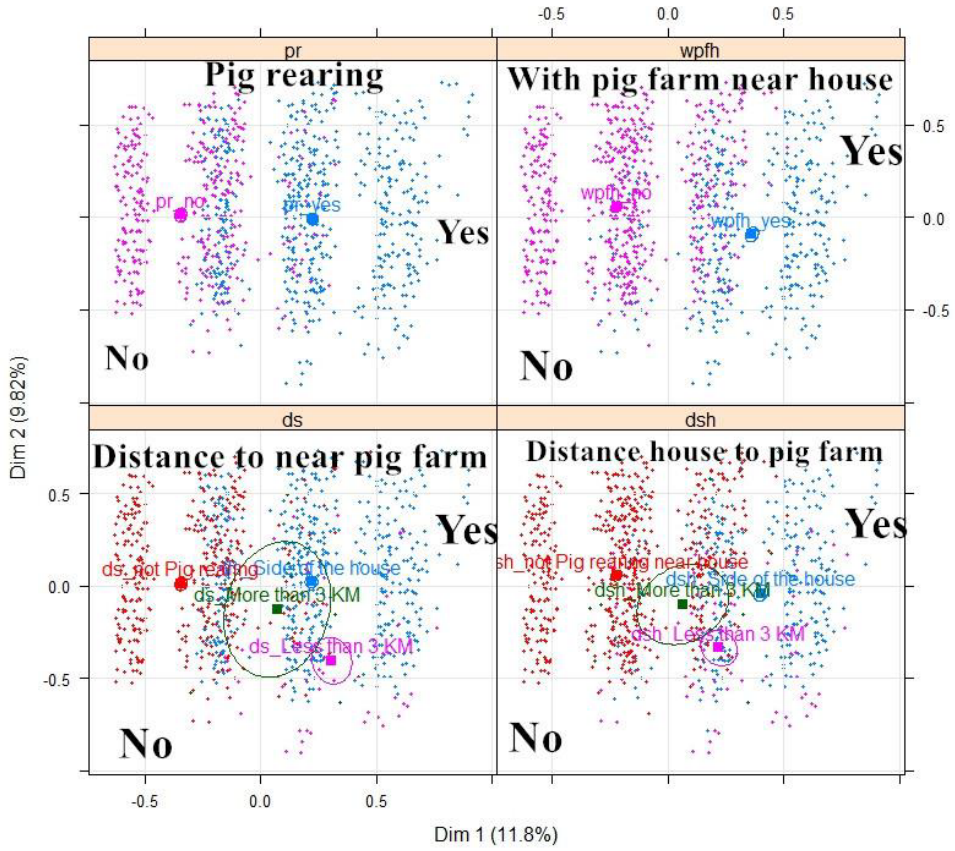


Figure 1 multiple correspondence analysis map among the environmental and behavior variables

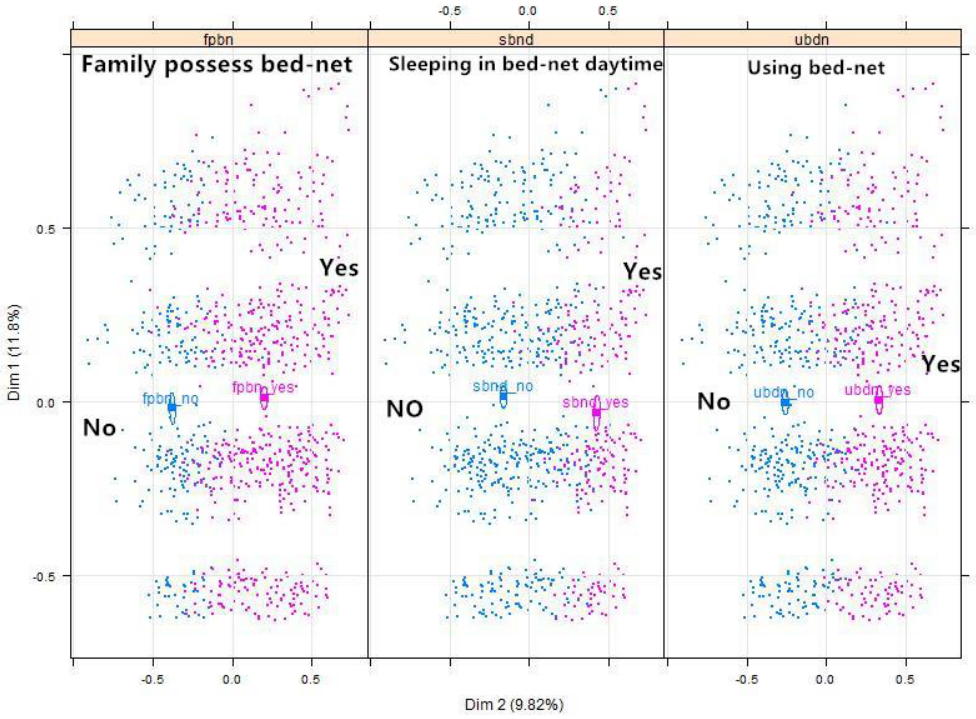


Figure 2 Typology of dimension1 environmental factors

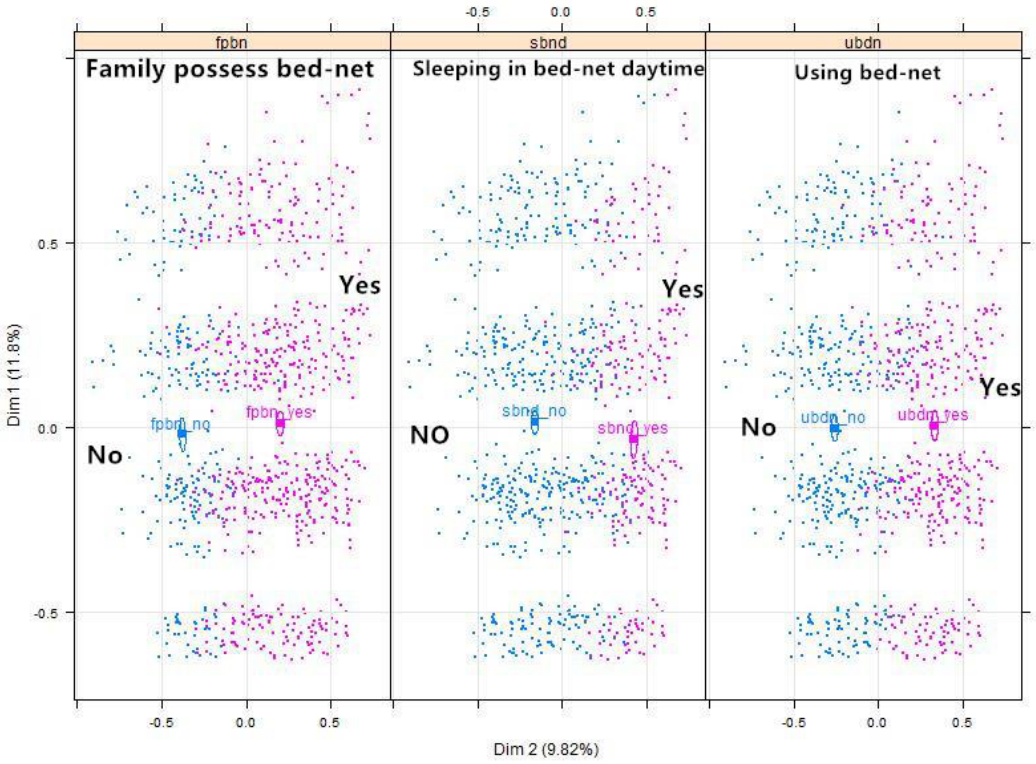


Figure 3 Typology of dimension2 bed-net using behaviors

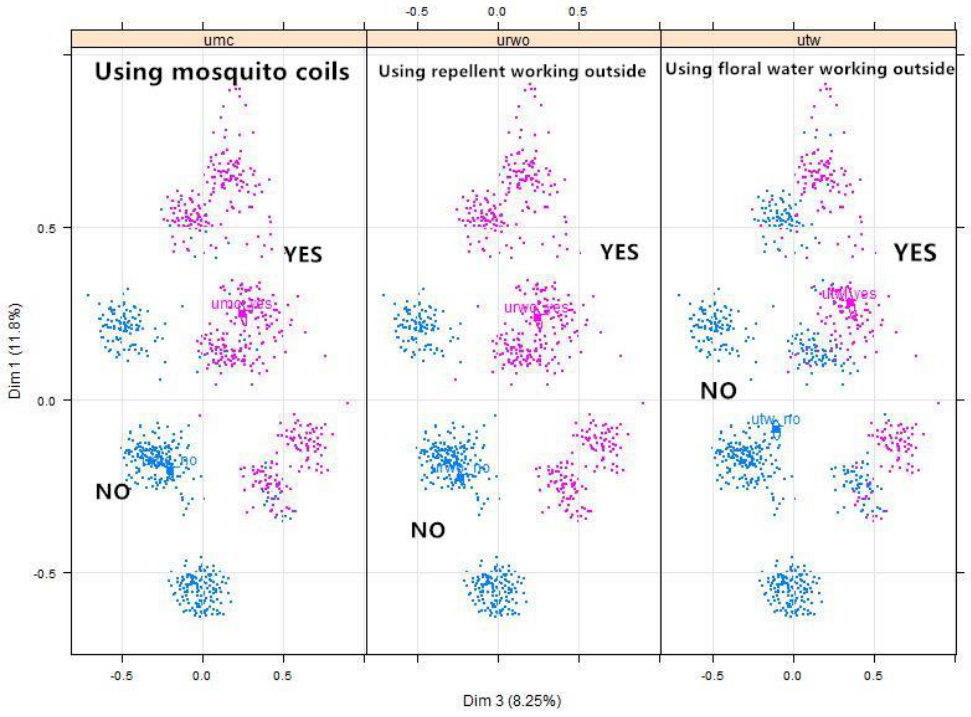


Figure 4 Typology of dimension3 repellent using behaviors

4.2 Discussion

By using MCA, we could group 10 out of 20 variables into 3 dimensions of mosquito-borne diseases behaviors namely, pig rearing environment, bed-net using behaviors and repellent using behaviors.

Pig rearing of environment were stronger associated with Japanese encephalitis. Existing studies revealed that the practice of paddy cultivation and pig rearing environment are two main risk factors of JE prevalence [7-12].

Bed-net using is well known to prevent mosquito-borne diseases. International health groups are providing long-lasting, insecticide-treated nets (LLIN) to residents in malaria endemic areas of underdeveloped countries, particularly in Africa. In such areas, regular use of insecticide-treated bed nets can reduce childhood mortality up to 20% and severe disease up to 50% [13, 14]. In sub-Saharan Africa, ITNs are a popular tool for malaria control [15]. Local residents are at high risk to mosquito-borne diseases, such as malaria, dengue fever, Japanese encephalitis, chikungunya and zika virus infection. It is important to improve the health education programme to ensure universal use of bed-net in this area.

Topical insect repellents are recommended by health authorities to avoid mosquito bites and prevent mosquito-borne disease[16]. Broadly defined, repellents are products used by individuals to reduce the number of bites from hematophagous arthropods [17]. Such products include topical repellents applied directly, to the skin, but they also include compounds on clothing, insecticide-treated bed nets (ITN) and various devices that emit vapor or droplets into a small space (e.g. mosquito coils)[18] . On a practical level, repellents can reduce the incidence of disease caused by vector-borne pathogens but they can only rarely eliminate the risk because of the imperfections of use by individuals. Personal protection measures must be used correctly to be effective. In our study sites, the use of repellent rate was 49% (635/1295). Whether they use correctly or not are needed further research.

This study was limited by the fact that half of the other item variables could not be grouped. However, the variables are rather non-specific and likely to play less important role in disease control. Further exploration is needed.

5. Conclusions

The nature of major risk behaviors related to mosquito-borne diseases can be divided into 3 dimension, pig rearing of environment, bet-net using behaviors and repellent using behaviors respectively along with China-Lao Border area. The finding from this study would be helpful in planning of various mosquito-borne diseases prevention and control in this area.

Competing interests

The fieldwork was supported by Yunnan Institute of Parasitic Diseases. All authors declare that they have no competing interesting.

Acknowledgments

The authors are grateful to staff of the Xishuangbanna Prefecture CDC: Mr. Jianhua Fan for supporting the fieldwork, the Mengla County CDC: Dr.Junming Li, Mr. Huaxin Liu, Dr. Yujiang Xiao and all the staff of five study sites Health center for supporting the fieldwork.

References

[1] Organization WH. A global brief on vector-borne diseases. 2014.
[2] Phommanivong V, Kanda S, Shimono T, Lamaningao P, Darcy AW, Mishima N, et al. Co-circulation of the dengue with chikungunya virus during the 2013 outbreak in the southern part of Lao PDR. Tropical Medicine and Health. 2016;44(1):24.
[3] Guo X, Yang H, Wu C, Jiang J, Fan J, Li H, et al. Molecular characterization and viral origin of the first dengue outbreak inXishuangbanna, Yunnan Province, China, 2013. The American Journal ofTropical Medicine and Hygiene. 2015;93(2):390-3.
[4] Le Roux B, Rouanet H. Geometric Data Analysis: from Correspondence Analysis to Structured Data Analysis: Dordrecht, Kluwer; 2004 2004. 475 p.
[5] Nenadic O,Greenacre M. Correspondence analysis in R, with two-and three-dimensional graphics: The Ca Package. 2007.
[6] Lê S, Josse J, Husson F. FactoMineR: An R Package for Multivariate Analysis. Journal of Statistical Software. 2008;25(1):1-18.
[7] Phukan A, Borah P, Mahanta J. Japanese encephalitis in Assam, northeast India. Southeast Asian Journal of Tropical Medicine and Public Health. 2004;35:618-22.
[8] Dwibedi B, Mohapatra N, Rathore SK, Panda M, Pati SS, Sabat J, et al. An outbreak of Japanese encephalitis after two decades in Odisha, India. The Indian Journal of Medical Research. 2015;142 (Suppl 1):S30.
[9] Richards EE, Masuoka P, Brett-Major D, Smith M, Klein TA, Kim HC, et al. The relationship between mosquito abundance and rice field density in the Republic of Korea. International Journal of Health Geographics. 2010;9(1):1.

[10] Masuoka P, Klein TA, Kim H-C, Claborn DM, Achee N, Andre R, et al. Modeling the distribution of Culex tritaeniorhynchus to predict Japanese encephalitis distribution in theRepublic of Korea. Geospatial Health. 2010;5(1):45-57.
[11] Impoinvil DE, Solomon T, Schluter WW, Rayamajhi A, Bichha RP, Shakya G, et al. The spatial heterogeneity between Japanese encephalitis incidence distribution and environmental variables in Nepal. PloS One. 2011;6(7):e22192.
[12] Khan S, Narain K, Handique R, Dutta P, Mahanta J, Satyanarayana K, et al. Role of some environmental factors in modulating seasonal abundance of potential Japanese encephalitis vectors in Assam, India. Southeast Asian Journal of TropicalMedicine and Public Health. 1996;27:382-91.
[13] Lindsay S, Adiamah J, Miller J, Armstrong J. Pyrethroid-treated bednet effects on mosquitoes of the Anopheles gambiae complex in The Gambia. Medical and Veterinary Entomology. 1991;5(4):477-83.
[14] Gimnig JE, Kolczak MS, Hightower AW, Vulule JM, Schoute E, Kamau L, et al. Effect of permethrin-treated bed nets on the spatial distribution of malaria vectors in western Kenya. The American Journal of Tropical Medicine and Hygiene. 2003;68(4_suppl):115-20.
[15] Lengeler C. Insecticide-treated bed nets and curtains for preventing malaria. The Cochrane Library. 2004.
[16] Webba CE, Hessc IM. A review of recommendations on the safe and effective use of topical mosquito repellents. Public Health Research & Practice. 2016;26(5).
[17] White G. Terminology of insect repellents. Insect repellents. Principles, methods and uses. Edited by: Debboun M, Frances SP, Strickman D. 2007. Boca Raton: CRC Press.
[18] Strickman D, Frances SP, Debboun M. Prevention of bug bites, stings, and disease: Oxford University Press; 2009.

Effect of Methotrexate on Interleukin-36γ Serum Levels in Psoriasis: A pilot study

Attawut Limsaengrat[1], Jitlada Meephansan[1,*] and Achara Phumyen[2]

[1] Division of Dermatology, Chulabhorn International College of Medicine, Thammasat University, Phahonyothin Road, Klonglung, Pathum Thani Thailand 12120
[2] Chulabhorn International College of Medicine, Thammasat University, Phahonyothin Road, Klonglung, Pathum Thani Thailand 12120

Abstract

Background: Interleukin 36 γ (IL-36γ), a member of the IL-1 family, is the molecule that can stimulate pro-inflammatory pathway, which can induce several cytokines and chemokines that take responsibility in the inflammatory process in many diseases, including psoriasis. The recent study, IL-36γ was found to be highly specific to psoriasis when compared with other inflammatory skin diseases. Methotrexate (MTX) is an immunosuppressive drug that commonly used to treat various types of psoriasis. It has multiple abilities including anti-proliferation, anti-inflammation, and immunosuppression, resulting from the inhibition of various enzymes and cytokines, but the effect of MTX on IL-36γ serum levels in psoriasis subject is still unknown.

Objective: To investigate the correlation of PASI score and IL-36γ serum levels of psoriasis subjects before and after methotrexate treatment.

Methods: Eight subjects with moderate-to-severe plaque-typed psoriasis were given MTX 15 mg per week for up to 12 weeks. The PASI score was evaluated at baseline and when the PASI score reached 75% improvement or up to 12 weeks. Serum levels of IL-36γ were determined by enzyme-linked immunosorbent assay (ELISA) before and after treatment.

Results: IL-36γ serum levels were detectable in all 8 subjects at baseline (358.21 ± 45.84 pg/ml). After MTX treatment, the mean of PASI score of all 8 subjects had significant reduction from before and after treatment ($p = 0.003$). There was no significant correlation between IL-36γ serum levels and PASI score in both before and after treatment ($r = -0.168$, $p = 0.692$ and $r = 0.441$, $p = 0.274$, respectively)

Conclusion: No correlation between PASI score and IL-36γ serum levels of psoriasis subjects before and after methotrexate treatment. Even though, all the subjects had significant reduction of PASI score.

Keywords: Interleukin-36γ, psoriasis, methotrexate

1.Introduction

Psoriasis is a common, chronic inflammatory skin disease with polygenic predisposition combined with the immune-mediated disorder and environmental triggering factors, which affect the quality of life, both physically and mentally. In addition, psoriasis subjects have relatively higher risk for metabolic syndrome, cardiovascular disease and rheumatologic comorbidities [1].

Interleukin-36 is a novel member of the IL-1 family. It consists of IL-36α, IL-36β and IL-36γ. These cytokines bind to the IL-1Rrp2 (IL-36R) and co-receptor, IL-RAcP [3]. IL-36 is produced by macrophages, DC, and lymphocytes, which are found abundantly in keratinocytes of the skin and a few other tissues, such as bronchial epithelium and synovial fibroblasts [4, 5]. The production of IL-36 can be induced by environmental factors directly stimulate keratinocytes and via the stimulation of DCs/Langerhans cells to secrete IL-1, IL-6, and IL-23 that later stimulate Th17 and γδ T cells to secrete IL-6, TNF-α, IL-17, IL-22, and IFN- γ, resulting in IL-36γ production [6]. Its function is to stimulate pro-inflammatory pathway by activating the mitogen-activate protein kinase and NF-kB signal transduction. Its signal can induce the production of cytokines (e.g. IL-6, IL-8, IL-17, TNF-α), and chemokines (e.g. CXCL8, CCL20) that take responsibility in the inflammatory process processes [7].

* Corresponding author; e-mail: kae_mdcu@yahoo.com

The recent study showed that IL-36γ, which is highly expressed in psoriatic skin lesions, was highly specific for psoriasis but weakly expressed in other inflammatory skin diseases including atopic dermatitis (AD), contact eczema (CE) and lichen planus (LP). Not only in the psoriatic skin lesions, but IL-36γ in peripheral blood serum levels also highly correlated with the severity of the disease, evaluated by PASI score, and significantly decreased after treated with etanercept, anti-TNF-α. Thus, IL-36γ may now be a potential biomarker in psoriasis subjects [2]. Nevertheless, the role of IL-36γ is not completely defined.

Methotrexate (MTX) is a derivative of aminopterin, which mechanism of action is to inhibit dihydrofolate reductase (DHFR), an enzyme for the reduction of dihydrofolate (DHF) to tetrahydrofolic acid (FH_4). The mechanism of action of MTX including inhibition of DNA synthesis, reinforcement of the T cells apoptosis and inhibition of the chemotaxis of neutrophils. In addition, MTX can also decrease the synthesis of pro-inflammatory cytokines such as TNF-α, IL-1, IFN-γ (8, 9). The reduction of TNF-α [10], IFN-γ [11] combined with the suppression of NF-kB pathway contribute to lowering protein and gene expression of caspase-1, which lead to the reduction of hyper-proliferating keratinocytes in the psoriatic epidermis [12]. We used therapeutic model with MTX, which is widely used and very effective to treat moderate-to-severe plaque-type psoriasis in Thailand, to evaluate the correlation between IL-36γ serum levels and PASI score.

2. Research objective

To investigate the correlation of PASI score and IL-36γ serum levels of psoriasis subjects before and after methotrexate treatment.

3. Materials and methods

Subjects and samples

Eight subjects with moderate-to-severe plaque-typed psoriasis (6 males, 2 females, mean age 42.25 years) at Thailand Tobacco Monopoly Hospital were enrolled. The severity of the subject was evaluated by using 'Psoriasis Area and Severity Index (PASI)' (<10=mild, 10-15=moderate, >15=severe). Subjects with pregnancy or lactation, psoriatic arthritis, IL-36γ associated diseases (HSV infection, inflammatory bowel disease, COPD, asthma), cancer, autoimmune disease, and immunocompromised conditions were excluded from the study. All the subjects were given oral MTX 15 mg once a week up to 12 weeks. The subjects in this study must not use topical therapies within 2 weeks, and systemic therapies within 4 weeks prior the study period. During the study, the subjects were not given any other medications. The study was approved by the Ethics Committee of Thammasat University and all participants signed an informed consent.

Measurement of IL-36γ serum levels

The peripheral blood was collected from the subjects and centrifuged to separate the serum at baseline and when the PASI score reached 75% improvement or up to 12 weeks. The IL-36γ serum levels were measured by enzyme-linked immunosorbent assay (ELISA) kit (RayBiotech, Inc., Norcross, Georgia, USA). All samples and standards were measured in duplicate.

Statistical analysis

The frequency (%) was used to evaluate qualitative data and mean ± SD was used to evaluate quantitative data for demographic of the subjects, PASI score and IL-36γ serum levels. Correlation analyses between IL-36γ serum levels and PASI score was performed by Pearson correlation. p-value <0.05 was considered to be significant.

4. Results

Baseline characteristics of the subjects are demonstrated in Table 1. PASI score and IL-36γ serum levels at baseline and after treatment are demonstrated in Table 2.

IL-36γ serum levels were detectable in all subjects at baseline (358.21 ± 45.84 pg/ml). After treatment with MTX, 4 of 8 subjects (50%) had reached 75% PASI score improvement. There was a significant reduction of mean PASI score from before and after treatment (p = 0.003). There was no significant correlation between IL-36γ serum level and PASI score in both before and after treatment (r = -0.168, p = 0.692 and r = 0.441, p = 0.274, respectively) (Figure 1).

Table 1 Baseline characteristics of the subjects

	Total (n=8)
Age (years)	***42.25 ± 15.29***
Sex	
Male	6 (75%)
Female	2 (25%)
Body Mass Index	28.71 ± 6.53
Smoking	3 (37.5%)
Alcohol Drinking	2 (25%)
FH of Psoriasis	3 (37.5%)

Values are presented as frequency (%) and mean. BMI, body mass index; FH, family history.

Table 2 PASI scores and IL-36γ serum levels for each psoriasis subject.

Subject No.	PASI before treatment	PASI after treatment	IL-36γ (pg/ml) serum levels before treatment	IL-36γ (pg/ml) serum levels after treatment
1	12.6	5.7	367.315	315.258
2	10.8	6.2	334.338	291.097
3	12.9	9.4	450.617	300.807
4	20.9	15.1	353.238	310.455
5	26.3	6	315.258	310.455
6	10.2	2.2	320.046	295.96
7	15.3	3.6	395.265	286.217
8	10.6	2.4	329.586	300.807

PASI, Psoriasis Area and Severity Index.

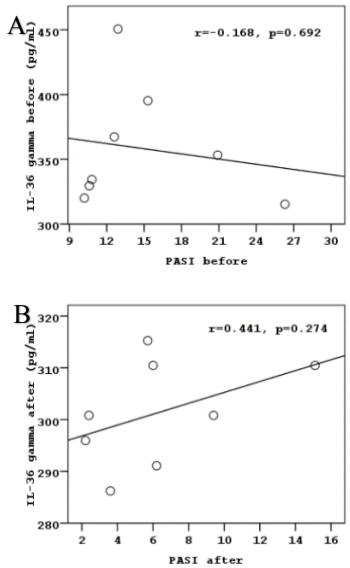


Figure 1 IL-36γ serum levels and PASI score in psoriasis subjects. A) Correlation between IL-36γ serum levels and PASI score at baseline (r = -0.168, p = 0.692 and). B) Correlation between IL-36γ serum levels and PASI score after treatment with MTX (r = 0.441, p = 0.274).

5. Discussion

The effect of MTX on IL-36γ serum levels remains unknown. To our knowledge, MTX has antiproliferative and anti-inflammatory effect by reducing the synthesis of several pro-inflammatory cytokines (e.g. TNF-α, IL-1, IFN-γ, IL-22) [8, 13, 14], which may lead to the reduction of IL-36γ production, since the production of IL-36 can be induced by IL-6, TNF-α, IL-17, IL-22, IFN- γ and IL-36 itself [15]. This study has

demonstrated that there is no significant correlation between IL-36γ serum levels and PASI score before and after treated with MTX. Even though, all the subjects have significant reduction of PASI score. Resulting from the complexity of the immunopathogenesis of psoriasis, there are other immunogenic pathways that can induce the production of IL-36γ that MTX cannot inhibit, for example, the environmental factors and IL-36γ itself can directly induce keratinocytes to produce IL-36γ. From the result, all subjects have high level of IL-36γ (>50 pg/ml), thus there may be some other unknown pathway that can also induce the production of IL-36γ. Moreover, from the strong association between IL-36γ and neutrophil and its chemokines, which play important role in generalized pustular psoriasis (GPP) [16], therefore, IL-36γ may not strongly express in chronic plaque-type psoriasis, which has Th1/Th17 as a key component.

References

[1] Schleicher SM. Psoriasis: Pathogenesis, assessment, and therapeutic update. Clin Podiatr Med Surg. 2016;33(3):355-66.

[2] D'Erme AM, Wilsmann-Theis D, Wagenpfeil J, Hölzel M, Ferring-Schmitt S, Sternberg S, et al. IL-36γ (IL-1F9) is a biomarker for psoriasis skin lesions. J Investig Dermatol. 2015;135(4):1025-32.

[3] Wu Y LH, Jiang Z and Lai Y. The interleukin-1 family: A key regulator in the pathogenesis of psoriasis. Austin J Clin Immunol. 2014;1(5):1023.

[4] Garlanda C, Dinarello CA, Mantovani A. The interleukin-1 family: back to the future. Immunity. 2013;39(6):1003-18.

[5] Sims JE, Smith DE. The IL-1 family: regulators of immunity. Nat Rev Immunol. 2010;10(2):89-102.

[6] Gabay C, Towne JE. Regulation and function of interleukin-36 cytokines in homeostasis and pathological conditions. J Leukoc Biol. 2015;97(4):645-52.

[7] Vigne S, Palmer G, Lamacchia C, Martin P, Talabot-Ayer D, Rodriguez E, et al. IL-36R ligands are potent regulators of dendritic and T cells. Blood. 2011;118(22):5813.

[8] Czarnecka-Operacz M, Sadowska-Przytocka A. The possibilities and principles of methotrexate treatment of psoriasis -- the updated knowledge. Postepy Dermatol Alergol. 2014;31(6):392-400.

[9] Chan ES, Cronstein BN. Mechanisms of action of methotrexate. Bulletin of the Hospital for Joint Disease (2013). 2013;71 Suppl 1:S5-8.

[10] Hildner K, Finotto S, Becker C, Schlaak J, Schirmacher P, Galle PR, et al. Tumour necrosis factor (TNF) production by T cell receptor-primed T lymphocytes is a target for low dose methotrexate in rheumatoid arthritis. Clin Exp Immunol. 1999;118(1):137-46.

[11] Constantin A, Loubet-Lescoulié P, Lambert N, Yassine-Diab B, Abbal M, Mazières B, et al. Antiinflammatory and immunoregulatory action of methotrexate in the treatment of rheumatoid arthritis: Evidence of increased interleukin-4 and interleukin-10 gene expression demonstrated in vitro by competitive reverse transcriptase-polymerase chain reaction. Arthritis Rheum. 1998;41(1):48-57.

[12] Thirupathi A, Elango T, Subramanian S, Gnanaraj P. Methotrexate regulates Th-1 response by suppressing caspase-1 and cytokines in psoriasis patients. Clin Chim Acta. 2016;453:164-9.

[13] Fellermann K, Jewell DP, Sandborn WJ, Schölmerich J, Stange EF. Immunosuppression in inflammatory bowel diseases: Standards, new developments, future trends: Springer Netherlands; 2001.

[14] Meephansan J, Ruchusatsawat K, Sindhupak W, Thorner PS, Wongpiyabovorn J. Effect of methotrexate on serum levels of IL-22 in subjects with psoriasis. Eur J Dermatol. 2011;21(4):501-4.

[15] Carrier Y, Ma H-L, Ramon HE, Napierata L, Small C, O'Toole M, et al. Inter-Regulation of Th17 cytokines and the IL-36 cytokines In vitro and In vivo: Implications in psoriasis pathogenesis. J Investig Dermatol. 2011;131(12):2428-37.

[16] Johnston A, Xing X, Wolterink L, Barnes DH, Yin Z, Reingold L, et al. IL-1 and IL-36 are dominant cytokines in generalized pustular psoriasis. J Allergy Clin Immunol. 2016;140(1):109-120.

Session of Nursing

The Humanized Care Behaviors among Nursing Students Studying at Boromarajonani Nursing College, Thailand

Thassanee Thipsungnoen[1,*] and Praphaphorn Suemram[1]

[1]Boromarajonani College of Nursing, Nakhorn Ratchasima 30000, Thailand

Abstract

This exploratory descriptive study aimed to identify the levels of humanized care behaviors according to the perception of the 3rd and the 4th year of the undergraduate nursing students and to test the differences among three domains of humanized care behaviors reported by those two nursing student groups. The Identities of Nursing Student Questionnaire which was adopted from Kittiporn Nounsuwan (2015) was applied for collecting data. Content validity of this questionnaire was approved by 3 experts. Cronbach's Alpha Coefficient for reliability was .96. The 96 samples were randomly selected from 186 population. The return rate of questionnaire was 100 %. Descriptive statistics and Independent t-test were used for data analysis.

The results revealed that the overall scores of humanized care behaviors of participants from the 3rd and the 4th year were at high level. There was no statistically significant difference between those two overall scores. The highest average scores of each domains (service mind, participation, and analytical thinking) for those two groups of participants were at high level. There were no statistically significant differences in service mind and analytical domains between those two groups of participants. However, those two groups of participants identified the difference on participation domain at a statistically significant level of .05.

Keywords: humanized care behavior, nursing student, service mind, analytical thinking, participation

1. Introduction

Today's technology has evolved very rapidly, bringing benefits to the area of health, but it is not always accompanied by respect, interaction, and empathy for others. In the hospital or healthcare service setting, the concept of humanization has become necessary in healthcare since some factors, such as the hospital or healthcare service routines, the advances of medical technology, and to a certain extent, the team paternalism tend to limit healthcare to the application of technical procedures with medical aims, resulting disadvantageous to patient autonomy. Some of the premises of the humanized healthcare are the perception of the human being as a bio-psycho-social and spiritual being and his essence and individuality should be respected. The respect towards the patient and the Principialist Bioethics principles, autonomy, beneficence, nonmaleficence, and justice ground the search for humanized care [1].

Praboromarajchanok Institute for Health Workforce Development (PIHWD), Ministry of Public Health, Thailand, describes the identity of their nursing students as "providers of healthcare services with humanized care" which means that graduated nurses from Boromarajonani College of Nursing under PIHWD will provide friendly service with love and compassion. Based on the definition of this identity, not only the

* Corresponding author; e-mail: tussanee@knc.ac.th

health problem, but also the suffering happen with the clients will be taken into the consideration. The PIHWD defines the identity of their nursing students within three key domains for humanized care, which are service minded (S), analytical thinking (A), and participation (P) or SAP [2].

Service minded is considered to be providers of friendly service delivered with love and compassion. Three characteristics of service minded are addressed. The first one provides the health service with a sense of willingness to help the clients based on their needs and accept, without any bias or any judgment on the attitudes, behaviors, and identity of the clients. The next one provides the health services without the need for incentive or any rewards or without conflicts of interest. The last one provides the health service based on the problem and needs of the majority and pays much attention to the client health problems and suffering [2, 3].

Analytical thinking is the ability of thinking based on a variety of resources and ability to analyze problems and needs of the clients critically. The implementation of clients' data through interventions that are related to the circumstances to their life is the essence of analytical thinking. Six characteristics of analytical thinking are addressed. The first one understands the real life situations and generates interventions to adopt in various settings. The second one uses the learning process and the continuous thinking process to collect data systematically. The third one analyzes health problems and the needs of clients based on their circumstances. The next one is the knowledge application to implement the interventions, which relies on the needs and condition of clients. After that set up a plan for health services that consider the daily activities of clients. The last one is competency development without boundary and does not rely on any theory or experiences [2, 3].

Participation in the health services is the last category of identity of humanized care. In doing this, students have to provide health services concerning individuality, condition, potential of the client and other factors that relate to the health status of clients. In addition, students should select knowledge and interventions that are appropriate to the preferences of clients. These interventions should be easy for students to implement. Moreover, interventions should have an effect on enhancing self-reliance among the clients. Therefore, participants in any interventions should have the right to make their own decision. Four characteristics of participation are addressed. In the first characteristics, students provide health services based on the clients' needs. The second one allows clients to participate in data collection, analyses and identification of solutions and allows clients to make their own decisions based on the appropriate and comprehensive information given. The next one, as a healthcare provider, students should pay a role in supporting, motivation, and providing solutions, but do not decide the medical intervention required for the clients. The last one, healthcare providers should promote competency in solving their own problem and build their strong self-reliance [2, 3].

Nursing is more than a learned science. It is the art a person uses to approach other people and establish a certain degree of relationship with them. In order to humanize, it is necessary for nursing students to adopt practices in which the biological, psychical, ethical, educational, social, spiritual and subjective aspects are integral parts of health care, benefiting both the client and the professional, as a tool for recovering and maintaining health [4]. In order to enhance humanized care behaviors among nursing students, nursing colleges under PIHWD included Boromarajonani College of Nursing, Nakhon Ratchasima, have implemented several activities conducted both inside and outside of the classroom, such as the ideas of volunteer for giving care the clients during their summer vacation to enhance nursing students to be service-minded individuals, employing a local wisdom, Korat song, for giving physical and mental health education to enhance humanized care in the community setting, and significantly, implementing moral camps, as a Buddhist, for enhancing humanized care

and increasing the strong relationship between caring and humanism. More importantly, Boromarajonani College of Nursing, Nakhon Ratchasima has been using authentic learning in order to enhance humanized care for many years. The authentic learning especially in clinical practices with real situations leads undergraduate nursing students to understand the relationship between caring individuals, understanding humanity, human right, and patients' right and providing human basic needs.

However, little empirical evidence from previous studies have showed the results of providing the humanized care model among nursing students under the PIHWD. The academic formation has an important role in training future professionals, it is essential that stimulate the development of sensitivity to know the reality of a client and also of the hospital, communication, listening to their complaints and find ways to facilitate their acceptance and understanding their health problems [5]. As nursing is a profession focused primary for the care. Therefore, during graduation the students especially the 3rd and the 4th year learn the concept of caring and when they develop their activities practice, they have the opportunity to put those concepts into practice, and thus students will be prepared for their professional life. Based on this scenario, it was important to make research about the levels of humanized care behaviors. In this aspect this study bring the problems as following : 1) how does the level of perception on humanized care among undergraduate nursing students of the 3rd and the 4th year who have been experienced in both hospital and community training field ?, and 2) how does the difference of their perception among those three domains on humanized care?

2. Research objective (s)

The aims of this exploratory descriptive study were 1) to identify the levels of humanized care behaviors according to the perception of the 3rd and the 4th year of the undergraduate nursing students and 2) to test the differences among three domains of humanized care behaviors reported by those two nursing student groups.

3. Materials and methods

Type of research

This study deals a research files, of quantitative type, of non-experimental nature, exploratory descriptive and transversal conducted in Nakhon Ratchasima, Thailand.

Population

The total population of this study consisted of 345 nursing students from the 3rd and the 4th year of the undergraduate nursing program.

Sample

The total samples for this study consisted of 186 nursing students. Taro Yamane formulation was used to calculate this sample size. A simple random sampling with a proportional method was adopted to select those samples from each class. The 90 samples were selected from the 3rd year and 96 samples were selected from the 4th year who consented to participate in the study voluntarily.

Criteria of inclusion and exclusion of subjects

Criteria of inclusion:

- The research subjects must be the 3rd and the 4th year undergraduate nursing student.
- The selected student must sign the Statement of Informed Consent.

Criteria of exclusion

- Not belong to the 3rd and the 4th year undergraduate nursing student.
- Students who perchance refuse to participate voluntarily or are absent during data collection.

Instrument for data collection

The four two-page, anonymous, self-administered questionnaire, "The Identities of Nursing Student Questionnaire" adopted from Kittiporn Nounsuwan (2015) was applied for collecting data [6]. It was composed of two parts. The first part contains 10 close-ended items is for requesting demographic information. The second part contains 75 close-ended items using a 5-point Likert scale is for identifying participants' perception that contributed to humanized care behaviors under three categories: service minded category contains 28 items, analytical thinking category contains 16 items, and participation category contains 31 items. Each item is rated so that "minimal practice" is 1 point and "maximal practice" is 5 points. The interpretation of score is ranked into 5 levels (10.00-1.50 = lowest, 1.51-2.50 = low, 2.51-3.50 = moderate, 3.51-4.50 = high, and 4.51-5.00 = highest). A higher score indicates a higher level of the perception toward humanized care.

Validity and reliability of the study

The content validity of this questionnaire was approved by three experts. It was pre-tested on 30 undergraduate nursing students - 15 from each class level - who did not participate in the actual study. Cronbach's alpha coefficient for reliability of this questionnaire was .96.

Description of data collection

After approval of the project at the Institutional Review Board (IRB) of Boromarajonani College of Nursing, Nakhon Ratchasima, data was collected by the researchers from October 11-23, 2017. All the 3rd and the the 4th year nursing students were individually contacted and invited to participate in the study. The sample recruitment timeline was scheduled. If some refused to be part of the study, the next participants would be randomly selected and invited to participant before the end of recruitment timeline. On the day of administration of the questionnaire, participants were requested to gather in the college hall. To reduce the non - respondent rate, the information was not disclosed until all participants had gathered in the hall. All participants were then informed about the study objectives and the time required for participation before seeking their written consent to take part. To protect confidentiality and anonymity, participants were not asked to identify themselves and were not required to write their names on the questionnaire. In addition, participants were informed that findings would be presented as group data with no personal respondent information being reported. They were also informed that finding would not affect their academic grades and school performances. Participants were also instructed the correct way of completing the questionnaire and the anticipated interest in participating in this research. The exercise took about 50-55 minutes to complete and they handed them back to the researcher immediately upon completion.

4. Results and discussion

Sample characteristics

The 186 participants (100% responding rate) completed the questionnaires. The socio-demographic characteristics of the respondents are illustrated in Table 1

Table 1 Socio-demographic characteristics of participants (N = 186)

Characteristics	3rd year		4th year		Total	
	n	%	n	%	n	%
Gender						
Male	3	3.3	8	8.3	11	5.9
Female	87	96.7	88	91.7	175	94.1
Age						
20	28	31.1	17	17.7	45	24.4
21	58	64.4	70	72.9	128	68.6
22	3	3.3	7	7.3	10	5.3
24	0	0	2	2.1	2	1.1
25	25	1.1	0	0	1	0.6

The prevalence of females in nursing profession is shared by few male, reflecting this historical characteristic of nursing where the profession of care is exercised exclusively by women due to the fact that the assignment of the great women have provided care for the education of children, housework and also conciliation with their work. It was found two age groups among participants, with the highest prevalence of students between 20 (24.4%) and 21(68.6%), a result that demonstrates the presence to young people entering the fact that the nursing program may be related to job offers and offer possibilities to enter quickly into the labor market.

Based on the objectives of this study, the results revealed that the overall scores of humanized care behaviors of participants from the 3rd ($\bar{x}$ = 4.11, SD = 0.39) and the 4th year ($\bar{x}$ = 4.12, SD = 0.32) were at high level. There was no statistically significant difference between those two overall scores. The highest average scores of each domains (service mind, participation, and analytical thinking) for those two groups of participants were at high level. There were no statistically significant differences in service mind and analytical domains between those two groups of participants. However, those two groups of participants identified the difference on participation domain at a statistically significant level of .05. The details are illustrated in Table 2. By means of the answers given by the participants, it was clear that they are aware of the importance that humanization of health care can bring to clients, their families members, the team and the institution as a whole.

Table 2 Mean, standard deviation, and independent sample t -test for testing the differences among three domains of humanized care behaviors between the 3rd and the 4th year participants

Variable / Group	3rd year	4th year	t -test	df	p (2-tailed)
	$\bar{x}$ (SD)	$\bar{x}$ (SD)			
Service mind	4.31(0.36)	4.37(.33)	-1.24	184	.22
Analytical thinking	3.91(0.42)	3.94(0.38)	-.53	184	.60
Participation	4.12(0.50)	4.25(0.37)	-2.17	162.73	.03*
Overall	4.11(0.39)	4.12(0.32)	-1.47	172.48	.14

$p^* <$ .05.

The study results suggested that participants from the 3rd and the 4th year of the undergraduate nursing program studying at Boromarajonani College of Nursing, Nakhon Ratchasima, under the PIHWD considered the importance of humanized care behavior at the same level although they are studying in the different academic

level. We expected that the 4th year undergraduate nursing students would express their perception on humanized care behaviors stronger than the other one. Considering the reasons to support this results, the syllabus subjects studied in the third year of the undergraduate nursing course would be the best evidence to support this finding. Many subjects both in theoretical and practical parts such as intensive nursing care, terminal illness nursing care, oncology nursing care, and psychiatry nursing care are best covered the theme of humanized care while many subjects studied in the fourth year are more focused in details of nursing profession and the advances of medical technology for healing the patients than other academic levels. In the undergraduate nursing course, much is taught on science and technology. However, the theme of humanized care should be and can be incorporated during all levels of education process of nursing profession. Within all this learning, the subjects with humanistic approached should also be an integral part of the curriculum, since the students are concerned with tasked related to cure, prevention, and rehabilitation of the client, as well as human nature and social well-being [4].

It is important to note that the actions intended to humanize health care need to be implemented and followed, not only as a rules, but as a chance of culture, from teaching institutions to hospital institutions. Only a humanized team can humanize health care. As professionals and human beings that come from a common society, together with patients and their families, we need to build a healthier world in harmony with the rights of human beings [4]. The nursing student when is aware of this importance, learn more clearly the nuances of caring, and acquire importance features to cope with difficulties, specifically, the sensitivity to recognize the reality of the patient, listening to their complaints and find ways to facilitate their acceptance, communication and understanding of the health problems, becoming a mature professional and trained in humanized care.

5. Conclusions

The present study led us to conclude that

- Humanized care behaviors reported by the 3rd and the 4th year of the undergraduate nursing students studying at Boromarajonani College of Nursing, Nakhon Ratchasima, under the PIHWD were the same at high level.
- All three domains of humanized care behaviors (service mind, analytical thinking, and participation) for those two groups of the undergraduate nursing students need to be promoting into higher level before graduation especially the participation domain.
- The theme of humanized care behaviors should be and can be incorporated during all levels of education process of nursing profession.

Acknowledgements

This study was funded by Boromarajonani College of Nursing, Nakhon Ratchasima, Thailand.

References

[1] Emilis CP, Ingrid AB, Maria Julia PS. Humanized care: the act with respect to design improving student nursing. Acta Paul Enferm. 2011; 24(3):334-40.

[2] Praboromarajchanok Institute for Health Workforce Development. Manual on the Implementation on Humanized Care. Bangkok: Yutharin Pub. 2013.

[3] Phepun P, Wareewan S. The opinions of nursing students regarding humanized care through volunteer

activities at Boromarajonani Collega of Nursing, Chonburi. International Scholarly and Scientific Research & Innovation. 2016; 10(6):2007-2010.

[4] Dyane R, Rachel DC. Humanizing health care: what do nursing students think? Einstein. 2007; 5(4); 315-320.

[5] Jaqueline GO, Aurea AV. Hospital nursing and humanization: knowledge of undergraduate nursing students. J Health Sci Inst. 2013; 31(3): 36-42.

[6] Kittiporn N, Sermsak W, Wittawat DS. Strategies to Develop the Nursing Students' Identity in Nursing Colleges, Ministry of Public Health. Hatyai Journal. 2015; 13(2) Jul-Dec: 117-132.

Session of Humanities and Social Sciences

The Impact of Perceived Transformational Leadership on Perceived Employee Creativity in Orchid Farming in Nakhon Pathom Province

Panyindee Janjirapon[1,*], Hirannapat Minmantra[1], and Thong-oon Woraya[1]

[1]Faculty of Management Science, Nakhon Pathom Rajabhat University

Abstract

The objective of this research was 1) to study perceived transformational leadership level, 2) to study perceived employee creativity level, and 3) to study the impact of perceived transformational leadership on perceived employee creativity in orchid farming in Nakhon Pathom province. The sample were 249 entrepreneurs in orchid farming. The Questionnaire was used as the tool for data collection. The data was analyzed in term of frequency, percentage, means, standard deviation, Pearson Correlation Coefficient, and Regression Analysis. The results from this research indicated as follows: the mean score of perceived transformational leadership was at 3.98 (S.D. = 0.39). The mean score of employee creativity was at 3.95 (S.D. = 0.41). In addition, perceived transformational leadership positively affected to perceived employee creativity in orchid farming in Nakhon Pathom province ($p<.01$).

Keywords: perceived transformational leadership, perceived employee creativity, entrepreneur

1. Introduction

Production factors which include land, labor, capital and entrepreneurship are not only factors to drive economic growth at present. As a result of the digital economy, information is rapidly spreading so creativity or innovation is essential. Creative product and service will add economic value or emotional value. Knowledge is not enough to develop this economy. Therefore, leadership and creativity will enhance the creative economy [1].

Leadership is an essential role in encouraging creativity, and performance of employees. Transformational leadership support employee creativity in dynamic environment [2]. There are many studies in the perceived transformational leadership and perceived creativity (e.g., [3];[4];[5];[6];[7]). Few studies are investigated in orchid farming context. Therefore, we investigate the impact of perceived transformational leadership on perceived employee creativity in orchid farming in Nakhon Pathom province.

2. Objectives

1. To study perceived transformational leadership level.
2. To study perceived employee creativity level.
3. To study the impact of perceived transformational leadership on perceived employee creativity in orchid farming in Nakhon Pathom province.

3. Review literature

Perceived transformational leadership refers to the perception of leader characteristics that develop full potential followers, meet the needs of followers, have ethics, and motivation. The developmental motivation helps followers to concentrate on the benefits of the organization over their own interests. Perceived transformational leadership consists of four components including idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration [4];[5].

Perceived employee creativity refers to the perception of followers abilities that think new ideas, innovation creation, and problem solving. Three components of perceived employee creativity include thinking ability, creating Innovation and problem solving [5];[8];[9];[10].

Perceived transformational leadership has a positive effect on perceived employee creativity [2];[3];[4];[5];[6];[7].

* Corresponding author; e-mail: janjirapon@webmail.npru.ac.th

4. Methods

The population and sample

The population were 653 entrepreneurs in orchid farming in 2015 [11].

The sample were 249 entrepreneurs in orchid farming by using Yamane formula [12].

Research tool

The questionnaire was used as the tool for data collection. It was self-rating. Perceived transformational leadership was adapted from [4];[5], using a 5-point Likert scale (1=strongly disagree, 5=strongly agree). There were four factors including twenty one items. [4] and [5] indicated that Cronbach Alpha scores were between 0.70-0.87. Perceived employee creativity was adapted from [8];[9], using a 5-point Likert scale (1=strongly disagree, 5=strongly agree). There were three factors including eleven items. [8] reported that Cronbach Alpha scores were 0.79 and [9] showed that Composite Reliability was 0.88.

Three experts evaluated the questionnaire for content validity. Item of objective congruence index were more than 0.5. For reliability test, Cronbach alpha scores were calculated from t30 respondents and the scores were more than 0.70 [13]. In addition, Item-total correlation were more than 0.4 [14] from discrimination power analysis and factor loading were more than 0.4 [15]. Discrimination power and reliability test are shown in Table 1.

Data analysis

The data was analyzed in terms of frequency, percentage, means, standard deviation, Pearson Correlation Coefficient, and Regression Analysis.

Table 1 Discrimination power and reliability test

Variable	Corrected item-total correlation	Cronbach alpha scores	Factor loadings
Perceived transformational leadership	0.453-0.909	0.95	0.439- 0.693
Perceived employee creativity	0.481-0.657	0.87	0.544- 0.706

5. Results

The results are presented in three parts as followings: demographic characteristics, descriptive statistics of the variables and regression analysis.

Demographic characteristics

The majority of respondents in the research, 125 (50.20%) were female, 118 (47.40%) were between the ages of 30-39 years, and 160 (64.30%) were lower than bachelor degree. 83 (33.30%) of respondents had income per month between 15,000 – 20,000 Baht and 102 (41%) of respondents had business experience between 5 – 10 years. Demographic characteristics are shown in Table 2.

Table 2 Demographic characteristics

Descriptions	Frequency	Percentage
Gender		
Female	125	50.20
Male	124	49.80
Age		
20-29 years	33	13.30
30-39 years	118	47.40
40 years and over	98	39.40
Education Level		
Lower than bachelor degree	160	64.30
Bachelor degree	71	28.50
Upper than bachelor degree	18	7.20
Income per month		
Less than 15,000 Baht	56	22.50
15,000 – 20,000 Baht	83	33.30
20,001 – 25,000 Baht	73	29.30
More than 25,000 Baht	37	14.90

Table 2 Demographic characteristics (continued)

Business Experience		
Less than 5 years	49	19.70
5 – 10 years	102	41.00
11-15 years	88	35.30
More than 15 years	10	4.00

Descriptive statistics of the variables

The mean score of perceived transformational leadership was at 3.98 (S.D.=0.39). The highest mean score of perceived transformational leadership components was intellectual stimulation (Mean=4.00, S.D.=0.48). The mean score of perceived employee creativity was at 3.95 (S.D.=0.41). Thinking ability was the highest mean score of The mean score of perceived employee creativity (Mean=3.97, S.D.=0.43). Descriptive statistics of the variables are shown in Table 3.

Table 3 Descriptive statistics of the variables

Variables	**Mean**	**S.D.**
Perceived transformational leadership	**3.98**	**0.39**
Idealized influence	3.94	0.51
Inspirational motivation	3.99	0.42
Intellectual stimulation	4.00	0.48
Individualized consideration	3.97	0.44
Perceived employee creativity	**3.95**	**0.41**
Thinking ability	3.97	0.43
Creating innovation	3.93	0.53
Problem solving	3.95	0.45

Correlation between perceived transformational leadership and perceived employee creativity

Perceived transformational leadership was positively related to perceived employee creativity ($r = .585$, $p < .01$) (Table 4).

Table 4 Correlation between perceived transformational leadership and perceived employee creativity

Variables	**Perceived transformational leadership**
Perceived transformational leadership	1
Perceived employee creativity	0.585**

**p-value<0.01

Regression analysis

Perceived transformational leadership explained 36.2% of the variance in perceived employee creativity (Table 5).

Table 5 Regression analysis

Variable	**B**	**SE**	**Beta (β)**	**t**	**Sig**
Constant	-0.001	0.051		-0.012	0.991
Perceived transformational leadership	0.603	0.051	0.602	11.819**	0.000
R^2	0.362				
Adjust R^2	0.360				

** p<0.01

6. Discussion

In this research, the mean score of perceived transformational leadership was at 3.98 which was in line with the previous research [4];[7]. The mean score of perceived employee creativity was at 3.95 which was in line with the previous research [7];[9]. In addition, perceived transformational leadership positively affected to perceived employee creativity in orchid farming in Nakhon Pathom province. The previous studies confirmed that perceived transformational leadership had a positive effect on perceived employee creativity [2];[3];[4];[5];[6];[7].

7. Conclusions

The results from this research indicated that the mean score of perceived transformational leadership was at 3.98 (S.D.=0.39). The mean score of employee creativity was at 3.95 (S.D.=0.41). In addition, perceived transformational leadership positively affected to perceived employee creativity in orchid farming in Nakhon Pathom province. Therefore, entrepreneurs should develop transformational leadership for increasing employee creativity. Entrepreneurs should focus on individualized consideration such as recognition about the differences in employee and fairness. For intellectual stimulation, entrepreneurs should support employee to think new things. Moreover, entrepreneurs should be idealized influence by being a role model. Entrepreneurs should be inspire followers such as communication, challenge, and reward.

References

[1] Patluang, K. A Holistic Policy for Stimulating Creative Economy. NIDA Development Journal. 2011;51 (3): 207-230.

[2] Teymournejad, K., & Elghaei, R. Effect of Transformational Leadership on the Creativity of Employees: An Empirical Investigation. *Engineering.* Technology & Applied Science Research. 2016; 7 (1): 1413-1419.

[3] Sharma, P., Nagar, P., & Pathak, S. C.). Impact of Transformational Leadership on Creative Flexibility of Engineers in India. Procedia-Social and Behavioral Sciences. 2012; 57: 555-559.

[4] Çekmecelioğlu, H. G., & Özbağ, G. K. Leadership and Creativity: The Impact of Transformational Leadership on Individual Creativity. Procedia-Social and Behavioral Sciences. 2016; 235: 243-249.

[5] Jyoti, J., & Dev, M. The impact of transformational leadership on employee creativity: the role of learning orientation. Journal of Asia Business Studies 2015; 9 (1): 78-98.

[6] Li, C., Zhao, H., & Begley, T. M. Transformational leadership dimensions and employee creativity in China: A cross-level analysis. Journal of Business research. 2015; 68 (6): 1149-1156.

[7] Qu, R., Janssen, O., & Shi, K. Transformational leadership and follower creativity: The mediating role of follower relational identification and the moderating role of leader creativity expectations. The Leadership Quarterly. 2015; 26 (2): 286-299.

[8] Pretorius, M., Millard, S. M., & Kruger, M. E. The relationship between implementation, creativity and innovation in small business ventures. Management Dynamics. 2006; 15 (1): 2-13.

[9] Khedhaouria, A., Gurau, C., & Torrès, O. Creativity, self-efficacy, and small-firm performance: The mediating role of entrepreneurial orientation. Small Business Economics. 2015; 44 (3): 485-504.

[10] Ahlin, B., Drnovsek, M., & Hisrich, R. D. Entrepreneurs' creativity and firm innovation: The moderating role of entrepreneurial self-efficacy. Small Business Economics. 2014; 43(1): 101-117.

[11] The department of agricultural extension. Agricultural Statistics in nakhonpathom [Internet]. 2015 [cited 10 Sep 2016]. Available from http://www.nakhonpathom.doae.go.th.

[12] Yamane, T. Statistics: an introductory analysis. New York: Harper and Row; 1973.

[13] Cronbach, L. J. My current thoughts on coefficient alpha and successor procedures. Educational and Psychological Measurement. 2004; 64 (3): 391-418.

[14] Johnson-Conley, C. D. Using community-based participatory research in the development of a consumer-driven cultural competency tool [dissertation]. University of Washington; 2009.

[15] Hair, J. F., Black, W. C., Babin, B. J. & Anderson, R. E. Multivariate data analysis. 7th ed. Upper Saddle River, NJ: Pearson Prentice Hall; 2010.

Determinants of Happiness in a Multicultural Setting: A Case of Chana District, Songkhla Province, Thailand

Nurainee Jangoe[1,3,*], Sarawuth Chesoh[2] and Apiradee Lim[1]

[1]Department of Mathematics and Computer Science
[2]Department of Science, Faculty of Science and Technology,
Prince of Songkla University, Pattani Campus, 94000 Thailand
[3]Centre of Excellence in Mathematics, CHE, Si Ayutthaya Rd., Bangkok 10400, Thailand

Abstract

Happiness is a psychological concept that has an impact on people's life in different aspects. The aim of the study was to identify the determinants of happiness among the multicultural residents in Chana district of Songkhla province in Thailand. Data were obtained from the annual monitoring database on socioeconomic and attitude of people inhabiting around EGAT's Chana Power Plant from 2010 to 2016. A total of 2,864 sample households from 45 communities were individually interviewed to evaluate the mental health of the respondents by using the Thai Happiness Indicators (THI-15) questionnaire of the Department of Mental Health, Ministry of Public Health. The determinants of happiness were identified by using multiple linear regression. The results showed that the overall mean of happiness index score was 30.24. There were significant relationship between happiness index score and survey year, place of living, occupation and income of residents (p-value <0.05). In conclusion, happiness of residents was mainly determined by time, place and economic status.

Keywords: Happiness score, Community psychology, Multicultural society, Thailand

1. Introduction

Happiness is defined as central human stimuli and a vital goal for all human generations [1]. It is a state of emotion and affection characterized by feelings of satisfaction and enjoyment. It is also related to well-being, life satisfaction, successful aging and good quality of life [2]. Being happy often leads to better health, longer life, decrease in disabilities and reduce mortality [3, 4].

From the current world happiness report [5], the top 10 countries with the highest happiness indices are Norway, Denmark, Iceland, Switzerland, Finland, Netherlands, Canada, New Zealand, Australia and Sweden. All these countries are developed countries, with 7 in Europe. On the other hand, developing countries (mostly in Africa and Asia) are documented with the least happiness levels [5]. Singapore and Thailand have remained the top two countries with high happiness levels in the Association of Southeast Asian Nations (ASEAN) region over the past 4 years [5, 6]

There have been documented evidence to show that age, gender, income level, marital status, occupation, place of domicile, education and religious belief affect the happiness levels among different groups of people [7, 8, 9, 10].

The Chana district in the Songkhla province of Thailand could be considered as a multicultural area. The inhabitants are exposed to cultural diversity by the presence of different religions such as Islam, Buddhism and Christianity. The district, which is in the Songkhla province has many industries, organizations and factories. It has given the Chana district diverse occupations such as agriculture, merchant, fishing and others. This exposure is likely to affect the way of life and happiness level of the communities in the district. This present study aimed to identify the factors that influence happiness among residents in Chana district.

2. Research objectives

2.1 To investigate the level of happiness index of the residents in Chana district, Songkhla province, Thailand.

2.2 To identify factors that influence happiness index of the residents in Chana district, Songkhla province, Thailand.

* Corresponding author; e-mail: nurainee.jangoe@gmail.com

3. Materials and methods

Study areas, Data source and variables

This study employed secondary data based on socio-economic factors and happiness index score of residents around the Chana power plant. These data were obtained from Electricity Generating Authority of Thailand (EGAT). A cross-sectional study was conducted from 2010 to 2016. The study area comprised of 7 sub–districts out of 14 sub-districts in the Chana district of Songkhla province, Thailand which are Ban Na, Na Wa, Klong Pia, Taling Chan, Chanong, Paching and Na Thap. The inclusion criteria for the selection of these seven sub–districts was based upon their distance away from the Chana power plant. The distance considered in this study is almost 5km. We assume that sub-districts closer to the power plant have more effect in terms of happiness than sub-districts outside the defined distance range.

The subjects were selected using systematic random sampling technique. A convenience sampling was used in the ease of difficultly of getting samples. A total of 2,864 subjects (393 subjects in 2010, 404 subjects in 2011, 451 subjects in 2012, 407 subjects in 2013, 389 subjects in 2014, 410 subjects in 2015 and 410 subjects in 2016) were interviewed.

The tool used in the study was the Thai Happiness Indicators questionnaire developed by the Department of Mental Health under the Ministry of Public Health [12]. The tool consist of 15 questions and each question has 4 choices: not at all (0 score), little (1 score), much (2 scores) and very much (3 scores). The total score for Thai happiness index score is 45. The scores ranged from 35 to 45 marks means the Happiness Indicator is higher than the general people, 28 to 34 marks means equal to general people and 0 to 27 marks means lower than general people[12].

Variables

Outcome variable

In this study, the outcome variable is happiness index score.

Determinants

The determinants in this study are survey year, place of living, age group, gender, occupation, education, income, religion, duration of resident (years).

Place of living consist of 7 groups namely Ban Na, Na Wa, Klong Pia, Taling Chan, Chanong, Paching and Na Thap. Survey years consist of 7 years: 2010, 2011, 2012, 2013, 2014, 2015 and 2016. Age was divided into 5 groups: 18-35 years old, 36-45 years old, 46-55 years old, 56-65 years old and >65 years old. Gender was grouped into male and female. Occupation was divided into 4 groups: agriculture, employee, seller and others. Education level was divided into 2 groups: lower or equal primary school and higher than primary school. Family income per month was classified into 2 groups: lower or equal 9,000 Baht and more than 9,000 Baht. We assume that 9,000 Baht is the lowest rate that can be earned monthly by people working in this district. Religion was divided into 2 groups: Islam and Buddhism. Duration of resident was divided into 3 groups namely <=25 years, 26-50 years and >50 years.

Statistical methods

A preliminary statistical analysis involved examining the frequency distribution of the independent variables. The happiness index score for each group of determinants was compared using the two-sample t-test for a dichotomous determinant and F-test for a multi-categorical determinant. The significant variables, identified in the univariate analysis were further examined using multiple linear regression to identify the strength of relationship between determinants and outcome. Statistical significance was set at p-value <0.05. All statistical analysis was carried out using R program [11].

4. Results and discussion

Figure 1 explains about demographic of respondents. The percentage of samples in each year from 2010, 2011, 2012, 2013, 2014, 2015 and 2016 were 13.7%, 14.1%, 15.8%, 14.2%, 13.6%, 14.3% and 14.3%, respectively (Figure 1a). The majority of respondents were living in Na Thap (NT) sub-district (27.1%) (Figure 1b). Most of respondents were female (62.5%) (Figure 1c). The majority of the respondents with the highest religious representation were Islam (62.7%) followed by Buddhism (37.3%) (Figure 1d). The age of the respondents ranges 18 to more than 65 years. The highest age group was between 36-45 years (27.1%) and the lowest age group was more than 65 years (7.9%) (Figure 1e). Over 45.6% of respondents had been settled in their village between 26- 50 years (Figure 1f). Approximately 59.1 % of respondents had education level primary school or lower (Figure 1g). Agriculture was the main occupation accounted for with 48.5%, employee accounted for 23.2% and seller with 17.7% (Figure 1h). The respondents had monthly income more than 9,000 Baht per month accounted for 70.7% (Figure 1i).

Happiness index score of people was assessed by the questionnaire and classified the score into three levels compared to the standard happiness index score reported for the whole of Thailand by the Department of

Mental Health, Ministry of Public Health [12]. The happiness index score of Thai people ranged between 28 and 34 scores, therefore, this scored was considered as the average score of happiness.

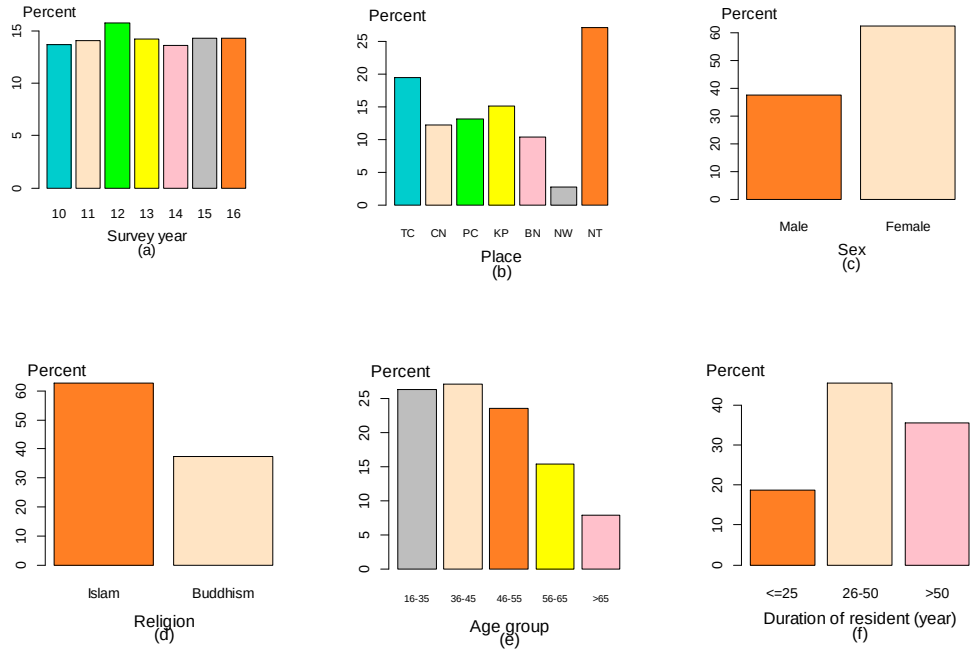
The results of this study showed that half of the respondents (52.3 %) had an average level of happiness followed by 21.0 % of the respondents' happiness level was above average while 26.7 % had happiness level below average (Table1).

Table 2 indicates preliminary results explaining that survey year, place of living, occupation and income are statistically significant. We conclude that the happiness index score are different for each of these determinants.

Table 3 Coefficient and standard errors of multiple linear regression on happiness index score. The model shows that happiness index score and survey year, place of living, occupation and income are statistically significant with p-value less than 0.05.This result is consistent with the results from a study conducted by department of Mental Health, National Statistical Office of Thailand and Institute for Population and Social Research of Mahidol University in 2015 [13]. The study found that there was a very small change in happiness level of Thai people between 2014 and 2015 from 31.52 to 31.44 [13].

Occupation was an important factor influencing happiness. We found that people with other occupation (civil servants and self-employed) had higher happiness index score compared to agricultural workers, seller and employees. The lowest happiness index score was recorded among employees. Other studies had confirmed the existence of a relationship between type of occupation and happiness [14].

This study also revealed that happiness index depended on income levels. Respondents with monthly income more than 9,000 Baht had higher happiness index score than those with monthly income 9,000 Baht or less. This is corroborated by the report of Yiengprugsawan et al., (2012) [15], which stated that household income levels could determine that level of happiness. Despite the fact that some studies had shown that happiness was associated with age, gender, education and religion [16,17] However, in our study found that there were no statistically significant association between happiness index score and age group, gender, education, religion and duration of residents.



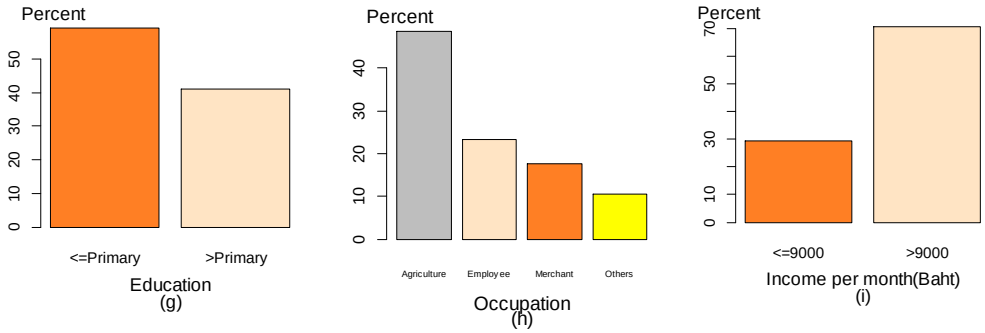


Figure 1 Distribution of demographic factors

Table1 Level of happiness of people in Chana district, Songkhla province,Thailand

Level of happiness	Number (n=2,864)	Percentage
Below average level of happiness	767	26.7
Average level of happiness	1497	52.3
Above average level of happiness	600	21.0

Table 2 The statistical significance of associations

Determinant	Statistical Valued	p-value
Survey year	F-statistic : 63.845	0.0000
Place of living	F-statistic : 2.643	0.0147
Age group	F-statistic : 2.242	0.0622
Gender	t-statistic : 1.639	0.1014
Occupation	F-statistic : 3.115	0.0252
Education	t-statistic : 1.142	0.2537
Income	t-statistic : 6.405	0.0000
Religion	t-statistic : 0.658	0.5107
Duration	F-statistic : 0.942	0.3901

Table 3 Coefficient and standard errors of multiple linear regression on happiness index score

Variable	Coefficient (95% CI)	standard errors (SE)	p-value
Constant	30.2416201	0.0968	
Survey year			<0.001
2010	(0)		
2011	2.1784407	0.2489	
2012	2.9480069	0.2434	
2013	-1.7630331	0.2259	
2014	2.0646288	0.2410	
2015	-0.2574708	0.2477	
2016	-2.8481875	0.2425	
Place of living			<0.001
Talingchan	(0)		
Chanong	0.6641486	0.1994	
Paching	-0.2698519	0.2629	
Klong Pia	0.5848071	0.2542	
Ban Na	-0.2523648	0.2380	
Na Wa	0.8862567	0.2978	
Na Thap	0.6770821	0.5868	
Occupation			<0.05
Agriculture	(0)		
Employee	0.1054269	0.1037	
Seller	-0.3645226	0.1856	
Others	-0.2051636	0.2120	
Income			<0.001
<=9,000Baht	(0)		
> 9,000Baht	-0.9984984	0.1588	

5. Conclusions

Happiness of residents in the study area was mainly determined by time, location and economic status. Happiness is an important indicator represent quality of life among residents in Chana district, Songkhla province. Therefore, happiness of people should be considered before setting up any policies or programs related to locals living conditions.

Acknowledgements

We gratefully acknowledge the Electricity Authority of Thailand (EGAT) for providing the data. We are also grateful to Emeritus Professor Don McNeil for his helpful advice and valuable suggestions. This research is (partially) supported by the Centre of Excellence in Mathematics, the Commission on Higher Education, Thailand and also by the Graduate School, Prince of Songkla University, Thesis Funding.

References

[1] Steptoe A, Wardle J, Marmot M. Positive affect and health-related neuroendocrine, cardiovascular, and inflammatory processes. Proceedings of the National Academy of Sciences. 2005; 102: 6508–6512.

[2] Miller, C. A. Nursing for Wellness in Older Adults: Theory and Practice .4th ed. Philadelphia: Lippincott Williams and Wilkins; 2004.

[3] Collins, A. L., Goldman, N., Rodriguez, G. Is positive well-being protective of mobility limitations among older adults?. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences. 2008; 63: 321-327.

[4] Danner, D. D., Snowden, D. A., Friesen, W. V. Positive emotion in early life and longevity: Finding from the Nun Study. Journal of Personality and Social Psychology. 2001; 80: 804-813.

[5] Helliwell, J.F., Layard, R., Sachs, J. World Happiness Report 2017. 1 st. New York: Sustainable Development Solutions Network; 2017.

[6] Helliwell, J.F., Layard, R., Sachs, J. World Happiness Report 2016. 1 st. New York: Sustainable Development Solutions Network; 2016.

[7] Yang, Y. Social inequalities in happiness in the United States, 1972 to 2004: An age-periodcohort analysis. American Sociological Review. 2008; 73: 204-226.

[8] Diener, E., Suh, E. M., Lucas, R. E., Smith, H. L. Subjective well-being: Three decades of progress. Psychological Bulletin. 1999; 125: 276-302.
[9] Layard, R. Happiness: Lessons from a new science. 1st.New York: Penguin Press; 2005.
[10] Blanchflower, D.G, Oswald, A.J. Well-being over time in Britain and the USA. Journal of Public Economics. 2004; 88: 1359-1386.
[11] R Development Core Team. A language and environment for statistical computing [Internet]. 2015. [cited April 18 2016]. Available from: http://www.R- project.org
[12] Mongkol, A., Hattaprom, W., Chedchoksuk, P., Chalowkul, W., Phayoyai, L. Thai Happiness Indicators (THI – 15) [Internet]. 2002. [cited December 17 2016] Available from:http://www.dmh.go.th/test/ download/files/thi15.pdf
[13] National Statistical Office of Thailand. Mental Health Survey (Happiness) Thai people 2015[Internet]. 2015. [cited January 17 2017] Available from: http://service.nso.go.th/nso/nsopublish/themes/files/ mental-healthm_jul_58.pdf
[14] Mehrdadi, A., Sadeghian, S., Direkvand-Moghadam, A., Hashemian, A. Factors affecting happiness: a cross-sectional study in the Iranian youth. Journal of Clinical and Diagnostic Research. 2016; 10: 1-3.
[15] Yiengprugsawan, V., Somboonsook, B., Seubsman, S., Sleigh, A.C. Happiness, mental health, and socio-demographic associations among a national cohort of Thai adults. Journal of Happiness Studies. 2012; 13: 1019-1029.
[16] Frey, B.S., Stutzer, A. What can economists learn from happiness research?. Journal of Economic Literature. 2002; 40: 402-435.
[17] Tiefenbach, T., Kohlbacher, F. Happiness and life satisfaction in Japan. German Institute for Japanese Studies (DIJ). 2013; 13 (1): 121.

The Comparative Study of Logistics Cost Structure for Farmers' Siamese Fighting Fish

Hirannapat Minmantra[1,*], Sukcharoenpong Sompon[1], and Ditsathaporncharoen Santi[1]

[1]Faculty of Management Science, Nakhon Pathom Rajabhat University

Abstract

The purposes of this study were 1) to study logistics cost structure, and 2) to compare logistics activities classified by fish amount. The sample were 99 farmers. The questionnaire was used as the tool for data collection. The data was analyzed in term of frequency, percentage, means, standard deviation, minimum, maximum, One – way ANOVA, and Scheffe method. The results showed that logistics cost structure for farmers' Siamese Fighting fish consisted of two logistics activities including purchasing the input supplies and preparing the delivery. Logistics cost structure for farmers' Siamese fighting fish was 74,081.93 baht per year. The highest logistics cost was transportation for purchasing the input supplies. Moreover, Communication with buyers which is the lowest logistics cost. Furthermore, farmers with different fish amount had no the different level in logistics activities. Farmers with different fish amount had the different level in preparing the delivery with the statistical significance at .05 level.

Keywords: Siamese Fighting fish, logistics cost structure, logistics activities

1. Introduction

In 2015, Thailand is the seven largest exporters in the world. The total value of exports is US$15.67 million, with a market share of 5.1 percent percentage of global [1]. Siamese fighting fish is favorite ornamental fish export from Thailand. The amount of export to global is 87,403 kilograms, value is 55,160,638 million baths [2]. Siamese fighting fish export to many countries such as Singapore, United States of America, China, Japan, etc.

The logistics cost is an important factor to manage Siamese Fighting fish Farm. Farmers should manage and control logistic cost because they will take competitive advantage. Moreover, customers satisfy and profit increase. The logistics cost structure consists of the activities of procurement, material handling, transportation, inventory, and customer communications [3]. The logistics cost depends on by farm size. Therefore, we investigate the comparative study of logistics cost structure for farmers' Siamese fighting fish. The objectives of this study are to study logistics cost structure, and compare logistics activities classified by fish amount. This study contributes to understanding of logistics cost. In addition, farmers can decide to choose suitable fish amount.

2. Objectives

1. To study logistics cost structure.
2. To compare logistics activities classified by fish amount

3. Review literature

The definition of logistics cost structure was entrepreneur activities cost such as purchasing, handling, inventory, serving [4] Logistics cost structure referred to resources allocation cost from supplier to customer [5]. [6] showed that logistics cost structure included procurement, material handling, transportation, inventory, and customer communications. Logistics cost structure had the different level classified by the size of farms. The logistics cost structure included procurement, material handling, transportation, inventory, customer service, and communications. The logistics costs varied by farm size. For example, farmers with small, medium and large size had the different level of material handling costs or preparing the delivery [3].

4. Methods

The population and sample

The population were 131 farmers in Nakhon Pathom Province 2015 [7].

The sample were 99 farmers by using Yamane formula [8].

* Corresponding author; e-mail: minmantra@webmail.npru.ac.th

The questionnaire was used as the tool for data collection. The questionnaire consisted of two parts including demographic characteristics, and logistics cost structure. Three experts verified the content validity. The experts included academic and experienced farmers. Item of objective congruence index were more than 0.5. For reliability test, Cronbach's alpha coefficient were more than 0.70 [9].

Data analysis

The data was analyzed in term of frequency, percentage, means, standard deviation, minimum, maximum, One – way ANOVA, and Scheffe method.

5. Results

The results are presented in three parts as followings: demographic characteristics, descriptive statistics of logistics cost structure, One – way ANOVA, and Scheffe method.

Demographic characteristics

In the study, the majority of farmers, 69 (69.70%) were male, 32 (32.32%) were between the ages of 41 – 50 years, and 56 (56.57%) were elementary school. 46 (46.47%) of farmers had experience between 15 – 21 years and 61 (61.62%) of farmers had fish amount less than 50,000 fish. Demographic characteristics are shown in Table 1.

Table 1 Demographic characteristics

Descriptions	Frequency	Percentage
Gender		
Female	30	30.30
Male	69	69.70
Total	**99**	**100**
Age		
21 years and Lower	5	5.05
21 – 30 years	8	8.08
31 – 40 years	27	27.28
41 – 50 years	32	32.32
51 – 60 years	17	17.17
60 years upper	10	10.10
Total	**99**	**100**
Education Level		
Elementary School	56	56.57
Junior High School	27	27.27
Senior High School	9	9.09
Vocational Diploma	2	2.02
Bachelor degree	5	5.05
Upper than bachelor degree	0	0.00
Total	**99**	**100**
Experience		
1 – 7 years	0	0.00
8 – 14 years	29	29.29
15 – 21 years	46	46.47
22 – 28 years	14	14.14
29 – 35 years	6	6.06
More than 35 year	4	4.04
Total	**99**	**100**
Siamese Fighting fish owned by farmers		
Fewer than 50,000 fish	61	61.62
50,000 – 100,000 fish	25	25.25
100,001 – 150,000 fish	4	4.04
150,001 – 200,000 fish	3	3.03
200,001 – 250,000 fish	6	6.06
More than 250,000 fish	0	0.00
Total	**99**	**100**

Descriptive statistics of logistics cost structure

Logistics cost structure for farmers' Siamese Fighting fish consisted of two logistics activities including purchasing the input supplies and preparing the delivery. Purchasing the input supplies comprises communication

with suppliers and transportation for purchasing the input supplies. In addition, preparing the delivery comprises communication with buyers, material, equipment and packaging for preparing the delivery, and labor for preparing the delivery.

Logistics cost structure for farmers' Siamese fighting fish was 74,081.93 baht per year. The highest logistics cost is transportation for purchasing the input supplies which was 39,334.55 baht per year. Moreover, Communication with buyers which was the lowest logistics cost is 4,514.79 baht per year. Descriptive statistics of logistics cost structure are shown in Table 2.

Table 2 Descriptive statistics of logistics cost structure

Logistics Activities	**Logistics Cost (Baht/Year)**	Standard Deviation	**Minimum**	**Maximum**
1.Purchasing the Input Supplies	43,970.55	68,025.41	3,000.00	484,800.00
1.1 Communication with Suppliers	4,636.00	3,193.00	600.00	21,600.00
1.2 Transportation for Purchasing the Input Supplies	39,334.55	67,621.30	2,400.00	480,000.00
2. Preparing the Delivery	30,111.37	22,480.58	8,686.76	150,540.00
2.1 Communication with Buyers	4,514.79	3,264.87	400.00	21,600.00
2.2 Material, Equipment and Packaging for Preparing the Delivery	5,342.04	2,153.00	286.76	9,965.50
2.3 Labor for Preparing the Delivery	20,254.55	21,428.76	7,200.00	132,000.00
Total Costs of Logistics Activities	74,081.92	73,271.44	15,166.76	531,042.00

A comparative study of logistics activities classified by fish amount

The results indicated that farmers with different fish amount had no the different level in logistics activities. Nevertheless, farmers with different fish amount had the different level in preparing the delivery with the statistical significance at .05 level. A comparative study of logistics activities classified by fish amount are shown in Table 3.

Table 3 A Comparative Study of logistics activities classified by fish amount

Logistics Activities	**F**	**Sig**
1. Purchasing the Input Supplies	.849	.498
2. Preparing the Delivery	8.075*	.000
Total Costs of Logistics Activities	.444	.776

* $p < .05$

Post Hoc Tests

A comparative study of preparing the delivery classified by fish amount with Scheffe method are shown in Table 4. Farmers with less than 50,000 fish, and 200,001 – 250,000 fish had the different level in preparing the delivery. Farmers with 50,000 – 100,000 fish, and 200,001 – 250,000 fish had the different level in preparing the delivery. In addition, farmers with 150,001 – 200,000 fish and 200,001 – 250,000 fish had the different level in preparing the delivery.

Table 4 Post Hoc Tests

Fish Amount		Lower than 50,000 fish	50,000 – 100,000 fish	100,001 – 150,000 fish	150,001 – 200,000 fish	200,001 – 250,000 fish
	Mean	**24,940.97**	**25,300.00**	**30,604.22**	**50,382.50**	**69,515.20**
Less than 50,000 fish	**24,940.97**	-	-	-	-	-44,574.23*
50,000 – 100,000 fish	**25,300.00**		-	-	-	-38,910.98*
100,001 – 150,000 fish	**30,604.22**			-	-	-19,132.70
150,001 – 200,000 fish	**50,382.50**				-	-44,215.20*
200,001 – 250,000 fish	**69,515.20**					-

* $p < .05$

6. Discussion

In this study, logistics cost structure for farmers' Siamese Fighting fish consisted of two logistics activities including purchasing the input supplies and preparing the delivery which was in accord with the previous research [3], [6] . Farmers with different fish amount had the different level in preparing the delivery with the statistical significance at .05 level which was in accord with the previous research. [3]

7. Conclusions

The results from this research indicated that logistics cost structure for farmers' Siamese Fighting fish consisted of two logistics activities including purchasing the input supplies and preparing the delivery. Logistics cost structure for farmers' Siamese fighting fish was 74,081.93 baht per year. The highest logistics cost was transportation for purchasing the input supplies which is 39,334.55 baht per year. Moreover, Communication with buyers which is the lowest logistics cost was 4,514.79 baht per year. The results indicated that farmers with different fish amount had no the different level in logistics activities. Nevertheless, farmers with different fish amount had the different level in preparing the delivery with the statistical significance at .05 level. Farmers should plan transportation to decrease cost and control preparing the delivery cost.

References

[1] Factfish Reserch. Thailand: Ornamental fish, live, export value (US $)[Internet]. 2015. [cited 10 Aug 2017]. Available from http://www.factfish.com.

[2] Fisheries trade statistics of Thailand. Fisheries trade statistics annual report 2015. 2015; p. 103.

[3] Srisaeng, O., Chaveesuk, R., Suwandechochai, R., & Ongkunarak, P. Analysis of production costs and logistics costs of white shrimp farming in Thailand. In Proceedings of the 48th Kasetsart University Annual Conference. 2010; 3-5 March.

[4] Stępień, M., Łęgowik-Świącik, S., Skibińska, W., & Turek, I. Identification and Measurement of Logistics Cost Parameters in the Company. Transportation Research Procedia. 2016; 16: 490-497.

[5] Christopher, M. Logistics & supply chain management. UK: Pearson Prentice Hall; 2016.

[6] Ongkunaruk, P., & Piyakarn, C. Logistics cost structure for mangosteen farmers in Thailand. Systems Engineering Procedia. 2011; 2: 40-48.

[7] Department of Fisheries in Nakhon Pathom Province. 2016.

[8] Yamane, T. Statistics: an introductory analysis. NY: Harper and Row; 1973.

[9] Cronbach, L. J. My current thoughts on coefficient alpha and successor procedures. Educational and Psychological Measurement. 2004; 64(3): 391-418.

Developing Intrinsic Reward System in Digital Era of Chandrakasem Rajabhat University: Discursive Practice to Social Reproduction

Chonticha Tippratum[1,*]

[1] Faculty of Management Science Chandrakasem Rajabhat University

Abstract

This is a qualitative research with the aims to create 1) a discourse on developing intrinsic reward system in digital era of Chandrakasem Rajabhat University and 2) a social reproduction in discursive practice and social practice on developing intrinsic reward system in digital era of Chandrakasem Rajabhat University by using the discourse analysis of Norman Fairclough. The key informants are 19 managements in Chandrakasem Rajabhat University and using purposive and snowball techniques. The data was collected by in-depth interviews and analyst from text, discursive practice and social practice.

The findings revealed that a University focused on encouraging process of employee's intrinsic reward via an empowerment both formal and informal practice, which based on using social media that under a supervision of a University. In addition to a University allow to the related department to data screening before disseminating to social context to build a credibility on data and recognize to people. All these bring a University to have a solid to retain a human resource in extremely competition on education industry.

Keywords: Intrinsic Reward System, Digital Era, Discursive Practice, Social Reproduction

1. Introduction

During a dynamic changing on conceptual paradigm in digital era, technology is a key role in all process, many problems has to be addressed in order to closed a human gap such as inconsistent problem between the factor that employees need and the factor that offer by organization which related with social exchange theory. [1-2] So, many organizations try to using an efficiency tools of sustainable human resource management. Since nowadays, a human thinking leads by technology, hence a human need to learn and develop themselves for having a necessary skill, feature with a capability needed to cope with the actual fast changing, but at the same time, data - rich environment. [3] Using technology wisely become to the key success factor and affect to human resource management process in digital era. Because, the human can perceive data and information from online social media which convenient and faster than before. So, an empowerment by using a technology intelligently to approach required information are important that human desire. Whenever they satisfied on the empowerment, then they will tend to perceive an intrinsic reward which is a tool of decreasing an attrition rate. [4]

All of these, it is can be clearly seen that all organization need a develop their intrinsic reward system through an empowerment process because, nowadays the human needs more money or other incentives that stimulate them only in short time. Intrinsic reward is an important alternative to fixed challenges gap, because when an employee perceives this kind of reward, a workplace will become like a second house and colleague as a family [5] also as a key factor to make employee have well-being. [6]

Accordingly, to make an understanding on phenomenon required interpretation deeply and sharply, led to the application of the intrinsic reward system in digital era tangibly need an experienced and expert people to disclose their perspectives. In order to open the social space, a qualitative research used by discourse analysis led to discursive practice and social practice.

2. Research objectives

2.1 To study a discourse on developing intrinsic reward system in digital era of Chandrakasem Rajabhat University.

* Corresponding author; e-mail: aj.chonticha@gmail.com

2.2 To study a social reproduction in discursive practice and social practice on developing intrinsic reward system in digital era of Chandrakasem Rajabhat University.

3. Methods

3.1 Research design

This is a qualitative research by using a discourse analysis method of Norman Fairclough [7] including text, discursive practice and social practice. To build a discursive practice for social reproduction of intrinsic reward system in digital era through in-depth interview.

3.2 Research Area

1) The content framework, to get to understand the intrinsic reward system in digital era which able to divide to be 4 factors as per Tippratum [4,8] Tymon, Stumpf and Doh [9] stated follows;

1.1) Meaningfulness, this reward involves the meaningfulness or importance of the purpose that employee are trying to fulfill, they feel have an opportunity to accomplish something of real value.

1.2) Competence, this reward involves encouraging their efforts are really accomplishing something and they see convincing signs that things are working out, giving they confidence in the choices they have made and confidence in the future.

1.3) Recognition and praise, this reward involves they get the recognition in performance as well as receive the praise in their ability from colleagues, supervisors and others openly or give award to represents a success. As a result, they feel a sense of satisfaction and pride as well as make them have self - confidence in the future.

1.4) Achievement, this reward involves they working had achieved and succeed in working objective and they feel accomplish, ownership and responsibility in their work including believe in the approach they are used.

2) The area frameworks, the researcher studied with junior management to top management in Chandrakasem Rajabhut University who have experiences and expertise in human resource management and understand of essence in human needs in bureaucratic structures as well.

3) Timing framework, the researcher collects the data between May to July 2017.

3.3 Key informants and theoretical sampling

The researcher select the key informants and theoretical sampling by consistency and relationship with research objective total 19 persons, focus on since junior management to top management that working in Chandrakasem Rajabhat University who have experiences and expertise in human resource management. the researcher selects a sampling by purposively which based on logically and reasonably.

3.4 Research instruments

The researcher prepares the research questions guideline by use semi-structured interview which classified as 3 sessions: text, discursive practice and social practice about intrinsic reward system in digital era, which each sessions has contains the questions about; 1) the meaning of intrinsic reward, 2) the elements of intrinsic reward, 3) the influent factors to make the employee receive intrinsic reward, 4) how to motivate employees to receive intrinsic reward and 5) how to create a continuation of the practice. In addition the researcher use voice recorder, camera, and review literature to support researcher to get on theoretical sensitivity.

3.5 Data collection

A collecting data include 2 steps follows, 1) literature reviewing and empirical evident to make question guideline and 2) in-depth interview, before interview execution, an interviewing has to get acceptance from key informants before commencing a question to respect the human rights under the 3 basic ethical principles including; informing consent, data confidentiality and prevention of potential effects on data providers. [10]

3.6 Research validation and reliability

The researcher using a data triangulation to validate a data reliability when get a different sources, which mean the difference key informants that have working in Chandrakasem Rajabhat University in junior management to top management position [10] in order to confirm a data are trustable and fond theoretical conclusion.

3.7 Data manipulate and analysis

1) Data manipulate. The research focus on qualitative method from study the patterns and methods by carefully as well as data collection, data manipulate, data analysis and result under selection of appropriate tools to collect data. Which this is a qualitative research by using a discourse analysis method of Norman Fairclough [7] including text, discursive practice and social practice thru strict collection and analysis process as well as systematically interpret and scrutinize. For qualitative research, the researcher is the most important, so

have studied about concept, theory and empirical evident in order to get theoretical sensitivity. Also have built information reliability by data triangulation.

By the way, the researcher use the knowledge from behavioral sciences as a basic for learning verbal and non-verbal in order to understanding and interpreting the data from each phenomenon. However, to make all process for interviewing has are carefully and properly, the research use voice recorder and take photos together. All of these, beginning from creating trust climate and good relationship between interviewer and interviewee without bias and guide under the principle of respect for human rights.

2) Data analysis. The research focus on data analysis plan, because it has effect to theoretical conclusions include; [10-11]

2.1) Data organizing are the step to make the date form in-depth interview has systematic and convenience for accessing and using. By verbatim the data obtained from record while interviewing, after that the researcher will determine coding for classifying all data and group data with the same or similar meaning to the same code.

2.2) Data connection are the step to link each data code to make a group under compatibility theme, which the researcher identify 3 groups of analysis including; text, discursive practice and social practice about intrinsic reward system in digital era. These makes to get concept for describing phenomena at a certain level.

2.3) Integration data into stories are the step to find summary under concept relationship according to empirical data until theoretical saturation in order to create text, discursive practice and social practice of developing intrinsic reward system in digital era of Chandrakasem Rajabhat University.

4. Results and discussion

4.1 Discourse of intrinsic reward system development in digital era of Chandrakasem Rajabhat University

4.1.1 From the analyze text of intrinsic reward system development in digital era of Chandrakasem Rajabhat University found that;

Chandrakasem Rajabhat University has promoted and encouraged the employees to perceive intrinsic reward continuously of all transitions of social and technological systems. Due to a University recognizes an importance of human resource development to valuable person thru self-esteem is a valuable asset, which clearly stated in a University's strategic plan in many eras. But the past might not be clear, because intrinsic rewards are subjective and difficult to understand. The key point is intrinsic reward is difficult to buildup, if the employees haven't feel loyalty to a University truly.

An antecedent that a University focused on developing intrinsic reward system, because a University recognize that human resources are mainspring to drive vision's University. Even in digital era that all social context emphasizes to use technology as a guide in moving forward. However, technology will have efficiency when human have a knowledge, understanding and readiness to use. Consequently, if human resources got a hegemony by technology, morale must be retreated. So, a key of stimulating intrinsic reward's employees under acceptance the humanity's value in the world of rapid technological change is the empowerment both formal and informal types for accessing to necessary information and promote to be leader.

Attributed to rapid changes in digital era, the employee with critical skill become a valuable assets that a University needs retention. Especially for employee who has desire on self-demanding than monetary factors which influence to motivate them. As a result, motivation, attraction, and retention them by extrinsic reward such as money and fringe benefits for encouraging efforts and decrease dis-satisfaction, may not be sufficient and sustainable. Because an employee will be response to reward only they needed. Therefore, Motivating by intrinsic rewards are increasingly important in human resources management process, by reason of it's contributes to retention efficient employees as well as decrease intention rate. Accordingly, a University focused on support employees to receive intrinsic reward, classified into 5 factors according to priority as follow;

1) Sense of recognition; A University recognize in skills and abilities through empowerment by giving a chance to decision in critical work, trust and confident in working as well as support to employee's requirement. Although in practice found that,

> *Somporn (pseudonym) [12] say that "a University operating under bureaucratic structure, accepting some cross-functional employees might be difficult. So, A University is trying to develop recognition system in informal form."*

2) Sense of responsibility; A University contribute employees to have feeling ownership in working style and their output, as well as giving a chance to take responsibility for their results neither positive nor negative.

3) Sense of competency; A University assign a challenge work by matching with their abilities, skills and ex-experiences, for reinforcing them to try and seeking a new method to accomplish their work.

4) Sense of achievement; A University show that if an employee has a dedicate and efforts to a University and they perceive it their physical or mental, they can get desire achievement in short time by using an effective performance appraisal method under standard and transparency although in practice found that,

Sompit (pseudonym) [13] say that "some employees think about performance evaluation system of University without good governance. And the past, a university or some department evaluated under the patronage system. Therefore, a University try to create transparency and add channels to check and monitor.

5) Sense of obligingness; A University create friendly working climate, without abusing both sexual and social status, as well as to discourage inequality climate from some employees with a superior social class.

It's can be clearly seen that text of intrinsic reward system in digital era can divide to 2 parts which related to each other. In other words, intrinsic reward system in digital era is strengthened when a University have the empowerment to the employees.

4.1.2 From the analyze discursive practice of intrinsic reward system development in digital era of Chandrakasem Rajabhat University found that;

Key issues that motivate employees to perceive on intrinsic reward under rapidly changing of technology is an empowerment both formal and informal, which a university must create the empowerment from the curriculum, faculty up to institutional levels. Especially, leader of all unit has to uphold in same direction and vision, that is "human resources are important mechanism to propel a University along with the way to use ingeniously technology." Accordingly, each unit has to create social space for showing employee's potential and use social media as a channel for accessing data and information as well as sharing a necessary knowledge from person to person. Which a University have insinuate that;

Somrak (pseudonym) [14] say that "technology is important, people are the same. If one is missing, it's like a car without a battery."

For discursive practice of intrinsic reward system development in digital era of Chandrakasem Rajabhat University has totally 5 factors as follow;

1) Sense of recognition's discursive practice; A University acknowledge in skill and ability of employees through decision empowerment in formal type, such as delegation of authority by appoint them to be a committee in each project and informal type, such as delegation to leader in some situation or special assignment over routine as well as other work that a University assigned. In addition to a University also promote recognition and praise in employee's efficacy by research or project contests etc. The reason to do this because a University wants to honor employees that have ability and make creative until manifested, via social media created by a University, because it's widest and most rapidly spreading news in present.

2) Sense of responsibility's discursive practice; A University use an empowerment via delegation and accountability by clearly which each employee has empirical of ownership such as an appointment order or document record that has been published in a University's information system. These, to build a feeling of ownership including other employees perceive a scope of other's responsibility. However, they have to accept when they do a good work, in turn, they have to confess when their work has a problems or obstacles.

3) Sense of competency's discursive practice; A University analyze a capability of employees systematically on basic knowledge and experience accumulated throughout working experience, for assigning more challenging works. All this will lead to new method and working approach which is called "best practice" that can be transmitted to others to be a guideline for a similar operation. A University would select a knowledge management tools as a channel for empowering to employees to publish their best practice via University's social media, to help everybody can access and absorption best practice for adapting by quickly and easily. As mentioned;

Sombat (pseudonym) [15] "the employees do not be like a Sled horse that have a cover on his eyes then see only way ahead. Because, they have to learn a new knowledge from internal people. Due to those people working under same environment, problem and politic, therefore, knowledge from people to people is valued and as a treasure."

4) Sense of achievement's discursive practice; A University transform a performance evaluation system of civil servants and university staff in order to evaluate under a same criteria. Because, a University want to empower in equality and decrease social status disparity, which chronic problem in Thai public sector for a long time. As a result, most of university staff has not feel a exploited from civil servants. In addition, a University has open the chance to lecturer can use social network or electronic media in teaching then a University able to use these new teaching methods to be part of performance evaluation, forasmuch in this era, classroom must be more than a classroom and lecturer are the same. Attributed to a University create a transparency under a good governance policy which always state in a master plan, by meeting and communicate all process in evaluation system and criteria to contribute employees with insight and pride in their own evaluation results.

5) Sense of obligingness's discursive practice; A University use an empowerment in managing to all gender, especially "transgender". Due to a University want to open the social space to some talented get a chance for promoting to executive positions without gender border as before that they use to have abused hegemony because of different in gender and physical, Include a University develop a mentor system between seniors and junior both academic and general living as well as data publishing by Social network such as Line or Facebook to create a family climate within a University.

4.2 Social reproduction in discursive practice and social practice of intrinsic reward system development in digital era of Chandrakasem Rajabhat University.

From social practice analyze found that, intrinsic reward system in digital era of Chandrakasem Rajabhat University has efficiency since a key success factor is "empowerment" both formal and informal types. Which a University selected one faculty with best empowerment model for creating intrinsic reward to become best practice to other faculty and department, to demonstrate substantial method of decentralization system and power transfer to employees in bureaucratic structure. From this best practice can be apply and support an employees to participate in manage and decision about important work as well as routine responsibilities which all related with a management on good governance principle.

Nowadays, a competitive in education industrial has surge both a number of students down and moving employees to new organization. So, the employees retention by intrinsic reward thru empowerment process thus becoming the important factor because its make employees loyalty in long-term than other factor. Attributed to a University use learning from generation to generation under clan control to decrease an employee attrition rate in a University.

Intrinsic reward system in digital era thru empowerment process leads to successful by using a network and communication within University both from people to people and network to people, which all way have similar speed of information distribution and output but different on a width of results, In other words, when a University has a formal empowering to employees, they will use communication channel thru internal network in order to get a width of results and understanding in same direction. In turn, when the University use an informal empowering, they will have a stimulate to viral communication between people to people and group to group in order to get acceptance from each other before social acceptance.

This study of intrinsic reward system development in digital era of Chandrakasem Rajabhat University: discursive practice to social reproduction show that, text can encourage and support employees to perceive an intrinsic reward successfully in all social system and technology paradigm inasmuch as a University recognize on an important of human resource development to create valued people which clearly stated in the strategic plan of a university in several eras. Hence in digital era, a University focused on using a technology as a guide for moving forward thru empowerment both formal and informal types, consistent with the research results of Tippratum [4] found that an empowerment is a key success factor for creating employee's intrinsic reward, due to they will have a feeling self-value and important enough to get a trust for decision making in necessary work as same as a finding from Li *et al*. [16] Meng *et al*. [17] found that the employees feel proud in power and use correctly when they received in right way, its link to increase their performance because they working under willingness that without compulsion.

From text, it's can be clearly seen that when the employees perceived all 5-intrinsic reward including; sense of recognition, sense of responsibility, sense of competency, sense of competency and sense of obligingness which align with a research of Tippratum [4,8] Tymon, Stumpf, and Doh [9] found a same result and suggestions state that an employees will build a mental power by themselves, without compulsion or offer monetary incentives.

Discursive practice of intrinsic reward system of a University depends on foundation of the empowerment in all types, by using social media under a University's oversight as a mechanism to publish to all context. Because, this method driving a quick acceptance, efficiency and reliability. By the way, various data and information will be screening from public relations department of a University before online published. Consistent

with the research of Hill, Betts and Gardner [18] found that, digital technology serving as a tools to empowerment and people use digital technology to empower themselves and protect them from the negative effects of the digital divide, it's can be clearly seen that the empowerment is the best thing in all era, as seen from research of Wahid *et al.* [19] found that building capacity at local level is an important ingredient for sustainable development, as it not only provides local stakeholders with an opportunity to participate in decision-making, but also enables "community ownership", a key component of empowerment. Therefore, a University support the empowerment concept in work process to all level of employees in order to create substantial intrinsic reward.

5. Conclusions

Discourse of developing intrinsic reward system in digital era have a clear blueprint and can apply for retention employees which are a key mechanism to drive a University. All concept are depend on systematic thinking Somsri (pseudonym) [20] say that "the employees are member of our family. So, insider have to receive privilege before outsider." These things help to build enormously employee's morale. However, a retreat and intense competition in education industry decrease a number of students which is necessary problem to keeping stay in top rank of Rajabhat University as in the past, so, to stimulate an employee to have a loyalty to a University by creating intrinsic reward may not be enough because these employees should be talented who can makes a competitive advantage to a University. Therefore, in the future, a University should develop suitable intrinsic reward system with high potential successor, As mentioned;

Somrak (pseudonym) [14] say that "all of paradigm shift of human resource management, good people are not enough, must be talented to be winner"

Acknowledgements

This paper are based on many research and empirical evident as well as received good cooperation from 15 key informants that working on Chandrakasem Rajabhat University. Especially, the researcher obtained encouragement from the family, friends that support to create this research paper which continue from my thesis in doctoral degree.

References

[1] Cropanzano R. Mitchell MS. Social exchange theory: an interdisciplinary review. Journal of Management. 2005; 31(6): 874-900.
[2] Elstad E, Christophersen KA, Turmo A. Social exchange theory as an explanation of organizational citizenship behaviour among teachers. International Journal of Leadership in Education; 14(4): 405-421.
[3] Orlandi LB. Organizational capabilities in the digital era: Reframing strategic orientation. Journal of Innovation & Knowledge. 2016; 1: 156-161.
[4] Tippratum C. Intrinsic reward of retirees: study for grounded theory. Proceeding The 41st National and 5th International Graduate Research Conference Valaya Alongkorn Rajabhat University under the Rayal Patronahe. 2016; 45-56.
[5] Tippratum C. Organizational Behavior. Bangkok: Faculty of Management Sciences, Chandrakasem Rajabhat University; 2015.
[6] Robertson I, Cooper C. Well-Being; Productivity and Happiness at Work. London: Palgrave Macmillan; 2011.
[7] Fairclough N. Discourse and social change. Oxford: Polity. 1999.
[8] Tippratum C. Factors of Intrinsic reward in Chandrakasem Rajabhat University. Proceeding National Graduate Research Conference Eastern Asia University. 2017; 167-168.
[9] Tymon WG Jr, Stumpf SA, Doh JP. Exploring talent management in India: the neglected role of intrinsic rewards. Journal of World Business. 2010; 45(2): 109-121.
[10] Podhisita C. Science and art of qualitative research. 6st ed. Bangkok: Amarin Printing & Publishing Public Co., Ltd. 2013.
[11] Creswell JW. Qualitative research inquiry and research design: Choosing among five approach. 2nd ed. California: Sega Publication, Inc. 2007.
[12] Somporn (pseudonym) (key informant). Tippratum C. (Interviewer). June, 20th 2017.
[13] Sompit (pseudonym) (key informant). Tippratum C. (Interviewer). June, 24th 2017.
[14] Somrak (pseudonym) (key informant). Tippratum C. (Interviewer). July, 2nd 2017.
[15] Sombat (pseudonym) (key informant). Tippratum C. (Interviewer). July, 15th 2017.
[16] Li Y. et al. Locus of control, psychological empowerment and intrinsic motivation relation to performance. Journal of Managerial Psychology. 2015; 30(4): 422-438.

[17] Meng Y. et al. Supervisors' leadership and health science searchers' intrinsic motivation. Nankai Business Review International. 2015; 6(1): 68-81.
[18] Hill R, Betts LR, Gardner SE. Older adults' experiences and perceptions of digital technology: (Dis) empowerment, wellbeing, and inclusion. Computers in Human Behavior. 2015; 48: 415-423.
[19] Wahid A. et al. Barriers to empowerment: Assessment of community-led local development organizations in Pakistan. Renewable and Sustainable Energy Reviews. 2017; 74: 1361-1370.
[20] Somsri (pseudonym) (key informant). Tippratum C. (Interviewer). July, 17th 2017.

The Academic and Vocational Service Model of Institute Vocational Education of Bangkok in Thailand

Chantana Potikruprasert[1,*], Pariyaporn Tungkunanan[2]
and Siripan Choomnoom[3]

[1]Educational Administration, Industrial Education and technology Faculty,
King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand
[2]Asssociated Professor, Industrial Education and technology Faculty,
King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand
[3] Retired Government Officials
Department of Industrial Education, Faculty of Industrial Education
King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand, Thailand

Abstract

The aim of this research to educate the Academic and Vocational Service Model of Institute Vocational Education of Bangkok in Thailand. The researcher used the Documentary research method. The research result were found that the Academic and Vocational Service Model of Institute Vocational Education of Bangkok in Thailand consisted of 3 parts, 1) there are six categories of academic services as following; Examination and analysis, To advise about the academic and learning, Organization of training, meeting and seminar, To set machinery and equipment, Research service, and Maintenance service. 2) The five factors of academic service learning principles as follows: The principle of trustworthiness, the principle of confidence, the principle of instant response, the principle of regard, and the principle of objectiveness. And 3) The Academic Services-Learning Procedure are as following: To survey demand of the community, To plan academic service-learning and profession, To follow the academic service- learning and profession plan, To monitor and evaluate, To develop the academic service, and To disseminate knowledge to community and public.

Keywords: Academic and Vocational Service Model, Academic Service, Institute Vocational Education of Bangkok

1. Introduction

Service learning is a teaching and learning strategy that integrates meaningful community service with instruction and reflection to enrich the learning experience, teach civic responsibility, and strengthen communities[1].

The academic service-learning is a main mission of Higher education institutions, in order to develop the community and society permanently. Institute should serve the academic to the community, society and the country in many categories. Moreover, effective institute should provide free academic service or with reasonable fee. The institute should serve both public and private sections, public and private organization, community and society. The academic service is not only useful for the society, but the institute itself gets advantages from many ways. For example, the institute can increase knowledge and experience of the lecturer,

Then they can improve course, integrate the knowledge in teaching management and research, and develop the academic position of the lecturer. In addition, the institute can create network with other organization, which can be job source of the student. The institute itself can gain income from academic service as it is specified in the vocational reform that nine elements must be reformed; 1) quality of learner, course and vocational learning, 2) image and vocational values, 3) education standard, 4) cooperation with enterprise, 5) ICT for vocational education, 6) learner increasing, 7) to produce and develop lecturer, 8) Financial system and vocational education budget, and 9) vocational education structure/ decentralization/ area based [2].

To develop the community to be strong, the government or the concerned have to seriously support learning of the community because effective learning guide the people how to solve the problem in their daily life and can develop the community continuously. Moreover, the local wisdom will be supported and the results will be extended.

*Corresponding author; e-mail: 54630164@kmitl.ac.th

The policy of the Institute of Vocational Education shows that the academic service-learning is very important as it is issued in the Vocational Education Act BE 2551. However, variety and category of the academic service-learning is still not be designed. Therefore, it is very interesting to study variety and category of the academic service-learning of the Institute of Vocational Education of Bangkok in Thailand, in order to be guideline for proper management of the academic service-learning, and develop life quality of the community. Then, the people can stay on their own and live happily. Therefore the researcher interested to create the Academic and Vocational Service Model of Institute Vocational Education of Bangkok in Thailand.

2. Research objective

To design the Academic and Vocational Service Model of Institute Vocational Education of Bangkok in Thailand

3. Materials and methods

The researchers use the documentary research method followed on the theory of Scott [16] with the use of primary and secondary materials, the researchers assessed and analyze the documents ourselves before extracting content. Appraising documents typically includes four criteria: authenticity, credibility, representativeness, and meaning.

The researchers educate the Academic and Vocational Service Model of Institute Vocational Education of Bangkok in Thailand. Researchers studied 3 parts contains of the first idea was the conceptual were the ideal from academic service of the Institute of Vocational Education of Bangkok. The second was the concept about the service principles in academic service learning principles in the Institute of Vocational Education, Bangkok, and the third was The Concept about the Academic Services - Learning Procedure.

A. The conceptual were the ideal about the academic service from the universitys in Thailand as follows: 1) King Mongkut's University of Technology Thonburi[3] 2) King Mongkut's Institute of Technology Ladkrabang [4] 3) Maejo University [5] 4) Rajamangala University of Technology Thanyaburi [6] 5) Kasetsart University Kamphaengsaen Campus [7] 6) King Mongkut's University of Technology North Bangkok [8] 7) The Office of Vocational Education Commission [2] and 8)Prince of Songkla University [9]. In order to find the concept about variety of academic services of the Institute of Vocational Education of Bangkok under the OVEC, there are many concepts from many Institutes were studied as the following.

1. King Mongkut's University of Technology Thonburi [4] specified concept about variety of academic service-learning in four categories.

1.1 Examination and analysis
1.2 Advice about the academic
1.3 Organization of training, meeting and seminar
1.4 To design and set up the machinery and equipment

2. King Mongkut's Institute of Technology Ladkrabang [5] specified concept about variety of academic service-learning in six categories.

2.1 Examination and analysis
2.2 Advice about the academic and researches
2.3 Research service
2.4 To design and set up the machinery and equipment
2.5 To design, calculate and sketch
2.6 Organization of training, meeting and seminar

3. Maejo University [6] specified concept about variety of academic services in three categories.

3.1 Making a study trip, training, discussion and workshop
3.2 Tools and equipment, place, educational information technology service
3.3 Advice about the academic, technique, profession and information

4. Rajamangala University of Technology Thanyaburi [7] has concept of creative academic service for self-employed and profession, in order to increase the competitive quality. The service consists of three categories.

4.1 Organization of training
4.2 Demonstration and practicing
4.3 To advise

5. The concept of academic service of Kasetsart University Kamphaengsaen Campus [8] consist of four categories.

5.1 Making a study trip
5.2 Job training

5.3 Training
5.4 Research service

6. The concept of academic service-learning of King Mongkut's University of Technology North Bangkok [9], in which there are six institutes; Institute of Technological Development for Industry (ITDI), Thai-French Innovation Institute, Institutes of Computer and Information Technology (ICIT), Thai –German Dual Education and e-learning Development Institute (TGDE), Institute of Science and Technology, and Institute of Technical Education Development (ITED), consist of six categories.

6.1 Training and seminar
6.2 Examination and Monitoring
6.3 Research service
6.4 Academic and learning service
6.5 Data base service
6.6 Location service

7. The Office of Vocational Education Commission [2] specified the concept of academic service-learning as following.

7.1 To advise the academic and learning
7.2 Training, meeting and seminar
7.3 To provide community welfare
7.4 Maintenance service
7.5 Development of technology and innovation

8. Prince of Songkla University [10] specified variety of the concept of academic service-learning as following.

8.1 Analysis, examination, monitoring and maintenance service
8.2 Health service
8.3 Organization of training, seminar and workshop
8.4 To study, research, analyze, and design assessment
8.5 To advise and suggest
8.6 Information and translation service
8.7 Other services

The concept of academic service of the Institute of Vocational Education of Bangkok in Thailand was analyzed, it can be synthesized that there are six categories of academic services, considering only the choices with frequencies of three or up, there are six academic services as following.

1. Examination and analysis
2. To advise about the academic and learning
3. Organization of training, meeting and seminar
4. To set machinery and equipment
5. Research service
6. Maintenance service.

B. The concepts of service principles from 1) Wittaya Danthamrongkun [10] 2) Jittinan Nantapaiboon [11] 3) Pisit Pipatpokakun [12], and 4) Berry, Zeithamal and Parasuraman [13]. The ideal as defined by organizations, academicians, and researchers were studied and then synthesized. considering only the choices with frequencies of three or up, there are six of service principles as following. It was concluded that there were 5 a factors of academic service learning principles in the Institute of Vocational Education, Bangkok, as follows:

1. The principle of trustworthiness;
2. The principle of confidence;
3. The principle of instant response;
4. The principle of regard, and
5. The principle of objectiveness.

The detail of academic service learning principles in the Institute of Vocational Education, Bangkok, as follows:

1.The principle of trustworthiness means the knowledge and ability of the academic and professional service providers to the recipient properly , Polite and friendly

2. The principle of confidence means the confidence in the academic and professional services that to provide the exact service with integrity which is respond to the needs.

3. The principle of instant response Means the readiness of the potential personnel that response for the requirement of customers in a timely manner.

4. The principle of regard means being courteous, willing to pay attention to the needs of the academic and professional service providers with consistently, benefit of the recipient.

5. The principle of objectiveness means materiality, quality of service. There are location, equipment, materials and personnel, and enables the service provider to recognize that the service provider is willing to serve.

C. The Concept about the Academic Services-Learning Procedure from many institute and researchers. There are 1) Lampang Rajabhat University [14] 2) Office of Vocational Education Commission [2], and 3) Thammasat University [15], as following:

1. Lampang Rajabhat University [14] specified the Academic Services-Learning Procedure as following.

1.1. To survey demand in the community
1.2. To plan academic service-learning and profession
1.3. To follow the academic service-learning and profession plan
1.4. To monitor and evaluate
1.5. To integrate academic knowledge
1.6. To develop the academic service
1.7. To disseminate knowledge
1.8.To conclude, evaluate success, and to report

2. Office of Vocational Education Commission [2] specified the Academic Services-Learning Procedure as following.

2.1. To follow the academic service-learning and profession plan
2.2. To disseminate knowledge
2.3 To appoint committees for academic service-learning
2.4 To hold meetings for academic service-learning frameworks of own institutes
2.5 To make operation handbooks for users

3. Thammasat University [15] specified the Academic Services-Learning Procedure as following.

3.1. To survey demand in the community
3.2. To plan academic service-learning and profession
3.3. To follow the academic service-learning and profession plan
3.4. To monitor and evaluate
3.5. To develop the academic service
3.6 To disseminate knowledge

Considering only the choices with frequencies of three or up, there are six academic service-learning procedures, as follows:

1. To survey demand in the community;
2. To plan academic service-learning and profession;
3. To follow academic service- learning and profession planning;
4. To monitor and evaluate;
5. To develop academic service, and
6. To disseminate knowledge to the community and the public.

4. Results

The result in the academic and vocational service model of institute vocational education of Bangkok in Thailand as shown in the Figure 1.

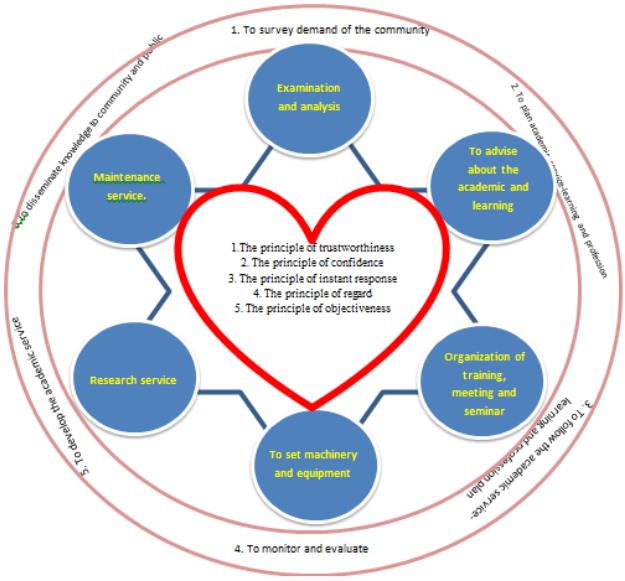


Figure 1. The academic and vocational service model of institute vocational education of Bangkok in Thailand

From the Figure 1 that found the academic and vocational service model of institute vocational education of Bangkok in Thailand as follow:

A. The concept of academic service of the Institute of Vocational Education of Bangkok in Thailand was analyzed, it can be synthesized that there are six categories of academic services as following.

1. Examination and analysis means systematic measurement by using scientific learning processes. This interpret classification into categories to visualize the relationships of different parts. This is tell about the amount, quantity and quality of the test or analysis.

2. To advise about the academic and learning means the process of educating people about education and careers through the use of educational media content and practice to changed idea , attitude, and behavior about the that thing.

3. Organization of training, meeting and seminar means the gathering of people for exchanged knowledge or find a solution by using Knowledge, Understanding, Skill, and Attitude of individuals to create new guidelines for work effectively.

4. To set machinery and equipment means the allocation of location, location, machinery, equipment, personnel equipment to be appropriate, safe and effective.

5. Research service means the implementation of the knowledge to undertake various research projects that can be useful to achieved the needs. This is for the public and private sectors, the community or bring the research results to the development of knowledge, skills, new projects to the community.

6. Maintenance service means treatment and rehabilitation for the device is available every time, with the most flexibility and speed.

B. The Concepts of service principles of the Institute of Vocational Education of Bangkok in Thailand as follows:.

1.The principle of trustworthiness means the knowledge and ability of the academic and professional service providers to the recipient properly , Polite and friendly

2. The principle of confidence means the confidence in the academic and professional services that to provide the exact service with integrity which is respond to the needs.

3. The principle of instant response Means the readiness of the potential personnel that response for the requirement of customers in a timely manner.

4. The principle of regard means being courteous, willing to pay attention to the needs of the academic and professional service providers with consistently, benefit of the recipient.

5. The principle of objectiveness means materiality, quality of service. There are location, equipment, materials and personnel, and enables the service provider to recognize that the service provider is willing to serve.

C. The Concept about the Academic Services-Learning Procedure of the Institute of Vocational Education of Bangkok in Thailand are as following.

1.To survey demand of the community means identify the academic and professional services to the community by setting a success indicator based on the basic needs of the community, the project is designed to benefit for the community.

2.To plan academic service-learning and profession means the implementation of a survey of the requirements of the social community to set the goals and indicators for providing services that are responsive to the capacity and readiness of the quality service.

3.To follow the academic service- learning and profession plan action follow on the plan by think about the benefit of community.

4.To monitor and evaluate means the process of controlling the collection of data at the beginning and during the provision of academic and professional services by checking the plan. Collected information for analyzing and evaluating the value of academic and professional services.

5.To develop the academic service means apply the evaluation results to improve the quality of academic and professional services in terms of personnel, facilities, materials, equipment and processes, to better serve academic and professional services for the service recipients are more satisfied.

6.To disseminate knowledge to community and public means the transfer of knowledge resulting from academic and professional services and to personnel within the organization via the public through various media, such as organizing meetings, publishing leaflets, brochures, websites and so on, to strengthen the local community and the benefit of the public.

The academic and vocational service model will be useful for institute vocational education of Bangkok in Thailand to service management for community and guideline for effective development of happy life quality and self-reliance in the community.

5. Conclusions and discussion

The Academic and Vocational Service Model of Institute Vocational Education of Bangkok in Thailand were comprised; The research result were found that the Academic and Vocational Service Model of Institute Vocational Education of Bangkok in Thailand consisted of 3 parts, 1) there are six categories of academic services as following; Examination and analysis, To advise about the academic and learning, Organization of training, meeting and seminar, To set machinery and equipment, Research service, and Maintenance service. 2) The five factors of academic service learning principles as follows: The principle of trustworthiness, The principle of confidence, The principle of instant response, The principle of regard, and The principle of objectiveness. and 3) The Academic Services-Learning Procedure are as following: To survey demand of the community, To plan academic service-learning and profession, To follow the academic service- learning and profession plan, To monitor and evaluate, To develop the academic service, and To disseminate knowledge to community and public. This result consistent with the research of Latib, Azlan Abdul, and others [17] that studied about Impact of a Service Learning Program to the University and the Community The findings show that SL played a significant role towards students' skills development, especially in communication, leadership and other soft skills. Apart from enhancing students' skills development, SL also helped to increase positive images of the universities and, at the same time, to show the universities' role as an agent for social change. As for society, the benefits that people could gain from SL were related to technology transfer, expertise and socio-economic improvement.

This is also related with Maznah, Hj Ibrahim, and others [18] that stated integrating service learning in a liberal education course. Service learning is a teaching pedagogy that combines meaningful community service with academic instruction because Service learning project enriches students' experiences by involving them in community service activities and relating those experiences to their academic and personal development.

Acknowledgements

I would like to express my sincere thanks to Assoc. Prof.Dr.Pariyaporn Tungkunanan and Dr.Siripan Choomnoom for their invaluable help and constant encouragement to me. In addition, I am grateful for the special expert and others person for suggestions and all their help.

References

[1] Office of Civic Engagement & Service Learning . Definition of Service Learning. http://www.uncfsu.edu/civic-engagement/service-learning/definition-of-service-learning. Retrieved on August 19, 2017.

[2] Office of the Vocational Education Commission. Policy and Strategy for Education Reform in Vocational Education Development. [Online] Retrieved on December 15, 2015, from www.vec.go.th. 2015.

[3] King Mongkut's University of Technology Thonburi. Regulation of King Mongkut's University of

Technology Thonburi on payment for hire and service. (No. 2) 2008.
[4] King Mongkut's Institute of Technology Ladkrabang. Institute of Technology King Mongkut's Institute of Technology Ladkrabang With the income of the Office of Promotion and Academic Services. 2009.
[5] Maejo University. Research Report "Education needs of the surrounding community." Academic service Of the Faculty of Agriculture, Mae Jo University " Faculty of Agriculture, Mae Jo University. 2012.
[6] Rajamangala University of Technology Thanyaburi. Strategic Development Agenda, Rajamangala University of Technology Thanyaburi, 2014 - 2017. Policy and Strategic Plan Policy and Planning Division, Rajamangala University of Technology Thanyaburi. Retrieved on August 15, 2016.
[7] Kasetsart University Kamphaengsaen Campus. Self Assessment Report Academic year 2014. Kasetsart University. Kamphaeng Saen Campus. 2014.
[8] King Mongkut's University of Technology North Bangkok. Academic service Learning. [Online] Retrieved on December 15, 2015, from https://www.kmutnb.ac.th. 2016.
[9] Prince of Songkla University. Academic service to the community. [Online] Retrieved on October 21, 2015, from https:// www.psu.ac.th. 2008.
[10] Wittaya Danthamrongkun. The Heart of Service. Bangkok : SE-EDUCATION Public Company Limited.2004.
[11] Jittinan Nantapaiboon. Service Psychology . Bangkok : SE-EDUCATION Public Company Limited.2008.
[12] Pisit Pipatpokakun. Service to the heart ... everyone come back. Bangkok : Thailand Productivity Institute. 2008.
[13] Berry, Leonard L., Valarie A. Zeithamal, and A. Parasuraman. “Five Imperatives for Improving Service Quality. “Sloan Management Review. 31. (1990) : 29 – 38.1990.
[14] Lampang Rajabhat University Faculty of Education. Academic Services Manual. Retrieved on August 10, 2016.
[15] Thammasat University. Academic Service Manual for Institutional Society Board of Social. http://sras.tu.ac.th/images/phocagallery/service_society/manaul_all.pdf Retrieved on November 11, 2016.
[16] Scott, J. P. (Ed.). Documentary research. Thousand Oaks, CA: Sage Publications. 2006.
[17] Latib, Azlan Abdul; Amin, Nor Fadila; Saud, Muhammad Sukri; Kamin, Yusri. Impact of a Service Learning Program to the University and the Community. Advanced Science Letters, Volume 23, Number 1, January 2017, pp. 596-599(4) DOI: https://doi.org/10.1166/asl.2017.7268
[18] Maznah, Hj Ibrahim; Adi, Irfan Che-Ani; Afian, Mohd Yusof Nor; Khaidzir, Hj Ismail. Decide and Recycle—Service Learning in Liberal Education Course. Advanced Science Letters, Volume 21, Number 7, July 2015, pp. 2289-2292(4)DOI: https://doi.org/10.1166/asl.2015.6329

Community Welfare: Welfare with a Cultural Background

Jirachaya Jeawkok[1,*], Wanchai Dhammasaccakarn[2], Kasetchai Laeheem[2] and Preedee Shoteshong[3]

[1] Human and Social Development department, Faculty of Liberal Arts, Prince of Songkla University, Hat Yai, Songkhla, Thailand 90112

[2] Human and Social Development department, Faculty of Liberal Arts, Prince of Songkla University, Hat Yai, Songkhla, Thailand 90112

[3] Political Development Council, Chaengwattana Road, Thung Song Hong, Chaengwattana Road, Laksi, Bangkok 10210

Abstract

This qualitative study aimed to describe the phenomenon community welfare with a cultural background of fishermen on the Andaman coast in southern Thailand. The study performed through intensive interview as well as observation with both local community welfare receivers and non-receivers in total 16 key informants. The study results were analyzed, classified, encoded, interpreted and compiled to describe the data. The study found that the Community welfare is the management of a community's natural resources with the focus on culture. It guarantees that the community can dictate its own quality way of life. Community members should feel safe, with regards to their lives and properties, education, health, shelter, work and income, administration of justice, and social service. These may be in the forms of things, money, or gratitude. It concerns life from the moment of birth until death.

Keywords: Community Welfare, Cultural Background, Fishermen

1. Introduction

"…In developing a country, one must follow certain steps. First, one must lay the foundation, which is sufficiency in having, eating, and using for the majority of the population, and by using equipment that is not costly but accurate by its principles. Having laid a firm foundation which is adequately ready and practical, one then builds the prosperity and economic status at a higher level respectively…" *[1]*

The student would like to respectfully engage the royal guidance of His Majesty King Bhumibol Adulyadej as the preamble to this article, due to his Middle-Path work ethics and approach which accorded with the things that surrounded him and was truly practical. He was conscientious and always inventing new ways for development, focusing on maximum benefits for his people. He was a role model worthy of imitation for living well, in alignment with the approach of community welfare, in which everyone can live together as valued individuals, with dignity, virtues, good quality of life, and capability of self-sufficiency. Therefore, in this article, the student will explain the meaning of social welfare, the approach to community welfare management, the forms

* Corresponding author; e-mail: jk.jirachaya@gmail.com

of community welfare management, the difference between community welfare and social welfare, and "exploding from within" community welfare, which was the work approach of King Bhumibol.

During the past 50 years, developmental effects—development of which is focused on economy and material sophistication—resulted in the degradation of religious beliefs, which had been a spiritual anchor and cultural origin. Relationship amongst community members which have been marked by kindness, goodwill, reliance, and dependability, has now changed from kindness giving into monetary trading. Government agencies are viewed as giving agencies, and therefore villagers must request permission for various projects from them. In addition, the effects of development have diminished the villagers' power in managing their community's natural resources and even in allocating their own agricultural produce. Furthermore, past development has lessened the villagers' capability for sustainable living, for they were led to produce, sell for a lot of money, then spend in order to satisfy their demands. This has caused them to rely on external factors and to lack stability in living, because they are always restricted by outside determinants. Meanwhile, culture is what man has earned through learning, and is a process and product that will forever walk side-by-side with man. However, in utilization of culture, changes and adjustments can be made according to present times and factors, but still with the same objective; that is, to help humans live well physically, mentally, emotionally, socially, and spiritually. Thus, this equates to utilizing the fruits of knowledge, thoughts, and forms of behaviors. [2]

Thus, the student would like to actualize "explosion from within," the work principle of King Bhumibol, by utilizing community culture—a social capital—for community welfare. If viewed only from the surface, "community welfare" is a guarantee for its members' "live well, eat well, be happy" way of life. However, at its core veracity, underneath the "live well, eat well, be happy" theme lie the relationships of man-and-man and man-and-nature, which are characteristic of village culture. These core values enable happiness living amidst today's social influences that storm for competition.

As explained above, the researcher is interested in studying community welfare : welfare with a cultural background on the Andaman coast in southern Thailand, which promotes community welfare in cultural, facilitates the learning process of community welfare, and exemplifies the community as a stable, prosperous and sustainable community.

2. Purposes

To describe the phenomenon of community welfare with a cultural background of fishermen on the Andaman coast in southern Thailand.

3. Methods

Key informants

Specific selection criteria was employed to provide a group of informants who were able to address the research problem deeply which would be beneficial to the research. The respondents were knowledgeable in the subject area. There were 3 groups in total: 1) villagers and fishermen who receive community welfare 2) Community directors and community welfare providers. 3) Professional leaders and career representatives total 16 key informants.

Content

This study uses the concept of community welfare. The researchers used the Community Welfare of the Community Organizations Development Institute defined community welfare as the creation of guarantee for the confidence of community members, which comprehensively included everything that gave better life to

community members, might it be in the forms of money, gratitude, support, or anything that related to life from birth till death.[3] Researchers use the Cultural Background's Khamhom, R said that welfare pluralism diversifies services according to the culture, custom, beliefs, and values of people in a community. It also gives importance to participation by all parties—individual, private, and public sectors—in servicing the society in alignment with the problems, locations, and groups. It also focuses on work integration according to the readiness and suitability of each location. For this reason, community welfare is similar to welfare pluralism. [4]

Research tools

1. Observations are participatory and not involved. The method of observation of the researcher is to determine the purpose of observation. When the researcher was on the field, observe the context of the general condition of the area and observe the social behavior associated with the research.

2. The interviews were conducted by interviewers in accordance with the researcher's questionnaire based on objectives and interviewed on the issues that occurred during observation. In-depth interviews are used for in-depth interviews. However, contextual interviews may be adapted in area.

Research area

1) Pa Khlok sub-district, Thalang district, Phuket province, 2) LaemSak sub-district, Aow Luk district Krabi province, 3) Tha Kham sub-district, Palian district, Trang province, 4) Tammalung sub-district, Mueang district, Satun province, 5) Khlong Khan sub-district, Takua Thung district, Phang Nga province, 6) KamPun sub-district, Suk Samran district, Ranong province.

Data analysis

Observation and interview were used to gain data. Data were then synthesized, content analyzed to the objectives and the conceptual framework in the study. [5]

4. Results and Discussion

Social Capital and Community Culture Toward "Explosion from Within"

The humans create culture, and culture creates humans, thus the holism of humans is one with culture. Culture has the characteristic of being learned, accumulated, and passed on by humans; it is a process and product that lives alongside humans. If culture is viewed superficially, one cannot reach the true understanding of culture creation's purpose. Therefore, the use of community culture in development will help to create mutual dependency in the man-nature relationship, so that people in the community can be more dependent on inside rather than outside resources. [2]

"Explosion from within" signifies development that focuses on fortifying the people and families in the community, so that they are first ready for development, before stepping out to outside society. It is opposed to bringing development from outside society into the community and villagers, of which many communities are not ready for and cannot adjust accordingly to the changes, thus possibly leading to failures.[6] The developmental process that uses the power of culture is the society's true capital. It is development by people in the community for the community, which is regarded as sustainable development. Issues from key informants are consistent with Boonpanya, B. proposed the concept of the competition-for-resources crisis in today's world. He wrote that the crisis is due to Western social development and discourse by capitalistic sects in many countries, including Thailand. In giving prominence to material possession, competition in trade, and investment, which imply competition for resources, people are turning their backs to the "roots of culture." Many times this course of development prohibits villagers from reaching their resources. Thus, villagers create their own discourse to protect

their leverage power and capital, by their use of local knowledge, thoughts, and environment. This is the "social capital" that builds a holistic network of harmonious relations, whose accumulation over time has turned into shared empathy among people in the community. [7]

Karnjanapan, A. viewed social capital as being critical to today's social development, such as in the areas of social support, charity, opportunity distribution, and rights defense. In raising social funds, one must consider 3 basic principles: (1) Basic approach and vision of Thai welfare, (2) basic approach of autonomous private agencies in Thai society, and (3) approach for supporting autonomous private agencies in their adjustment of roles and relations in order to measure up to changes in modern structure. Social rules and regulations for rewards or compensation and mutual use of benefits are all forms of social capital, which give equal, rightful opportunities to its members in accessing resources. [8] Meanwhile, Issues from key informants 3 topics are consistent with Phrompakping, B asserted that in analyzing social capital, one must do so in tandem with cultural capital. To briefly summarize, social capital is a horizontal and vertical social relationship between individuals, institutions, and organizations, which may be in the forms of individual, group, or network. It includes values and standards that society holds onto the influence the way of life and production method of community families. [9]

In conclusion, community culture can explain the relationships between people in the community, and may be an important factor in encouraging members to collaborate in team work and in reviving community unity, for it is a product created and passed down by the community.

Social Capital and Management of Community Welfare

At the present, in both rural and urban communities, various organizations and groups have been set up, either under government policy or community-established groups, in order to support and sustain their communities [10]. Social capital is included in these networks of organizations, along with standards, values, and mutual understanding in order to effect collaboration in the group and between groups. Meanwhile, Issues from key informants (2017). Groups that are strong will increase their roles to the development of the society; these groups have rules that specify the management of welfare for their members, or the management of activities within the community that benefit the common good. Issues from key informants are consistent with Boonyaratanasunthorn, J. presented an approach to managing community welfare which can be carried out in community development activities with differing details for each community, and can be summarized into 3 points: 1) The manner of fund raising for use in the creation and improvement of work for members of the community by mutual fund accumulation; 2) the manner of development by relying on the community's capability for unity in carrying out economic activities in order to reduce outside exploitation; 3) the manner in establishing an organization that gives support or capital for running activities that resolve community issues completely. The purpose of such establishment is to help those who face hardship as its first step, then after receiving profits, the revenue can be used to manage community welfare, such as medical units to alleviate disaster victims, handicapped individuals, and impoverished elders and children.[11] Furthermore, Organization for economic cooperation and development (2001) additionally announced that social capital will be created at the levels of family, community, company, institution, or agency at the national and regional levels. In general, the approach to social capital relates to the approach to society and population. However, the connection between "trust" and "network" is dependent upon public institutions and organizations.[12]

Moreover, Poshnukul, S. P. studied welfare on the foundation of culture. It derives from the concept of giving value and importance to community culture, and the clash between government, market, and community,

in that outside dependency has been dominated by capitalism and the government. In this matter, a community's indicator of strength is its capability to retain its unique characteristics and determine its own direction. Community is still free to determine its production in order to satisfy the demands of its families and community; and community can still preserve its values system and cultural foundation. In fact, most studies explain that changes in a community's way of life correlate with changes in the economy, especially the production system. Thus, changes in rural areas are clearly evident.[12] Issues from key informants (2017) The concepts of community culture, social capital, and fortification of local communities can help the student to understand and explain the development of community welfare under the framework of community culture. It helps the student to see dimensions of self-sustainability in communities.

The results of community welfare management are the blossoming of good relations between members of the community, mutual support, feelings of confidence, pride, honor, and happiness, both physically and mentally. Additionally, Wetyachai, A. and Yodkamolsart, S. formulated the management of community welfare. Important aspects of managing welfare of a cultural basis are to support religious places is an important source of welfare since times past. For example, in Buddhist communities, the disadvantaged would ordain in order to receive education from temples. Some were ordained in order to receive food to feed their families.[13] In Muslim communities, charity giving of zakat is a support system according to Islamic principles, which believe that all Muslims with income have the duty to aid the disadvantaged by giving 2.5% of their annual income. Receivers of zakat fall into 8 categories, such as those without possession or tools to make a living, those without tools to earn a living which will adequately satisfy standard needs, those who have freed themselves from slavery, those who need support for continuing education, those with debts, and those who face difficulties while traveling.

Community Welfare: Welfare Based on Culture

Community welfare is the building of guarantee, so that its members may be confident in matters of education, health, dwelling, work, income, recreation, justice process, and social service. It betters everyone in the community, and may come in the forms of things, money, kindness, or help. It intertwines with its members' way of life from birth till death. Community welfare is a social act; therefore, it needs the collaboration and learning of people in the community. It gives the people maturity of wisdom, good relationships, and feelings of pride, eligibility, honor, and happiness, or what they say, "Live well. Eat well. Be happy." It is regarded as development with culture as its basis. It focuses on building strength for the people and families in its community, by first making them ready to receive development, or "to explode from within," which is King Bhumibol Adulyadej's work approach.

However, this synthesis considers monetary welfare as monetary support for "buying" outside welfare, so that it members may be guaranteed "access" to the welfare produced by the government and market (for example, education and medical care), not welfare produced by the community itself. On the other hand, for welfare based on the foundations of culture and resource, the community itself is the producer of welfare, such as the production and exchange of food, medicine, clothing, and danger protection. Modern community welfare which creates some sort of guarantee by the community itself is an endeavor that should be encouraged (especially when it results in social and mental development). Moreover, the author is of view that each community should be able to see its role as being more than simply providing welfare through other monetary organizations, because in actuality, each community is capable of welfare provisions in many ways, as follows.

(1) Creation of guarantee or financial service for its members to gain access to welfare provided by the government and market (as is done by many groups at the present).

(2) Production of welfare by the community for the community. Due to the limited budget of each community, production of welfare should be chosen according to its effects on the community's identity, way of thinking, and culture (because the government cannot do this better). It is a welfare production that utilizes local wisdom, workforce, and resources.

(3) Creation of a community network to push forward policies in order for the government and market to produce quality welfare which better aligns with the needs of communities.

The creation of networks can reflect the relationships and agglomeration of the people in the forms of network groups with various interconnecting ties, in which members of the networks generally exhibit similar characteristics, such as inclinations for the same types of sports or occupations. This also includes groups of relatives and friends (Issues from key informants, 2017). From the explanation in the work of Norat, C. it can be seen that the management of community welfare relates to and is important to the local economy. He categorized types of community welfare in line with the categories of social welfare; that is, community welfare is composed of:[14]

Community service means welfare in order to prepare for and manage the community economy, such as ways of living, eating, and using, as well as physical and mental health, by collaboration of similar strong members.

Community insurance means welfare from the process of distribution and consumption of the community economy, such as family insurance, community insurance, and environmental insurance, in which stronger members temporarily manage for weaker members.

Community charity means welfare from the process of distribution and consumption of the community economy (gratuitous), such as merit festival and sharing, in which stronger members or laypeople organize for weaker members or the ordained. It is noteworthy that Norat, C's categorization considers the relationship between the giver and receiver, in a way that relies on and is dependent on one another.

5. Conclusions

Community welfare is a social act, thus it entails cooperation and education of people in the community, so that the community may have cognitive maturity, mutual understanding, and feelings of stability and confidence, and may live eligibly, honorably, and happily.

Cultural Background In the article, fishermen’s community culture is characterized by its holism and dynamics. Each dimension and component of culture interconnects itself and with the external system, until they cannot be differentiated. The fishermen dynamically move and adjust according to the context and time.

Recommendations

1. Policy Recommendations to Apply Research Results in Practice

The implementation of community activities regarding community welfare should be in-depth and clear. The activities should encourage people in the community to be able to identify problems, find solutions and prevent problems themselves. This will help raise community awareness of building a strong community. State

organization should promote self-driven communities rather than communities which are always dependent on state's assistance.

2. Suggestions for Future Research

This study describes the phenomenon of community welfare with a cultural background of fishermen on the Andaman coast in southern Thailand. Future research may be done in one provinces to describe in the cultural background depth to community depth of the province. It is also recommended to study the development and implementation of community welfare systems among fishermen.

Acknowledgements

An article in partial fulfillment of the thesis: The process of driving community welfare by fishermen on the Andaman coast of southern Thailand. Funded by the Office of the Higher Education Commission, Faculty of Liberal Arts and Graduate School, Prince of Songkla University.

References

[1] Royal Guidance in the Commencement Ceremony of Kasetsart University at the University Auditorium on July 18, 1974. Retrieved on August 9, 2016, from http://www.sa.ku.ac.th/king-spku/2517-1.htm

[2] Jeawkok, J., Yammai, S. & Sangharat, U. Norah and Health of People and Their Community. Thai Case Study Journal. 2016, 13 (1); 150-176.

[3] Community Organizations Development Institute. Handbook for the Actuation of Community Welfare Support Project. Bangkok in Thailand: Appa Printing Group. 2009.

[4] Khamhom, R. Community Welfare and Thai Society. 4th ed., amended. Bangkok in Thailand: Thammasat University Printing Press. 2014.

[5] Phothisa, C. The science and art of qualitative research. 2nd ed. Bangkok in Thailand: Aammarin printing. 2006.

[6] Office of the National Economics and Social Development Board. Learning from the Work Approach of the King.; 2008 [cited 9 August 2016]. Available from: http://www.nesdb.go.th/download/article/article_20150728110135.pdf

[7] Boonpanya, B. Three Decades of Community Culture Approaches. Bangkok in Thailand: October Printing Press. 2001.

[8] Karnjanapan, A. Social Capital and Community Rights in the Community's Viewpoint: Local Thoughts on Rights, Power, and Resource Management. Bangkok in Thailand: Thailand Research Fund. 2001.

[9] Phrompakping, B. Report of Research, Formation, Re-Production, and Expansion of Social Capital in Rural Northeastern Thailand. Bangkok in Thailand: Thailand Research Fund. 2004.

[10] Rojpaisarnkij, K. Development of Integration Methods of Community Welfare Funds Network at the District Level, Chachoengsao Province. Rajabhat Rajanagarindra University. 2007.

[11] Boonyaratanasunthorn, J. Community welfare: Approaches and Methods for Knowledge Creation and Development of Thai Society. Thammasat University. 2004.

[12] Organization for Economic Cooperation and Development. The Well-being of Nations: The Role of Human and Social Capital. Paris: Organization for Economic Cooperation and Development. 2001.

[12] Poshnukul, S. P. Literature Criticism and Knowledge Synthesis of Community Welfare in Thailand. Bangkok in Thailand: Insitution of Knowledge Development for Community Happiness. 2009.

[13] Wetyachai, A. & Yodkamolsart, S. Social Welfare the Villager Version. Economics and Politics Study Center, Faculty of Economics, Chulalongkorn University. 2003.

[14] Norat, C. Thai Rural Community Welfare. Doctoral dissertation, Faculty of Social Administration. Bangkok in Thailand: Thammasat University. 2003.

Individual Interviews

Ann who respondents. Jeawkok, J. who interview, Tha Klang community, Moo 4, KamPun sub-district, Suk Samran district, Ranong province, Thailand. On February 15, 2017.

BandMad who respondents. Jeawkok Jirachaya who interview, Pa Khlok sub-district, Thalang district, Phuket province, Thailand. On February 6, 2017.

BangDum who respondents. Jeawkok Jirachaya who interview, Pa Khlok sub-district, Thalang district, Phuket province, Thailand. On February 6, 2017.

BangLae who respondents. Jeawkok Jirachaya who interview, Khlong Khan sub-district, Takua Thung district, Phang Nga province, Thailand. On February 12, 2017.

BangLao who respondents. Jeawkok Jirachaya who interview, Pa Khlok sub-district, Thalang district, Phuket province, Thailand. On February 6, 2017.

Bangmad Leamsak who respondents. Jeawkok Jirachaya who interview, Ao Nam community, Leamsak sub-district, Ao Luek district, Krabi province, Thailand. On February 9, 2017.

BangMee who respondents. Jeawkok Jirachaya who interview, Moo 1, Tha Kham sub-district, Palian district, Trang province, Thailand. On February 7, 2017.

Bung Chad who respondents. Jeawkok, J. who interview, Tha Klang community, Moo 4, KamPun sub-district, Suk Samran district, Ranong province, Thailand. On February 15, 2017.

Bung Chai who respondents. Jeawkok, J. who interview, Tha Klang community, Moo 4, KamPun sub-district, Suk Samran district, Ranong province, Thailand. On February 15, 2017.

KaCha who respondents. Jeawkok, J. who interview, Tha Klang community, Moo 2, Tammalung sub-district, Mueang district, Satun province, Thailand. On February 5, 2017.

KoSee who respondents. Jeawkok Jirachaya who interview, Khlong Khan sub-district, Takua Thung district, Phang Nga province, Thailand. On February 12, 2017.

Muaenjai who respondents. Jeawkok, J. who interview, Tha Klang community, Moo 1, Tha Kham sub-district, Palian district, Trang province, Thailand. On February 7, 2017.

PeeDew who respondents. Jeawkok Jirachaya who interview, Moo 2, Tha Kham sub-district, Palian district, Trang province, Thailand. On February 7, 2017.

Peeya Aoboto who respondents. Jeawkok Jirachaya who interview, Ao Nam community, Leamsak sub-district, Ao Luek district, Krabi province, Thailand. On February 9, 2017.

To-ei-mum who respondents. Jeawkok Jirachaya who interview, Moo 3, Tammalung sub-district, Mueang district, Satun province, Thailand. On February 5, 2017.

WaDin who respondents. Jeawkok Jirachaya who interview, Ao Nam community, Leamsak sub-district, Ao Luek district, Krabi province, Thailand. On February 9, 2017.

Lifestyles of Gen Y Men Consumer that Influenced the Loyalty of Fashion Products in Thailand

Thatchavong Julsawat[1,*], Sutasinee Siripokapiroma[1]

[1]Faculty of Management Science, Thepsatri Rajabhat University, Lopburi 15000, Thailand

Abstract

The purposes of studying Lifestyles of Gen Y men consumer that influenced to the loyalty of fashion's products in Thailand were 1) to study how Gen Y men have loyalty to the fashion products in Thailand. 2) to study what is the life style of Gen Y men that impact to the loyalty of fashion products in Thailand. This study was a mixed method research which combined both qualitative and quantitative research. The population was the generation Y men, which they were born in 1981-1996. Sampling technique started from the snowball method with in-depth interview 20 Gen Y men for correcting data under the structured interview. Secondly, the content analysis data collection was used to created 5 rating scale for designing the online questionnaire. Thirdly, sampling for the questionnaire used the snowball sent via the social network which 454 questionnaires were collected back. The data from questionnaire were analyzed by using the Exploratory Factor Analysis (EFA) to classify the life style of Gen Y men and followed with Confirmation Factor Analysis (CFA) method to confirmed the life style factors, then further analyzed by multi regression analysis base on the Analysis of Moment Structures (AMOS) program.

After compared by using the Confirmation Factor Analysis, the result showed that Gen Y men had the loyalty toward the fashion products based on the attitude loyalty more than the behavioral loyalty. Gen Y men feel that the fashion products under the brand that they bought made their personality nice looking. In case of the lifestyles, can classified into 6 lifestyles which contain with 1) lifestyle model like commentator 2) lifestyle model like the athlete 3) stylish modern lifestyle. 4) a world-class lifestyle. 5) tourist lifestyle and 6) epicurean lifestyle. And the lifestyle model like a commentator had impact to the fashion product's loyalty.

Keywords: lifestyle, gen Y, loyalty, fashion product

1. Introduction

The fashion industrial in Thailand has been grow up in the past and keep continue going well even the economic has been decelerated but the product groups which related to lifestyle still generate the sales volume as well and has been expanded to many groups of the consumer[1]. In 2014, found that the fashion products have been ranked 1 of the top 3 most valuables [2]. And the target of fashion businesses is the Generation Y (Gen Y) which now they are become to be a big customer than before and they were born in the period of 1981-2000 [3].

In Thailand, Gen Y population is about 16 million or one in the third of country (Department of Provincial Administration, 2015) and prefigured that in 2025 Gen Y Group will occupies more than 75% in the world and also come up with high income and spend a variety of goods or services [4]. Currently, these consumers are influenced to the consumption of fashion products because they are high spending group, especially in technology and fashion [5]. Nowadays Gen Y men become to be big customers who that interested in fashion product similar as women, and also men in current can separated into 2 groups, one called Metrosexual and another called Spornosexual [6,7] which both of them always take care themselves and consume more fashions and health products, so that why the businesses have to focus on this customer.

Consequently, entrepreneurs in this business need to understand the needs of these consumers deeply both in behaviorally and psychologically [8] and part of the personality traits are important to the fashion market, especially those in young adolescents who are highly influenced by their own personality. When it is so, it affects to the behaviours in the purchasing of various types of products, especially in the fashion category [9]. Moreover,

* Corresponding author; e-mail: thatchavong.j@lawasri.tru.ac.th

they want to get a good personality and image because they believe that it could encourage to facilitate socialization and success in their job [10].

For the lifestyles Peter Drucker [11] said that "the main point of the business is customer, so the businesses should know what the customer need in fact", also Engel, Blackwell and Miniard [12] said that "lifestyles or how one lives mean how people spend the time, spend the money". Which lifestyles of human it depends on the experiences in the past and the different context, so consumer lifestyles and it can be said that the lifestyle of the consumer is the result of a combination of individuality and past experience to interact with the social environment, which affects to the behaviors of consumers in each part of the life cycle as well [13].

Lifestyle can indicate the values of people in the lifestyle through behaviors and patterns in the consumption of various goods mostly people with the same behaviors can grouping together by something that they like the same. So, businesses should set strategies or produce products or services that match the characteristics and needs of the customers in different groups [14].

Kotler [15] said that, the acting is the lifestyle of person in the form of activities, interests and opinions. Consumer's lifestyles are the output from mixed between characteristics and experiences in the past interaction with the social context which these are impact to the consumer's behaviors in each stage of the life cycle [16,17].

Consumers in the same age range behave similarly in consumption behavior. Therefore, businesses need to improve and develop products that are consistent and appropriate for the target consumer's age range [10]. And sexual differences are important issues in marketing(18). Gender is one factor influencing consumer behaviors [19].

Product loyalty refers to consumer satisfaction toward products and services so this can affect to repeat buying behavior of consumers[20,21]. Brand loyalty means continuous satisfaction or buying a brand in one of the products of a particular company [22]. Brand loyalty as a result of the consumer's satisfaction who have used the product. It makes commitment to the product without changing it to another brand [23]. Brand loyalty, not only in the addition to the regular purchase of a brand, but also included with branding in such a way that occurs as a result of brand emotion [24] and brand loyalty is the Assessing level of consumer engagement to the brand based on the purchase of the consumer, the consumer takes into account the true value of the brand [25].

Engaging in brand building or branding has influences to the consumers' loyalty toward fashion products [26] similarly to the finding of Stathopoulou and Balabanis [27] which found that value branding is important to the consumer satisfaction. In addition, the value of the brand is partly due to innovation thinking and creating value until consumers are satisfied. Innovation in branding affects perceived quality, customer satisfaction and loyalty which brand innovation affects customer satisfaction through perceived quality of goods [28]

Perception of product quality is a factor that demonstrates consumer attitudes and loyalty but personality factors are the intermediary in the perception of product quality. The branding of prestige, fit and consistent with personality including a group of brands it does not directly affect brand loyalty [29] and Gen Y's consumer focusing on variables in brand awareness and motivation to consume and also found that consumer perception is a leading issue for consumers of fashionable brands [30]. The suitability of the product and the suitability of the consumer have effect on consumer attitudes and loyalty more than brand equity [31].

2. Objectives

2.1 How Gen Y men loyalty toward the fashion products in Thailand.

2.2 What is the life styles of Gen Y men impact to the loyalty of fashion products in Thailand.

3. Methods

As the study aimed to explore the factor of lifestyles that influence to the fashion products loyalty in Thailand. Mixed method research was adopted, started with qualitative method by review the literatures and come up with the structured interview and interview to 20 informants under in-depth interview method which sampling by using the snowball approach. The population were Gen Y men in Thailand that they were born in rage of 1981-1996.

The content analysis was adopted to analyzed for designing the online questionnaire and forward to the sample via the social networks such as Facebook, Line etc. At the first time, the researcher expected questionnaires respond back for 400 copies based on Yamane theory in case of unknown the total of population with reliability 95% confident [[32] but 454 questionnaires were back.

Data Collection

Data was collected by 2 methods. Firstly, for the qualitative method used in-depth interviews under the structured interview form with content validity checking by 3 specialists and interviewed to a person who that researcher knows and then spread out to another by snowball method. Secondly, for the quantitative the data was collected by using the 5 rating Likert scale questionnaire with .957 Cronbach's Alpha Reliability with 5 specialists checked for the content validity and designed into online questionnaire then sent to the sampling via the social networks such as Facebook, Line and Instagram etc., because as literature reviews showed that Gen Y mostly they always attend on the social network.

Data Analysis

This research has used mix method research which combined Qualitative and Quantitative research. For the qualitative research used the content analysis and for the quantitative the research started with Exploratory Factor Analysis (EFA) from the questionnaire which referred from AIO theory (Attitude, Interest and Opinion) to identify the lifestyles of male Gen-Y with Kaiser-Meyer-Olkin measure of sampling adequacy (KMO .878) with Principal Component Analysis Extraction Method and Varimax Rotation Method, for classified the life styles of Gen Y men so it specified into 6 lifestyles. After classified the lifestyles of Gen Y men then followed with Confirmation Factor Analysis (CFA) to confirmed whether the component structure or features in each population group is the same composition [33]. and analyzed the data by regression analysis buy AMOS program

Table 1 Rotated Component Matrix for EFA

Observe Variables	Component					
	1	2	3	4	5	6
Opi6	.818					
Opi7	.768					
Opi2	.710					
Opi5	.685					
Opi3	.683					
Opi4		.796				
Int7		.758				
Act6		.693				
Int5			.754			
Int3			.660			
Int4			.634			
Int6			.552			
Int8			.500			
Int1						
Act2				.718		
Act9				.688		
Act4				.572		
Act7				.522		
Act1					.756	
Int2					.728	
Opi1					.629	
Act5						.742
Act3						.609
Act8						.538

Extraction Method: *Principal Component Analysis*.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 9 iterations.

4. Results and discussion

The Results of the Loyalty based on Confirmation Factor Analysis (CFA) of male's Gen Y toward fashion products showed that Loy4 factor has most high regression weight (.829) which mean that males Gen Y always talk about the favorite's fashion products to other person in a good way, so this case it can refer to the behavioral loyalty as show in the figure 1.

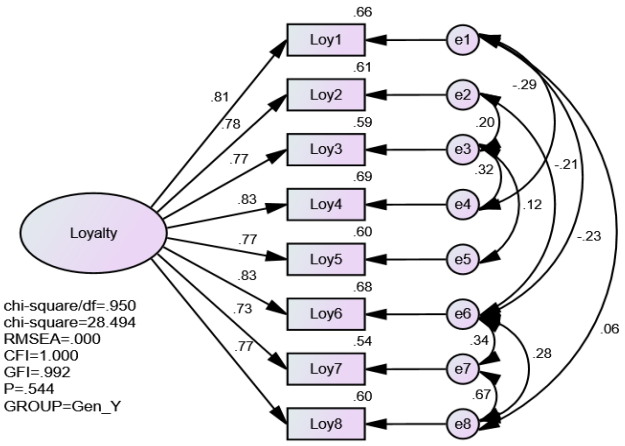


Figure 1 Loyalty confirmation factor analysis of Gen Y men

Table 2 Standardized Regression Weights (Loyalty of Gen Y men)

Observe Variables		Latent Variables	Regression Weights	R^2
Loy1	<---	Loyalty	.813	.661
Loy2	<---	Loyalty	.781	.610
Loy3	<---	Loyalty	.766	.586
Loy4	<---	Loyalty	.829	.687
Loy5	<---	Loyalty	.772	.597
Loy6	<---	Loyalty	.828	.685
Loy7	<---	Loyalty	.732	.536
Loy8	<---	Loyalty	.774	.600

The results of lifestyles which based on Confirmation Factor Analysis (CFA) showed that, lifestyle of males Gen Y can have classified into 6 lifestyles, the lifestyle that Gen Y men most action was Life_Style3 (regression weight .767) which mean that males Gen Y mostly act like the stylish modern lifestyle as show in the figure 2.

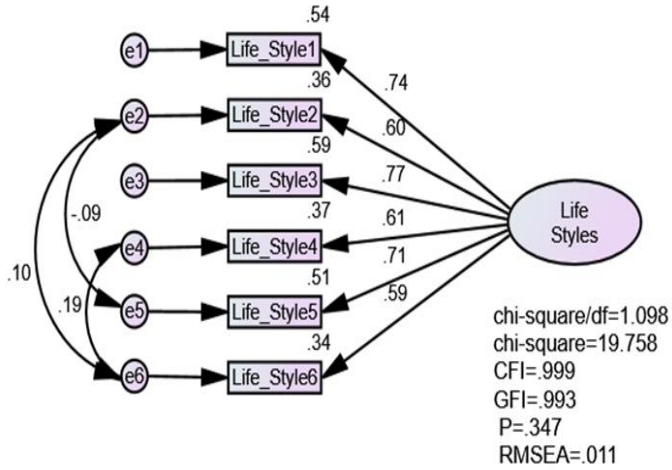


Figure 2 Lifestyle confirmation factor analysis of Gen Y men

Table 3 Standardized Regression Weights (Lifestyle of Gen Y men)

Observe Variables		Latent Variables	Regression Weights
Life_Style6	<---	Life_Styles	.587
Life_Style5	<---	Life_Styles	.712
Life_Style4	<---	Life_Styles	.610
Life_Style3	<---	Life_Styles	.767
Life_Style2	<---	Life_Styles	.598
Life_Style1	<---	Life_Styles	.737

After Confirmation Factor Analysis (CFA) was used for both of lifestyles and loyalties, next step was regression analysis which AMOS program was adopted to analyzed the data. The result showed that lifestyle factors had influence to the loyalty of fashion's product with coefficient of determination ($R2 = .29$). And Life_Style1 (observe variable) had high regression weight (.404) when compared with another observe variables with significant level at .001 which mean that stylish modern lifestyle of Gen Y men had influenced to the loyalty of fashion's product as show in the figure 3.

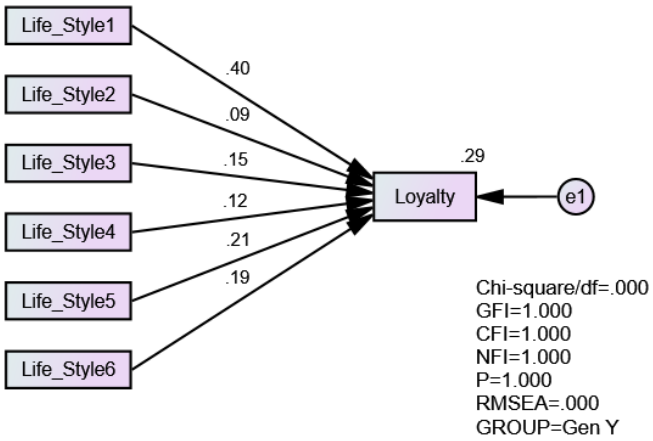


Figure 3 Regression analysis of Gen Y men's life styles toward loyalty

Table 4 Factor Regression Weights (Gen Y men - Default model)

Observe Variables		Latent Variables	Estimate	P
Loyalty	<---	Life_Style1	.404	***
Loyalty	<---	Life_Style2	.090	.024
Loyalty	<---	Life_Style3	.153	***
Loyalty	<---	Life_Style4	.115	.004
Loyalty	<---	Life_Style5	.209	***
Loyalty	<---	Life_Style6	.190	***

Note. *** mean significant level at . 001

In case of Gen Y men loyalty toward the fashion products, the study found that Gen Y men always talk about the favorite's fashion products to other person in a good way, so it can refer to the behavioral loyalty. This result concerned to the study of Hawkins, Best and Coney [24] which found that the consumers when they loyalty to the goods or services they always talk to the other like the source of information. So, this result may out from the behaviors of Gen Y which they like to communicates, and as the information also showed that Gen Y growth with the technology and internet so they like to share almost everything that they like or even they don't like as well via the social network.

As the study of Morton LP [34] found that Gen Y are risk adverse, mistrustful of mass media and can best be reached through word- of- mouth promotion, celebrity testimonials, loud and quick visuals, and advertisements that reflect their lifestyles and core values in humorous and emotional ways. These information also concerned to the study of Yarrow K [35] the they found that the characteristic of Gen Y always spend the time with social technology and internet that lead them to make communicate with the people who that have same interesting and have same comments till become to be a group and social and acts in the same behaviors.

In case of life styles and loyalty to the fashion products of Gen Y men, the study found that stylish modern lifestyle is the factor that most significant and influenced to the loyalty toward fashion product of Gen Y men. This result it concerned to the study of [36] they found that the effects of physical quality and lifestyle-congruence on brand loyalty are fully mediated by consumer satisfaction. similarly to the study of [37] they found that the variables for fashion lifestyle significantly influenced to the willingness of consumers to pay for luxury fashion brands. so, these supported to the finding and because lifestyles of Gen Y men always concern to the fashion, if fashion' marketers can design the stylish products and respond to the inspiration of Gen Y consumer it may lead them loyalty to that product as well.

5. Conclusions

This research has objectives that concern to the loyalty behaviors of Gen Y men in Thailand. By the way the finding come out base on EFA and CFA. Firstly, EFA used to specified lifestyles of Gen Y men then CFA to confirm the factors. the finding showed that the stylish modern lifestyle is the factor that most significant and influenced to the loyalty toward fashion product and lifestyles of Gen Y men have separated into 6 lifestyles.

This research focused on only Gen Y men toward loyalty behaviors into fashion's products, so in the future the researchers should adapt into another product, especially the products that high impact to the country's economic such as the tourisms nor health's product. Whether, in the future should adapt to another generation such as Generation Me that interesting because of we are going into digital globalization and should compare to another culture, in case of using the same generation, to compare how they are different or the same finding. this study just only in Thailand, so if can find more result in the different countries it may lead to the marketing strategies. About the factors, in the future it can change into another such as, the experiences of consumer or the inspiration that may influence to the loyalty.

References

[1] The Federation of Thai SME. fashion industrial. 2015.
[2] Electronic Transactions Development Agency. Terminology - ETDA [Internet]. 2015. Available at: https://www.etda.or.th/terminology.html
[3] Economic Intelligence Center (EIC). Economic Intelligence Center (EIC) [Internet]. SCBEIC. 2014. Available at: https://www.scbeic.com/en/home
[4] Bergh JV den, Behrer M. How Cool Brands Stay Hot: Branding to Generation Y. Kogan Page Publishers; 2011. p. 273.
[5] Rugimbana R. Generation Y: How cultural values can be used to predict their choice of electronic financial services. J Financ Serv Mark. 5 June 2007;11(4):301–13.
[6] Coad D. Metrosexual, The: Gender, Sexuality, and Sport. SUNY Press; 2008. p.224.
[7] Keeble E. Politics and Sex: Exploring the Connections between Gender, Sexuality, and the State. Canadian Scholars' Press; 2016. p. 238.
[8] Sullivan P, Kang J, Heitmeyer J. Fashion involvement and experiential value: Gen Y retail apparel patronage. Int Rev Retail Distrib Consum Res. 2012;22(5):459–83.
[9] Szmigin I, Piacentini M. Consumer Behaviour. Oxford University Press; 2014. p. 471.
[10] Solomon MR. Consumer Behavior: Buying, Having, and Being. Pearson Education; 2014. p. 607.
[11] Drucker PF. The Five Most Important Questions You Will Ever Ask About Your Organization. John Wiley & Sons; 2011. p. 81.
[12] Engel JF, Blackwell RD, Miniard PW. Consumer Behavior. Dryden Press; 1995. p. 951.
[13] Michman RD, Mazze EM, Greco AJ. Lifestyle Marketing: Reaching the New American Consumer. Greenwood Publishing Group; 2003. p.268.
[14] Solomon MR, Bamossy G, Askegaard S. Consumer Behaviour: A European Perspective. Prentice Hall Europe; 1999. p. 612.
[15] Kotler P. Kotler On Marketing. Simon and Schuster; 2012. p.275.
[16] Christafore D, Leguizamon S. The influence of gay and lesbian coupled households on house prices in conservative and liberal neighborhoods. J Urban Econ. 2012;71(2):258–67.
[17] Simmers CS, Parker RS, Schaefer AD. The Importance of Fashion: The Chinese and U.S. Gen Y Perspective. J Glob Mark. 2014;27(2):94.
[18] Arnould EJ, Price LL, Zinkhan GM. Consumers. 2nd ed. Boston: McGraw-Hill/Irwin; 2004. p.845. (McGraw-Hill/Irwin series in marketing).
[19] Underhill S. Boy Next Door. Bruno Gmunder Verlag GmbH; 2000. p. 104.
[20] Dick AS, Basu K. Customer loyalty: Toward an integrated conceptual framework. J Acad Mark Sci. 1994;22(2):99–113.
[21] Richard L. Oliver. Whence Consumer Loyalty? Am Mark Assoc. 1999; 63:33–4.
[22] Schiffman LG, Kanuk LL. Consumer Behavior. Prentice Hall; 2000. p. 469.
[23] Berkman HW, Lindquist JD, Sirgy MJ. Consumer Behavior. Lincolnwood, Ill: Natl Textbook Co; 1997. p.626 .
[24] Hawkins DI, Best RJ, Coney KA. Consumer Behavior: Building Marketing Strategy. Irwin/McGraw Hill; 2001. p. 775.
[25] Aaker DA. Building strong brands. New York: Free Press; 1996.
[26] Park M-J, Lee Y-R. Explanatory Variables of Customer's Brand Loyalty to Fashion Luxury Goods. J Korean Soc Cloth Text. 2005;29(11):1485–97.
[27] Stathopoulou A, Balabanis G. The effects of loyalty programs on customer satisfaction, trust, and loyalty toward high- and low-end fashion retailers. J Bus Res. 2016;69(12):5801–8.
[28] Pappu R, Quester P. Brand Innovativeness Effects on Perceived Quality, Satisfaction and Loyalty. Campbell C, Ma JJ. Look Forw Look Back Draw Past Shape Future Mark. 2016;763–763.
[29] Esmaeilpour F. The role of functional and symbolic brand associations on brand loyalty: A study on luxury brands. J Fash Mark Manag. 2015;19(4):467–84.
[30] Sarah Giovannini, Yingjiao Xu, Jane Thomas. Luxury fashion consumption and Generation Y consumers: Self, brand consciousness, and consumption motivations. J Fash Mark Manag Int J. 2015;19(1):22–40.
[31] Fang Liu, Jianyao Li, Dick Mizerski, Huangting Soh. Self□congruity, brand attitude, and brand loyalty: a study on luxury brands. Eur J Mark. 2012;46(7/8):922–37.
[32] Yamane T. Elementary sampling theory. Prentice-Hall; 1967. 424 น.
[33] Bollen KA, Bollen KA. The General Model, Part I: Latent Variable and Measurement Models Combined. In: Structural Equations with Latent Variables [Internet]. John Wiley & Sons, Inc.; 1989. 319–94. Available at: http://onlinelibrary.wiley.com/doi/10.1002/9781118619179.ch8/summary
[34] Morton LP. Targeting generation Y. Public Relat Q Rhinebeck. 2002;47(2):46–8.

[35] Yarrow K, O' Donnell J. Gen BuY: How Tweens, Teens and Twenty-Somethings Are Revolutionizing Retail. John Wiley and Sons; 2009. p.274.
[36] Nam J, Ekinci Y, Whyatt G. Brand equity, brand loyalty and consumer satisfaction. Ann Tour Res. 1 July 2011;38(3):1009–30.
[37] Li G, Li G, Kambele Z. Luxury fashion brand consumers in China: Perceived value, fashion lifestyle, and willingness to pay. J Bus Res. 2012;65(10):1516–22.

Session of Water Engineering, Groundwater Hydrology and Environmental Science

The Potential Solutions of Water Resource Problem in Cisarua Sub-District, Bogor, West Java, Indonesia

M. Faisi Ikhwali[1,*] and Titiek Ujianti Karunia[2]

[1]A master student of Department of Civil Engineering, Faculty of Engineering, Khon Kaen University, Thailand
[2]A lecturer of Department of Civil and Environmental Engineering, Bogor Agricultural University, Indonesia

Abstract

Problems of water shortage for domestic uses being experienced in Cisarua Sub-district, as local government fail to offer their people with this basic need. The water from public services such as PDAM seems not enough to cover whole domestic need. The other existing and potential problem is deforestation that causing the increase of runoff volume. Forest Area in Cisarua is a specific territory of forest ecosystem determined and or decided by the government as a permanent forest has violated by society. The cause of land use changes in Cisarua is the growth number of construction especially hotel that increase continuously. The goals of this research were to analyze the tentative or potential ways to solve the water resource problems occurring in Cisarua Sub-district related to water resource. This study used primary and secondary data collected from related governments and interviews with the local people's opinion. Cisarua is included in the climate type Af humid tropical climate (with no real dry months) with rainfall annual average over the period 2003 to 2012 is 3040.6 mm/ year with an average of 253.4 mm monthly rainfall. Domestic customers that use PDAM Tirta Kahuripan in Cisarua sub-district is 1211 households even though at least there are 29148 households that should be connected to piped water. The changes of land use in Cisarua due to weak supervision and control of spatial level both central and local government. The best solution should be used by households is through rainwater harvesting. About 291480 cum will recharged during a month and can cover 66.378 % of water demand. Infiltration wells have been constructed around 201 units. Infiltration wells can reduce runoff that effected by deforestation so that runoff from Cisarua can be injected to soil and a groundwater.

Keywords: water shortage, deforestration, Cisarua sub-district, rainwater harvesting, infiltration wells

1. Introduction

Problems of water shortage for domestic uses are being experienced in Cisarua Sub-district, as local government fail to provide their people with this basic need. The water from public services such as PDAM (*Perusahaan Daerah Air Minum*) seems not enough to cover whole domestic need. According to data on 2016 (PDAM Tirta Kahuripan) in Cisarua Sub-district, there are 29148 households but until year of 2016 only 1211 households connected with piped water. This condition has forced the residents to adopt different way to fulfill their domestic water needs. They use another water source such as deep water well, shallow, or spring. Most of household in Cisarua Sub-district use wells and boreholes to supplement PDAM's piped water which is inadequate.

In addition to these problems, PDAM also faces problem in distribution system of water. PDAM Tirta Kahuripan has confront a decades-old system of distribution. This problem begins with poor planning, which ultimately affects the development of piping networks and maintenance. Lack of maintenance makes the pipe networks being in a bad condition. Breakages of pipe due to corrosion had compromised water pressure, water supply and water quality.

The other existing and potential problem related to water resource in Cisarua Sub-district is deforestation causing the increase of runoff volume. Forest Area in Cisarua ora specific territory of forest ecosystem that has been determined and or decided by the government as a permanent forest has been violated by society. Water catchment area in Cisarua is increasingly critical. If Area does not receive special attention, land use in the region keep changing and will have an impact on the increase of runoff volume constantly. Based on designation data (2005-2025) by BPDAS (*Balai Pengelola Daerah Aliran Sungai*) examining the spatial and land use changes in Cisarua is that the growth number of construction especially hotel increases continuously.

* Corresponding author; e-mail: faisi.ikhwali@gmail.com

The objective of this research is to analyze the tentative or potential ways to solve the water resource problems occurring in Cisarua Sub-district related to water resource.

2. Materials and methods

This study used primary and secondary data collected from related governments and interviews with the local people's opinion. The available data can be used to figure out specify causes of problem and the tentative or potential ways to solve the problems. A list of needed data has been prepared and then collected via government agencies such as average monthly rainfall and meteorological data, the number of population, household, and density per village in Cisarua Sub-district. In this area, forest inventories studies have been conducted and will be great help in this study. Also, the existing surface and ground water resource were collected to supporting analysis. After the existing data have been collected and analyzed, then determined the causes of problem and draw up the possibilities of solution.

2.1 The target area

The location of the target area is Cisarua Sub-district that is part of the Upper Ciliwung Watershed located at the geographic coordinates of 6 ° 37 '48 "- 6 ° 46' 12" latitude and 106 ° 49 '48 "- 107 ° 00' 00" E. Cisarua Sub-district map can be seen in Figure 1. Region Morphology type of Cisarua Sub-district is relative highlands. Cisarua Sub-district has 3 sub watersheds as shown in Table 1. Administratively Cisarua Sub-district is located in Bogor Regency including 10 villages. There are Cilember village, Jogjogan village, Batu Layang village, Kopo village, Cisarua village, Citeko village, Leuwimalang village, Tugu Utara village, Tugu Selatan village, and Cibeureum village which are part of the Local Government Level II Bogor Regency, West Java Province, Indonesia.

Table 1 Sub watershed include to Cisarua Sub-district

NO	Sub-watershed	Area (Ha)
1	Ciesek	233.8
2	Ciliwung Hulu	3.739.95
3	Cibogo - Cisarua	2.962.48
	Total	6.936.23

Source: BPDAS Citarum-Ciliwung (2013)

Geographically the layout of the Cisarua Sub-district is very strategic. This is because the Cisarua Sub District is up stream of the capital city of the Republic of Indonesia, so the Cisarua Sub District becomes a buffer area of Jakarta. Cisarua Sub-district has a cool weather that fits into a tourist spot. That is why the growth of hotel and villa increase continuously.

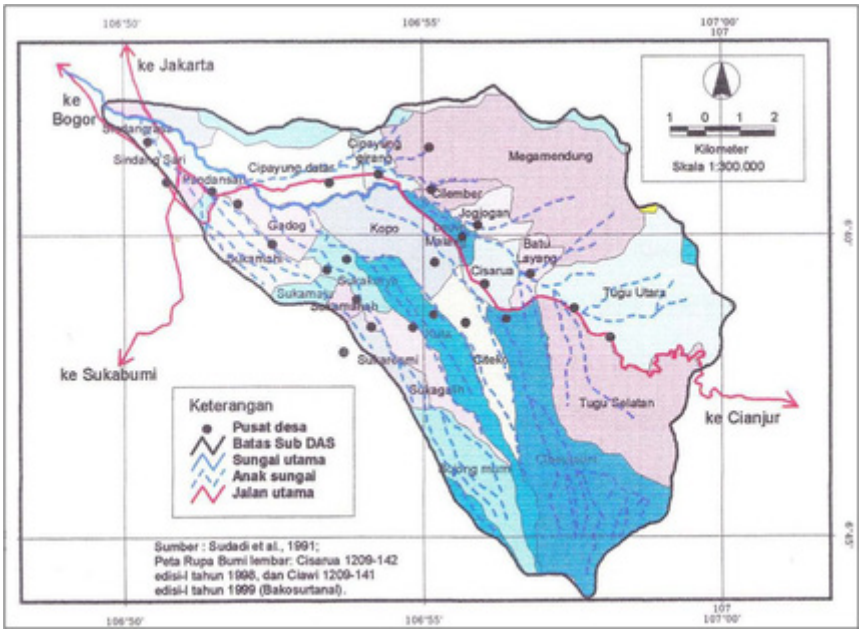


Figure 1: Map of Cisarua Sub-District

2.2 Data of population in Cisarua Sub-district

BPS-Statistics Indonesia in 2015 has already recorded data of population and household, area, density per sub-district village in Cisarua sub-district to support the activities of the Population, Agriculture, or Economic. The location of this study has an area of 7406.30 ha. Data of population, household, area, and density per sub-district village in Cisarua can be seen with details as shown in Table 2.

Table 2 Total population per village in Cisarua Sub-district

Villages	Area	Proportion	Population			Household	Density
	(ha)	(%)	Male	Female	Total		Capita/ha
Cilember	296.74	4.01	5518	501	6019	2632	20.2837501
Jogjogan	235.64	3.18	4986	4591	9577	235	40.6425055
Batu Layang	272.15	3.67	7698	8590	16288	3212	59.8493478
Kopo	652.6	8.81	9375	8588	17963	5225	27.5252835
Cisarua	240.36	3.25	5662	544	6206	2845	25.8196039
Citeko	585.69	7.91	7359	6664	14023	3536	23.9427001
Leuwimalang	136.98	1.85	3126	3450	6576	2349	48.0070083
Tugu Utara	1201.3	16.22	6696	6096	12792	3402	10.6484642
Tugu Selatan	2665.41	35.99	10877	1005	11882	556	4.45785076
Cibeureum	1119.43	15.11	10837	9815	20652	5156	18.4486748
Total	**7406.3**	**100**	**72134**	**49844**	**121978**	**29148**	**16.4694922**

Source: BPS- Statistics Indonesian (2015)

2.3 Average monthly rainfall data and Meteorological data

Rainfall information is the primary input to any hydrological analysis. Analysis of rainfall characteristics is becoming very important for rainfall forecasting in the context of integrated watershed management planning (Rezaul, 2012). The study area is included in the climate type Af humid tropical climate (with no real dry months) with rainfall annual average over the period 2003 to 2012 is 3040.6 mm / year with an average of 253.4 mm monthly rainfall. Monthly rainfall data (period 2003 to 2012) is depicted in Figure 2.

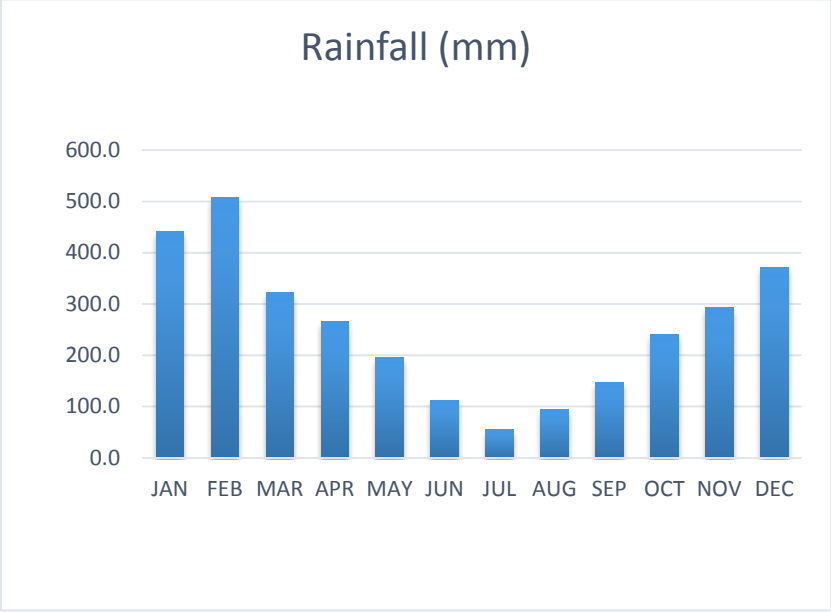


Figure 2: Average monthly rainfall (2003 to 2012)
Source: *Stasiun Meteorologi Citeko Bogor (2012)*

3. Results and discussion

3.1 Causes of problem

3.1.1 Water shortage for domestic uses

Local government in Cisarua sub-district has several projects to provide water for domestic and agriculture uses. For domestic uses the responsible agency is PDAM Tirta Kahuripan. PDAM Tirta Kahuripan's role is to develop and operate water supply systems in Bogor District. The local government provides and subsidies payment for construction costs and most of the operation and maintenance (O&M) costs. Water needed for irrigation is taken from Cisarua river. Volume of this water is saved in reservoirs that are needed to other uses such as flood protection, and recreation. Water used for irrigation is delivered through primary, secondary, canal system. Based on data cited from [1], PDAM Tirta Kahuripan had approximately more than 46 % water loss, due to geological factor, human activity, etc.

According to the data, in 2016 the number of domestic customers that use PDAM Tirta Pakuan in Cisarua sub-district is 1211 households. Water Usage for domestic in Cisarua Sub-district of 2015 is approximately 410,959 m^3 (Including water supply for industrial sector and public buildings). In fact at least there are 29148 households that should be connected to piped water.

This condition has forced the residents to adopt different way to make water available for domestic uses such as deep water well, shallow, or spring. Most households use water from wells and boreholes to supplement PDAM's piped water which is inadequate. Nowdays residents in Cisarua are facing the other problems of water resources with deep water well and shallow. The wells that they build are reduced since the establishment of many large-scale housing, villa and hotels. These constructions take up hundreds hectare areas that seriously affected to water resource (water wells and streams in the area) because they also use the wellbore.

3.1.2 Deforestation (Increasing the volume of runoff)

Forest Area is a specific territory of forest ecosystem determined by the government as a permanent forest. Government decision is important to maintain the size of forest area and to ensure its legitimation and boundary demarcation of permanent forest. Forest area is determined by the Minister of Forestry in the format of Minister Decree on the Designation of Provincial Forest Area and Inland Water, Coastal and Marine Ecosystem. The designation of Forest Area is formulated based on integrated and harmonized of Provincial Spatial Planning (RTRWP) and Forest Land by Concensus (TGHK) (BPS, 2016).

The designation of Forest Area in some cases also cover inland water, coastal, and marine ecosystem that may become part of Sanctuary Reserve Area (KSA) and Nature Conservation Area (KPA). In accordance to the Act on Forestry No. 41/1991, forest area is categorized as Conservation Forest, Protection Forest, Production Forest (BPS, 2016). Forest Area in Cisarua has been determined by Minister as shown in Table 3.

Table 3 The designation of Forest Area in Cisarua has been determined by Minister (Year 2005-2025). *Source: Afifah (2010)*

No	Designation of Provincial Spatial Planning and Forest Land Use	Area (ha)	Propotion
1	Conservation forest	1237.02	16.7
2	Protection forest	2584.7	34.9
3	Farm area	1107.77	14.96
4	Rural settlements (low density)	134.92	1.82
5	Rural settlements (medium density)	298.82	4.03
6	Urban settlement (low density)	792.74	10.7
7	Urban settlement (medium density)	341.54	4.61
8	Dryland Agriculture Area	834.72	11.27

No	Designation of Provincial Spatial Planning and Forest Land Use	Area (ha)	Propotion
9	Plantation	62.46	0.84
10	River	11.61	0.16
Total		7406.3	100

Source: Afifah (2010)

As shown in Table 3 which has been analyzed by previous researcher [4], Minister of Forestry purposes Conservation Forest area 1237.02 ha (16.7%) and Protection Forest area 2584.7 ha (34.9%) in Cisarua sub-district. Based on Bogor Regency Figure (2016), Conservation Forest means a forest area having specific characteristic established for the purposes of conservation of animal and plant species as well as their ecosystem. Meanwhile Protection Forest is a forest area designated to serve life support system, maintain hydrological system, prevent of flood, erosion control, seawater intrusion, and maintain soil fertility.
Ernan Rustiadi, Senior researcher of the Center for Development Studies Regional Development (P4W) Bogor Agricultural University (IPB), explained the changes of land use in Cisarua sub-district due to weak supervision and control of spatial level both central and local government. Land use for settlement has increased yearly. The land use change in Table 4 shows that a change of land use decided by the government in the target area cause the change of land use from forest to settlement in Cisarua. The decline for forest in the land use results a runoff increase in the target area.

Table 4 Land use change from Designation of Provincial Spatial Planning and Forest Land Use in Cisarua

No	Area based on designation	Land use change to							
		Building	Farm area	Farm area (tea)	Rural settlements (low density)	Rural settlements (medium density)	Paddy field	Dryland Agriculture Area	Villa/ Hotel
1	Conservation forest	1.33	21.07	70.1	1.03	4.15	0	117.63	1.54
2	Protection forest	6.8	152.02	524.18	11.87	5.19	9.49	9.49	12.87
3	Farm area	21.63	0	0	9.26	32.23	0	354.53	16.68
4	Dryland Agriculture Area	1.39	0	0	0	69.92	0	0	0
5	Plantation	0	0	0	0	3.65	0	22.76	97

Source: Afifah (2010)

3.2 Solutions to problem

Water shortage and deforestation are a growing concern for many areas in Bogor including Cisarua sub district. There are several solutions which could lead to solve water shortage and deforestation. Table 5 provides suggestions of tentative or potential ways to solve the problem.

Table 5 List of potential ways to solve the problem

No	Problems	Causes	Potential Solutions
1	Water shortage for domestic uses	Their yield of wells is reduced since the establishment of many large-scale housing and hotels	Rainwater Harvesting Improve pipe water supply system
2	Deforestation (Increasing the volume of runoff)	Due to weak supervision and control of spatial level both central and local government.	Reforestation law enforcement Re-planning land use Educative Campaigns
3	Increasing the volume of runoff	Land use change	Infiltration wells (Artificial recharging wells)

3.2.1 Solutions of water shortage for domestic uses

3.2.1.1 Rainwater Harvesting

Rainwater harvesting is a technique of collection and storage of rainwater into natural reservoirs or tanks, or the infiltration of surface water into subsurface aquifers (before it is lost as surface runoff). One method of rainwater harvesting is to collect water from rooftop. Rooftop harvesting can be used to intercept the flow of rainwater and provide a household with high-quantity water for domestic. Other uses include water for gardens, livestock, and irrigation, etc. Rainwater harvesting can also reduce the volume of runoff (Fayez, 2009). In settlement areas, the roof top rainwater can be conserved and used for collection of water. This approach requires connecting the outlet pipe from rooftop to divert the water to either existing tank or specially designed wells. Schematic of Rainwater Harvesting is depicted in Figure 3.

Figure 3: Schematic of Rainwater Harvesting [14]

3.2.1.2 Pipe Water Supply System Improvement

The numbers of PDAM Tirta Kahuripan's customers is still small. Until 2015 the number of customers is still 1211 customers of 29148 households. PDAM Tirta Kahuripan should improve and add the number of customers in Cisarua Sub district. The lack number of customers describes the main problems that are faced by PDAM Tirta Kahuripan are efficiency and reliability.

PDAM Tirta Kahuripan has been working to improve the water supply capacity of these systems by installing new infrastructure including wells, pipe mains, and trench crossings, within the past years. The water company has been working to ensure that its network is connected in such a way that if a pump fails in one area, it can shift water from one area to another area.

3.2.2 Deforestation

3.2.2.1 Deforestation prevention

Deforestation involves the conversion of forested regions to non-forest land for the use of pastures for livestock, logging companies, industrial gain, urban use, or simply to become a wasteland. Sadly, the trend has been in existence for many years in Cisarua sub-district, even though Cisarua Sub-district has been designed for conservation forest (16.7 % of total area) and protection forest (34.9 % of total area). As the population and demands on land resources increases, so does the deforestation in watershed will be increasing the volume of runoff.

To prevent deforestation or increase of the runoff, we have to include many stakeholders who live or need in this area to do their part in preventing deforestation. Stakeholders who can be included such as government, ingenious people, private sector, etc. Deforestation or the increase of runoff are a complex problems. While there are several solutions such as reforestation, law enforcement, educative campaigns, and re-planning for land use. These approaches can make a big difference to solve these problems.

3.2.2.2 Reforestation Promotion

Reforestation is the restoration or replanting of forests that have been reduced by the change of land use in Cisarua sub-district. Reforestation is needed because huge areas of forest are being damaged or destroyed by the establishment of settlement in Conservation forest and protection forest. Table 4 shows Land use change from designation of provincial spatial planning and forest land use in Cisarua sub-district.

This deforestation has a number of causes, including fires, the clearing of land to make way for agriculture or human settlement, and logging. In order to tackle deforestation there are a number of stakeholders that aim to replant trees and help to regenerate and restore forest habitats. It requires an ongoing process and should not be viewed as a onetime thing. People, communities, governments, and organizations are all active actors. It involves selecting and dedicating large tracts of land mainly for the purpose of cultivating forests. For instance, in local communities and urban centers, it can be done around market areas or within city parks. [5]

3.2.3 Runoff

3.2.3.1 Infiltration wells (Artificial recharging wells)

Artificial recharge well is the practice of decreasing volume of runoff by artificial well. The amount of runoff that flow on the land surface will be injected to a groundwater. This process usually occurs in the vadose zone below plant roots and is often expressed as a flux to the water table surface. Recharge occurs through artificial groundwater recharge, where rainwater and or reclaimed water is routed to the subsurface (Hossam, 2012).

3.3 Potential solutions to problem

These are some ideas to help solve the problems that appear. It is essential that everyone must become involved, including governments, after considering many aspects a lasting solution is going to be found. These problems can be done by building more rainwater collector and Infiltration wells (Artificial recharging wells). The main reason for these solution is the high rainfall in the region. This means there are more runoff. The best solution of each problem that appears is tabulated in Table 6.

Table 6 The best solution of each problem that appears

No	Problems	The best solution
1	Water shortage for domestic use	Rainwater Harvesting
2	Deforestation (Increasing the volume of runoff)	Infiltration wells (Artificial recharging wells)

3.3.1 Rainwater harvesting

Rainwater harvesting is a technology used for collecting and storing rainwater from rooftops, land surfaces, road surfaces or rock catchments using simple techniques such as pots, tanks and cistern as well as more complex techniques such as underground check dams. Harvested rainwater is a renewable source of clean water that is ideal for domestic and landscape uses. Water harvesting systems provide flexible solutions that can

effectively meet the needs of new and existing, as well as of small and large sites. Using a water harvesting system is an ongoing process that can be developed over time (Musa, 2011).

The best solution that should be used by households in Cisarua sub district to get water is through rainfall harvesting. Rainwater harvesting is appropriate to be applied in this area if we consider on rainfall annual average over the period 2003 to 2012 is 3040.6 mm / year with an average of 253.4 mm monthly rainfall. Rainwater harvesting is collected from rooftops through drains or gutters into storage containers like drums and surface tanks, and other storage facilities.

Rainwater harvesting method is low cost, easy maintenance and very effective. Table 8 shows availability of rainwater through roof top rainwater harvesting. Estimation of Availability of Rain Water through Roof Top Rain Water Harvesting in Table 7 if this method to be applied in Cisarua sub district:

Table 7 Input data for calculating rainwater harvesting

Items	Numbers	Unit	Source of data
Rainfall	253.4	mm/month	Stasiun Meteorologi Citeko Bogor (period 2003 to 2012)
Population	121978	capita	Badan Pusat Statistik (2015)
Households	29148	Units	Badan Pusat Statistik (2015)
Roof top area	48.8	sqm	Badan Pusat Statistik (2015)
Water demand for domestic	0.12	cum/day/capita	*Ministry of Public of Works and Housing (MoPWH)*

Calculation: Using Table 7 for determine volume water that can be harvested from roof top.

›Water Harvesting = 10 *cum/month* x 29148 *Households*
= 291480 *cum*

›Water demand for domestic = 0.12 *cum/day/capita* x 30*days* x 121978 *capita*
= 439120.8 *cum*

›Water demand/household/month = 0.12 *cum/day/capita x 4 persons x 30days*
= 14.4 *cum/month =3804.0776 Gallon*

Table 8 Availability of Rain Water through Roof Top Rain Water Harvesting

Rainfall(mm)	100	200	300	400	500	600	800	1000	1200	1400	1600	1800	2000
Roof top area (sqm)	Harvested water from Roof top (cum)												
20	1.6	3.2	4.8	6.4	8	9.6	12.8	16	19.2	22.4	25.6	28.8	32
30	2.4	4.8	7.2	9.6	12	14.4	19.2	24	28.8	33.6	38.4	43.2	48
40	3.2	6.4	9.6	12.8	16	19.2	25.6	32	38.4	44.8	51.2	57.6	64
50	4	8	12	16	20	24	32	40	48	56	64	72	80
60	4.8	9.6	14.4	19.2	24	28.8	38.4	48	57.6	67.2	76.8	86.4	96
70	5.6	11.2	16.8	22.4	28	33.6	44.8	56	67.2	78.4	89.6	100.8	112
80	6.4	12.8	19.2	25.6	32	38.4	51.2	64	76.8	89.6	102.4	115.2	128
90	7.2	14.4	21.6	28.8	36	43.2	57.6	72	86.4	100.8	115.2	129.6	144
100	8	16	24	32	40	48	64	80	96	112	128	144	160
150	12	24	36	48	60	72	96	120	144	168	192	216	240
200	16	32	48	64	80	96	128	160	192	224	256	288	320
250	20	40	60	80	100	120	160	200	240	280	320	360	400
300	24	48	72	96	120	144	192	240	288	336	384	432	480
400	32	64	96	128	160	192	256	320	384	448	512	576	640
500	40	80	120	160	200	240	320	400	480	560	640	720	800
1000	80	160	240	320	400	480	640	800	960	1120	1280	1440	1600
2000	160	320	480	640	800	960	1280	1600	1920	2240	2560	2880	3200
3000	240	480	720	960	1200	1440	1920	2400	2880	3360	3840	4320	4800

Source: Central ground water board ministry of water resources (2000)

In Cisarua sub-district roof top rain water experiment can be done in this area where the roof top rain water collected from the roof will be stored into the existing water supply tank of the buildings. About 291480 cum will be recharged during a month and can cover 66.378 % of water demand.

Infiltration wells (Artificial recharging wells)

3.3.2 Artificial recharge of groundwater is achieved by storing surface water in basins, furrows, ditches, or other facilities where it infiltrates into the soil and moves downward to recharge aquifers. Artificial recharge is increasingly used for short- or long-term underground storage, where it has several advantages over surface storage, and in water reuse. To design a system for artificial recharge of groundwater, infiltration rates of the soil must be determined and the unsaturated zone between land surface and the aquifer must be checked for adequate permeability and absence of polluted areas. The aquifer should be sufficiently transmissive to avoid excessive buildup of groundwater mounds (Bouwer, 2002).

Government has been working to provide Artificial recharging wells. In Cisarua Infiltration wells have been constructed around 201 units. There are 30 units in Batu Layang Village, 30 units in Kopo Village, 39 units in Citako Village, and 82 units in Tugu Selatan Village.

Artificial recharging wells can reduce runoff that effected by deforestation. As we know that Cisarua Sub-district is located in upstream, so that runoff from cisarua can be injected to groundwater. This method can indirectly prevent flood in Jakarta as capital of Indonesia. Hydrogeologic cross section can be seen in Figure 5.

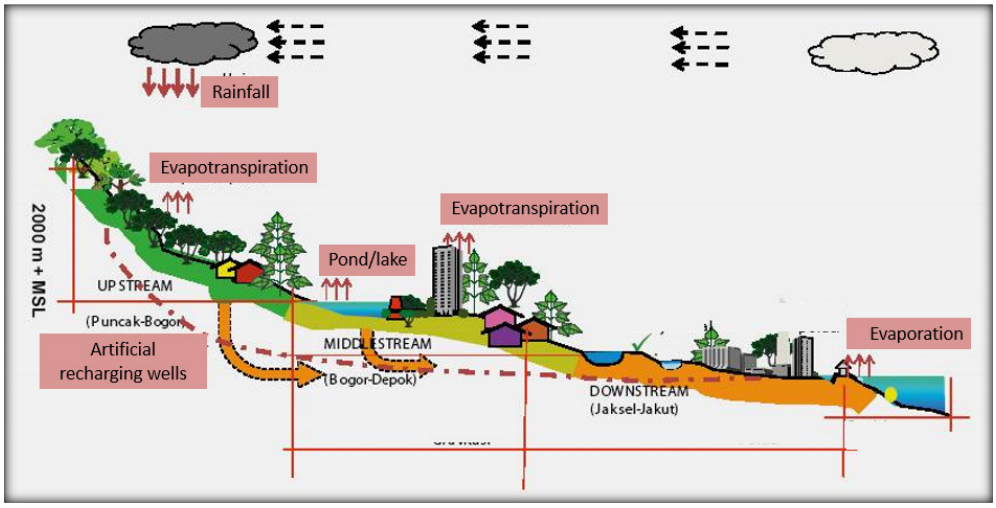


Figure 4: Hydrogeologic cross section showing features of the ground water flow system (Modified by Faisi and Titiek)

4. Conclusions

Water shortage for domestic uses and deforestation that have happened in Cisarua Sub district can be solved by rainwater harvesting and infiltration wells. The roof top rain water collected from the roof will be stored into the existing water supply tank of the buildings. About 291480 cum will be recharged during a month and can cover 66.378 % of water demand. The government has been working to provide infiltration wells. In Cisarua Infiltration wells have been constructed around 201 units. There are 30 units in Batu Layang Village, 30 units in Kopo Village, 39 units in Citako Village, and 82 units in Tugu Selatan Village. Artificial recharging wells or infiltration well can reduce runoff that effected by deforestation. This method can indirectly prevent flood in Jakarta as capital of Indonesia because Jakarta is located lower than Cisarua sub district.

Acknowledgements

The funding received for this project was from the authors and the authors declare that there is no conflict of interest.

References

[1] D. Parwatiningtyas, E.W. Ambarsari, S. Mariko. The Calculation of the Highest Leak Level of Water Pipe Lines Region at PDAM Tirta Kahuripan Using Fuzzy C-Means and ArcGIS Method Analysis. (2017). AIP Conference Proceedings 1862, 030196 (2017); doi: http://dx.doi.org/10.1063/1.4991300

[2] BPS – Statistics of Bogor Region. Bogor regency in figures 2016. Bogor: BPS – Statistics of Bogor Region; 2016

[3] BPS – Statistics of Bogor Region. Bogor regency in figures 2015. Bogor: BPS – Statistics of Bogor Region; 2015

[4] Afifah. Analisis inkonsistensi pemanfaatan ruang di kecamatan cisarua, kabupaten bogor dan faktor-faktor yang mempengaruhinya [Thesis]. Bogor: Bogor Agricultural University; 2010

[5] 8 Fantastic Solutions to Deforestation [Internet]. 2017 [cited 27 Sep 2017]. Available from: https://www.eartheclipse.com/environment/fantastic-solutions-to-deforestation.html

[6] Hossam H. Elewa, Atef A. Qaddah and Ayman A. El-Feel. Determining Potential Sites for Runoff Water Harvesting using Remote Sensing and Geographic Information Systems-Based Modeling in Sinai. American Journal of Environmental Sciences (2012). 8 (1): 42-55.

[7] A. R. Musa, N. M. Tawil*, S. M. Sood, A. I. Che-Ani, N. Hamzah, H. Basri. Constructing Formulation of Affordable Green Home for Middle Income Group. Procedia Engineering (elsavier.com). (2011) 466 – 473

[8] Bouwer, H. Artificial recharge of groundwater: hydrogeology and engineering. Hydrogeology Journal. 2002; 10: 121.

[9] Government of India Ministry of Water Resources. Manual on Artificial Recharge of Ground Water. New Delhi: Central ground water board ministry of water resources; 2007.

[10] Fayez A. Abdulla and A.W. Al-Shareef. Roof rainwater harvesting systems for household water supply in Jordan .2008; Desalination 243 (2009) 195–207

[11] Database of PDAM Kabupaten Bogor (2016)

[12] Database of BPDAS Citarum-Ciliwung (2013)

[13] Database of Stasiun Meteorologi Citeko Bogor (2012)

[14] Harvesting rainwater 2017 [cited 27 Sep 2017]. Available from: https://harvestingrainwater.ca/rainwater-harvesting/

[15] Rezaul K. Chowdhury and Simon Beecham. Characterization of rainfall spells for urban water management. International Journal of Climatology. 2013; 959-967

Development of Indicators for the Assessment of Social, Economic and Environmental Impacts of Clean Development Mechanism (CDM) Projects in Pakistan with a Case Analysis of Pakistan's First Approved CDM Project

Butt, Ayesha Aftab[1,2,*]

[1]Department of Environmental Sciences, Faculty of Basic and Applied Sciences, International Islamic University, Pakistan
[2]Department of Projects and Development, Muslim Hands, Pakistan

Abstract

The aim of this research is to review and develop the indicators which prove to be necessary in assessing the social, economic and environmental impacts of the on-going Clean Development Mechanism (CDM) projects in Pakistan. The study examines missing links, identified through comparative analysis of the on-going projects for the social, economic and environmental criteria. The study identifies the salient impacts of the on-going CDM projects in Pakistan i.e. CERs and generation of carbon credits. It highlights the benefits gained through those projects. The study also explores the potential sectors of CDM projects in Pakistan. It has identified the indicators and provided the means of testing the projects contribution to sustainable development. It is suggested that for any such project, to qualify at least two of the four pillars, namely environmental and social sustainability, must show positive results. The study combines the findings of different studies and communicates well the new tools to understand the evolving environmental factors and evaluate the CDM project performance. There are few literatures available addressing Pakistan's CDM from different perspectives. However, such projects are mostly focused on the methods, research and capacity building but there is a need also to converse the issues of sustainable development criterion and progress towards this aspect. CDM being the new intervention require attention, as great benefits are associated with it and development of indictors to assess the impacts of current CDM projects in Pakistan will actually depict the missing links which will then be focused by future projects and studies. An ultimate conclusion of this research study is the development of the indicators (social, economic and environmental) which provides an indicative answer to the actual research topic.

Keywords: Clean Development Mechanism, Indicators, Pakistan, projects

1. Introduction

Climate Change is the new emerging global environmental issue nowadays which has drawn the world's attention towards itself. Any changes occurring in the natural environment ultimately affects the human activities and hence effects the growth and development of a country. Global Warming is one the serious environmental problem which has aggravated other environmental problems like water and air pollution, soil erosion and loss of biodiversity as well. It is important to adopt some measures in order to reduce such impacts, improvements therefore is needed in energy efficiency, exploration of renewable energy sources and preservation of forests and agricultural lands prove to be great steps in solving various ecological dilemmas. [1]. Recognizing the consequences of climate change different intergovernmental conferences were being carried out in late 1980s and early 1990s particularly focusing on havoc impacts of climate change and its mitigation options. The Kyoto Protocol came into force in 1997, which is one of the great efforts for the protection of the environment and a step towards achieving the sustainable development. The Kyoto Protocol led to the formulation of 3 market based flexibility mechanisms to mitigate GHGs emissions, one of which is CDM. [2]

Clean Development Mechanism defined as, a tool which allows emission reduction projects that assist in creating sustainable development in developing countries to generate CERs for use by the investor [3]. The CDM is an innovative mechanism which has twin aim of supporting industrialized countries in meeting their GHG emission reduction commitments and assisting the developing countries in achieving sustainable development. CDM is newly emerging policy tools which aim to reduce the emissions all over the world and

* Corresponding author; email: ayeshag2@hotmail.com

has a great potential to combat with climate change impacts thus benefit the entire globe. It is important to encourage the CDM projects in order to fulfill the national requirements and cope with problems like poverty, food insecurity and illiteracy. The only way CDM can contribute to sustainable development in developing world is, if the mechanism embraces simultaneously social, economic and environmental responsibility and avoids becoming yet another tool to make the economically richer to be more rich. [4].

The aspect of sustainable development for CDM is not just a condition; it is the prime driver for establishing a country's interest in the development of CDM projects [5]. CDM projects generate number of impacts e.g. social, economic and environmental in the host countries besides the GHG emission reductions. The choice of the Sustainable Development criteria and the assessment of the Sustainable Development impacts are supreme matters of the host countries in the present operationalization of the Kyoto Protocol [5]. Therefore, all national authorities needs to establish the sustainable development dimension in order to assess the connection between national development goals and CDM projects, with intention of selection and designing of CDM projects to create synergy with the development goals of a nation. [6]

2. Research Objective

Assessment of sustainable development aspect of CDM projects is a chance for the national authorities to identify potential CDM projects and exploitation of local development synergies. The Designated National Authorities (DNAs) play a significant role in securing the recognition of national development benefits of CDM projects, since they are anticipated to examine the obligation of the CDM to assist Sustainable Development to be fulfilled in host countries [7].

As, Chapter 40 of Agenda 21 calls for the indicators of sustainable development. Agenda requires the countries, international, governmental and non-governmental organizations to develop the idea of sustainable development indicators to identify those in the perspective of CDM project performance. It is the choice of the host Party to verify whether a CDM project activity helps to achieve Sustainable Development goals or not. [8]

Pakistan, being the beneficiary of CDM, has huge potential through the development of these projects in various sectors. For the successful implementation of CDM, Pakistan needs to set up its own sustainable development indicators which may prove to be helpful in the assessment of future CDM projects in the country. Although Pakistan has endorsed host country approval to certain CDM projects and also leading towards Certified Emissions Reductions (CERs) but still there is a need to meet the sustainable development criteria through the development of Sustainable Development Indicators (SDI) to meet the desired goals of effective implementation of future CDM projects and their success in Pakistan as well as globally. This study will thus lead towards the following objectives;

1) Development of sustainable development indicators in Pakistan's context,
2) Assessment of sustainability of an on-going CDM project in Pakistan and,
3) Identification of missing gaps and possible recommendations.

3. Materials and Methods

Study Protocol

The research methodology handled the data in two main steps; Data Collection and Data Analysis. Data (qualitative / quantitative) was collected from different primary and secondary sources such as; literature reviews, series of interviews, meetings, field visits, focus group discussions, interviews, brain storming sessions with CDM experts, different events / conferences. It included; Meetings with relevant ministries (Ministry of Environment, Ministry of Industries, Ministry of Water and Power), International Organizations working on CDM projects implementation in Pakistan, Meetings with the CDM registered project proponents i.e. Pak Arab Fertilizer Limited (1st CDM approved project of Pakistan by UNFCCC), Brain storming sessions during field/site visit. Certain questions were also raised to reach towards the end objective of the study. The following sub questions were further developed regards current status of CDM in Pakistan and its promotion, possible barriers in implementation faced by industries and recommendations for effective implementation of such projects in the country.

Data Collection

In recognition of the situation, five specific tasks were identified/ highlighted in the project study including; Integrative review and analysis of CDM in Pakistan, Identification of the potential for CDM in Pakistan particularly in the potential sectors mentioned in the National CDM Strategy, Evaluation of the CDM performance in Pakistan and the sustainable development assessment of CDM projects in Pakistan, Development of the indicators for assessing the social, economic and environmental impacts of CDM projects in

Pakistan and Analysis of the sustainability criteria employed for the 1st CDM approved project, Pak Arab Fertilizer Multan in Pakistan.

The first step of data collection highlighted the background of the CDM approach in accordance with the sustainable development objectives. Various methods were used for the entire study; integrative review of CDM in Pakistan's context was based on the latest appropriate information obtained through review of literature and sequential progressive interviews conducted. Literatures included the scientific journals, research project reports, publications, Project Design Documents (PDDs), conference papers and presentations as well as up-to-date information from Ministry of Environment, CDM Cell website. The statistical data came from authoritative publications (ministries, international organizations, private sector working on CDM projects), formal interviews were taken (personally or via email). Some of the interviewees gave well-timed response to the project findings. Information related to CDM and Climate Change was collected by attending seminars, conferences and workshops on the subjects of CDM financing, Carbon Credit opportunities in power, renewable energy, waste management etc. conducted by different private, international and government organizations working on CDM project development in Pakistan like Winrock International, CDM Cell-Ministry of Environment, UNIDO, Carbon Services etc. The consequent interactions enhanced the sources of information and shaped further discussions. Comparative approach was also used in the study as well. Assessment of the Pak Arab Fertilizer, Multan project (1st CDM registered project of Pakistan) was carried out against the set defined indicators in the Gold Standard Manual. Degree of success was assessed in terms of meeting up of the criteria of sustainable development (social, economic and environmental).

Tools Devised

A close and open ended questionnaire was developed on the basis of standardized gold indicators and indicators extracted from the PDD for the assessment of social, economic and environmental impacts generated by the CDM project of Pak Arab Fertilizer Limited (PFL). The questionnaire highlighted the three criterions (social, environmental and economic) for the assessment of CDM project impacts. The questionnaire was discussed with the project officials and filled. Questions mentioned in the questionnaire were related to the current status of the project, benefits gained by the community through the project, economic wellbeing of the country and environmental wellbeing of the particular area where the project was operational. The questionnaire has helped in determining the missing links which were addressed by the study. The secondary data was also collected through different sources particularly from the studies already concluded and Ministry of Environment, DNA.

4. Results and Discussions

The study chiefly led towards devising a set of sustainable development indicators in Pakistan's context, the same set is then used to assess the sustainability of an on-going CDM first approved project in Pakistan. Alongside, the study revealed the gaps identified and possible recommendations for effective implementation of the model in developing country's context.

4.1. Prioritized Sustainable Development Indicators and Scaling: The ultimate outcome of the study is the list of sustainable development indicators addressing 3 main pillars i.e. social, economic and environmental particularly. A relative scale has also been provided for the assessment of the indicators. The list of indicators developed for the assessment of CDM projects in Pakistan clearly highlights the most important aspects which should be addressed properly for a developing country like Pakistan. The list of indicators defined under the criterion as highlighted in the given table;

Table 1 Proposed Set of Indicators for the Assessment of CDM projects sustainability of Pakistan

CRITERIA	INDICATORS
ENVIRONMENTAL	Reduction of greenhouse gas emissions compared with baseline (CO2 equivalent)
	Emission of air pollutants compared with baseline
	Noise level in the project site
	Odor Pollution
	Waste water quality
	Waste output of the project per raw material input
	Soil contamination in compliance with government standards
	Ground water contamination

CRITERIA	INDICATORS
	The amount of hazardous waste
	The project's water demand and efficiency of water usage
	Soil, coastal and river bank erosion in the project site
	Green Areas
	The impact on ecosystem diversity and biodiversity
	Population size and species of flora and fauna
SOCIAL	People's participation, sensitization, education
	Projects or activities based on sufficiency economy philosophy, Protection of natural and cultural heritage, Scholarship awards, Religious, arts and cultural activities, Healthcare support, Child nursery care, living standards, Supplying drinking water etc.
	Workers' health and surrounding community health
	Generation of Employment Opportunities
TECHNOLOGICAL	Development/import of technology
	Number of well skilled employees
	Post Crediting Period plan as outlined by the project
ECONOMIC	Workers' annual income
	Energy. Consumption, Production Use of alternative energy or energy efficiency (percentage %) Use of alternative energy / domestic renewable energy (tons of oil equivalent) Percentage of energy usage efficiency
	Provision of infrastructure and procedural requirements.

Keeping in view, the situation of a developing country like Pakistan, environment is the neglected area as compared to the social and economic criteria. In case of CDM projects (On-going and new project proposals) indicators provided prove to be useful as each criteria is addressed separately.

In contrast to the existing literature of the sustainability assessment of CDM projects such as MATA-CDM (Multi-Attributive Assessment of CDM projects) approach which is been defined under Kyoto Protocol and applicable to assess the sustainability of all international CDM projects, this study has focused on a specific perspective of development of indicators for the assessment of sustainable CDM projects of Pakistan. The set of proposed indicators resulted from the study are totally in compliance with the National Sustainable Development Strategy (NSDS) of Pakistan and addresses separately the environmental, social and economic challenges associated with the CDM projects which may hinders the sustainable development of the country.
It is important to carry out the assessment of sustainable development benefits of CDM projects applicable to the future CDM projects also. The easiest way is the application of a uniform checklist which considers different parameters against the defined scale. Different identified indicators can be calculated using the standardized values given in Table No. 7 indicating the values from -1 to 3.

Table 2 Assessment scale for determination of the Sustainable Development benefits of CDM projects

SCALE Value	SIGN	INDICATOR
-1	Negative	Project has negative sustainable development impacts. Negative impacts generated in terms of environmental and social development (ESD) policies and/or causing environmental/social impacts from the CDM project baseline.
0	Neutral	Sound CDM project having no difference from baseline in any of environmental/social or policy terms
1	Positive	One additional significant benefit e.g. one of social, local, environmental, health, poverty, community participation or economic/welfare gains.
2	Positive	Two or more additional benefits in two categories. i.e. social, environmental and economic
3	Positive	Significant benefits in three or more categories i.e. social, local, environmental, health, community participation and welfare/employment.

Proposed Set of Indicators for the assessment of Social, Environmental and Economic Impacts of CDM Projects in Pakistan: Pakistan being a developing country and a new entrant to the CDM business needs to develop the guidelines and the indicators for review and approval of CDM projects according to national sustainability goals. Sustainable development including technical and institutional infrastructural are required to be raised to an increased stage in order to evaluate the projects qualifying for CDM. All CDM projects need to demonstrate progress in all three pillars of sustainable development (environmental, social, and economic) as well as sustainable technological indicators.

Table 3 Set of Indicators for Assessing impacts of new and ongoing CDM projects in Pakistan

CRITERIA	INDICATORS	NEW CDM PROJECT PROPOSAL (PDD)	ONGOING CDM PROJECT
ENVIRONMENTAL			
1) Reduction of greenhouse gas emissions	Reduction of greenhouse gas emissions compared with baseline (CO2 equivalent)	0 Greenhouse gas emissions are equivalent to baseline +1 Greenhouse gas emissions are reduced	- 1 Increase in greenhouse gas Emissions 0 Greenhouse gas emissions are equivalent to baseline +1 Reduction of greenhouse gas emissions less than 10% by year +2 Reduction of greenhouse gas emissions by 10% and more by year
2) Reduction of air pollutant emissions in compliance with air quality standards Note: Standards concerning air pollutants should be in compliance with the laws of Ministry of Environment, EPAs, Pollution Control Departments etc.	Emission of air pollutants compared with baseline	-1 Increase in emissions of air Pollutants 0 Emission of air pollutants is equivalent to baseline +1 Reduction of air pollutant emissions	-1 Increase in emissions of air Pollutants 0 Emission of air pollutants is equivalent to baseline +1 Reduction of air pollutant emissions less than 20% by year +2 Reduction of air pollutant emissions by 20% and more by year
3) Noise pollution (in compliance with government standards announced by EPAs such as NEQs)	Noise level in the project site	0 Noise level meets standards +1 Noise level below standards	-1 Noise level exceeds standards 0 Noise level meets standards +1 Noise level below standards by 10 Decibel or less +2 Noise level below standards more than 10 decibels
4) Odor pollution (in compliance with government standards)	Odor pollution	0 Meets standards +1 Below standards	-1 Exceeds standards 0 Meets standards +1 Below standards +2 Odorless
5) Wastewater quality (According to set effluent standards)	Wastewater quality	0 Wastewater quality meets standards +1 Wastewater quality is below standards +2 Wastewater quality is below standards and wastewater discharge decreases	0 Wastewater quality meets standards +1 Wastewater quality is below Standards +2 Wastewater quality is below standards and wastewater discharge decreases +3 Zero discharge of wastewater/treated wastewater

		+3 Zero discharge of wastewater/treated wastewater	
6) Waste management	Waste output of the project per raw material input	-1 Increased waste output per raw material input 0 Waste output per raw material input remains intact +1 Reduction of waste output per raw material input +2 Zero flow of waste	-1 Increased waste output per raw material input 0 Waste output per raw material input remains intact. +1 Reduction of waste output per raw material input +2 Zero flow of waste
7) Soil Contamination	Soil Contamination in compliance with government standards	0 No soil contamination +1 Rehabilitation of soil quality	-1 Creating soil contamination 0 No soil contamination +1 Rehabilitation of soil quality
8) Groundwater contamination	Groundwater contamination	n/a Not applicable to the new proposals	-1 Groundwater contaminated 0 No groundwater contamination
9) Reduction of hazardous waste Note: Hazardous waste should be in compliance with laws announced by relevant ministries and authorities.	The amount of hazardous waste	-1 The amount of hazardous waste increases 0 The amount of hazardous waste remains intact +1 The amount of hazardous waste decreases.	-1 The amount of hazardous waste increases 0 The amount of hazardous waste remains intact +1 The amount of hazardous waste decreases
10) Water demand and efficiency of water usage	The project's water demands and efficiency of water usage	-2 Water usage impacts water resources and creates other environmental impacts in the water basin. -1 Water usage impacts water resources. Water usage per production unit increases. 0 Water usages does not impact water resources nor create environmental impacts in the water basin. +1 Self-contained water storage +2Self-contained water storage and decrease of water usage per unit.	-2 Water usage impacts water resources and creates other environmental impacts in the water basin. -1 Water usage impacts water resources. Water usage per production unit increases. 0 Water usages does not impact water resources nor create environmental impacts in the water basin. +1 Self-contained water storage +2 Self-contained water storage and decrease of water usage per unit.
11) Soil, coastal and river bank erosion.	Soil, coastal and river bank erosion in the project site	n/a Not applicable	-1 Soil, coastal/river bank erosion caused by the project's activities 0 No soil, coastal and river bank erosion caused by the project activities.

			0 No soil, coastal and river bank erosion caused by the nature due to impact of project activities.
12) Increase in green areas under the project's initiative.	Green areas	0 The project does not develop green areas. +1 The project develops green areas. +2 The project develops green areas above the average of provincial statistics. +3 The project develops green areas above the average of provincial statistics and does not pollute landscape.	0 The project does not develop green areas. +1 The project develops green areas. +2 The project develops green areas above the average of provincial statistics. +3 The project develops green areas above the average of provincial statistics and does not pollute landscape.
13) Ecosystem diversity	The impact on ecosystem diversity and biodiversity	-1 Impact on ecosystem diversity and biodiversity. 0 No impact on ecosystem diversity and biodiversity. +1 Increase of biodiversity to the ecosystem.	-1 Declined biodiversity in the ecosystem. 0 The ecosystem remains intact. +1 Increase of biodiversity to the ecosystem.
14) Species diversity	Population size and species of flora and fauna	-1 Decline in population size and species of flora and fauna. 0 Flora and fauna species remain intact. +1 Increase in flora and fauna species.	-1 Decline in population size and species of flora and fauna. 0 Flora and fauna species remain intact. +1 Increase in flora and fauna species.

4.3 Assessment of Sustainability of an On-going CDM project of Pakistan

During the field visit of the On-going CDM project i.e. PFL Project Multan, assessment has been made on the basis of the indicators extracted from the Gold Standard Manual typically being used for assessing the performance of the CDM projects. The scale values would be like;

• 0 -- Neutral (Sound CDM project with no significant benefits nor loss)

• +1-- Positive (One additional significant benefit e.g. one of social, local, environmental and economic).

• +2 – Positive (Two or more additional benefits in two categories. i.e. social, environmental and economic).

• +3 – Positive (Significant benefits in three or more categories i.e. social, local, environmental, health, community participation and welfare/employment).

• -1 – Negative (Negative impacts generated in terms of environmental and social development policies and/or causing environmental/social impacts from the CDM project baseline).

The following table shows the rating against the defined scale for the assessment of CDM project impacts for the PFL project Multan.

Table 4 Rating of Pak Arab Fertilizer (PFL) Project Impacts

THEME	INDICATORS	SCALE	BENEFITS
SOCIAL	Contribution to net employment generation	+1 -- Positive	Social
	Equal employment opportunities	0 -- Neutral	-
	Social security of work force	+2 – Positive	Social (health) Economic
	Capacity building of staff and learning	0 -- Neutral	-
	Education	+1 -- Positive	Social
	Improved quality of life	+2 –Positive	Social/ Environmental
ECONOMIC	Contribution to sustainability of the balance of payments	+2 –Positive	Economic/ Environmental
	Cost effectiveness	+1 – Positive	Economic
	Contribution to macroeconomic sustainability	+1 -- Positive	Economic
	Reduction of direct government investments	0 – Neutral	-
	Net foreign currency savings	+1 -- Positive	Economic
ENVIRONMENTAL	Air quality	+1 --Positive	Environmental
	Avoided emissions of local pollutants	+1 --Positive	Environmental
	Other Pollutants	+1 --Positive	Environmental
	Biodiversity	Not applied	-

5. Conclusion & Recommendations

Pakistan is a developing nation with problems like diminutive geographic area and burdened with population, political insecurity, resource constraints, unemployment, poverty and environmental problems. In this regard, implementation and development of CDM projects is vital. Environmental well-being can be achieved through execution of maximum number of CDM projects which helps in overcoming the problems like energy crisis, health hazard and economic instability. CDM projects development in Pakistan has faced several restrictions since its initiation. The major gaps identified in the CDM projects implementation in Pakistan are as follows;

- There is a lack of baseline data. A well-defined baseline should be established taking into consideration the opinions of country's experts and all concerned government, non-government and international organizations.
- There is a Low level of awareness amongst the public, private and financial sectors about CDM procedures and opportunities are the underlying obstacles to CDM's thrive in Pakistan. Awareness raising and dissemination of information should be carried out properly through seminars, workshops, trainings and advertisement.
- Pakistan lacks optimum funds in the CDM operation, in this regard government should mobilize the entrepreneurs through motivation and the banking sector should be called for raising fund for the CDM projects development. There is a need that the Board of Investment should convince foreign investors to set up projects with 100 per cent equity or in the form of joint ventures on the basis of CDM arrangements.
- There is low Capacity level of public and private institutions. It is important to build the capacities of the officials of these institutions particularly the staff of DNA through information dissemination and also to draw the attention of donor agencies and other foreign investor through participation in trade fairs, exhibitions, international workshops and websites of other national institutions. CDM project approval process is quite complex in Pakistan. Industrial stakeholders are not satisfied with the procedure of host country approval and they are of the view that the concerned government officials are not properly providing guidelines to complete the required procedure. In order to overcome this problem country like Pakistan should apply to the CDM Executive Board to relax and simplify the process for the sake of smooth growth of CDM in the

whole developing world. Proper guidelines for the preparation of PDD and all other related stuff must be made readily available on net for preparation of reports and studies otherwise stakeholder is bound to hire consultant services which may prove to be expensive.

- There is a gap in the understanding of the involvement of academic institutions in the CDM project development. In this regard, the academic institutions and consulting firms should be taken on board for their technical skills enhancement in order to provide technical resources in Pakistan for CDM project development and to address the projects' sustainability issues in a best way.
- The government alone however, cannot alleviate the seriousness of threat to sustainable development in Pakistan. It demands urgent action by all segments of society including the Government, private sector, NGOs and civil society at large. The government should take the lead in initiating the action through promoting participation for ownership of policies, programmes and projects and enforceability of laws and regulations.
- For carrying out the sound sustainable development activities/projects in Pakistan and to make NSDS effective it is important to devise an appropriate institutional mechanism for its implementation and monitoring. NSDS is multisectoral in nature, in this matter Government should constitute a multisectoral body which should not only plan, monitor or supervise the implementation of NSDS but also motivate the key stakeholders with a stake in a prosperous future of Pakistan, in its implementation and may also serve the purpose provided its mandate and membership is broadened in line with all three aspects of sustainable development i.e. economic, social and environmental dimensions.

This study has also provided a ground for the further research on how these indicators could be refined more in order to be used for the assessment of CDM projects according to the national priorities and project specific indicators could also be proposed. The future studies may also focus on the Development of a success criteria including Sustainable Development Indicators by assessing the projects through the DNA with the help of UNFCCC. To make this effective a Sustainable Development Unit could be established under the DNA to work on this special perspective of Sustainable Development. Further research to be carried should also need to focus on the following;

- Research into the need of Institutional Arrangements: - For the Developing nations say Pakistan like to host CDM projects need to put in place the necessary institutional mechanisms for approving CDM projects and ensuring their compatibility with national sustainable development goals and strategies.
- Need for financial arrangements: - There is a need for sufficient financial arrangements into the CDM sector in order to promote the associated sustainable (social, economic and environmental) benefits arising from these projects.
- It is needed to know how much sustainable development could be possible through CDM projects for the developing countries.

Sustainable development is not actually a requirement but should be considered as an important aspect in CDM scheme. For the developing countries like Pakistan CDM should be examined both at policy and implementation levels and the success stories of the advanced civilizations prove to be effective in this regard.

Acknowledgements

The author would like to extend special thanks to the department of environmental sciences, international Islamic university, Islamabad, Pakistan for providing the baselines and technical inputs to the study, moreover the CDM unit of United Nations Industrial Development Organization (Pakistan) providing ways of enriching the research with up-to-date information.

References

[1] Olhoff et al. (2007) CDM Sustainable Development Impacts Guide, CD4CDM UNEP Project
[2] UNFCCC (2015) Web link: http://unfccc.int/kyoto_protocol/items/2830.php
[3] Rosales, J. and G. Pronove (2002) A Layperson's Guide to the Clean Development Mechanism. UNCTAD-Earth Council
[3] Pembina Institute for Appropriate Development (2003) A User's Guide to the Clean Development Mechanism (CDM) – Second Edition.

[4] Liguang, L. (2006) Seeking synergies to achieve sustainable development. Clean Development Mechanism in China. Master Thesis, Masters of Science Programme, Jinan University, China
[5] Verles, M. (2016) Sustainable Development from Kyoto to Paris and Beyond
[6] Curnow, P. (2009) A guidebook to host country legal issues
[7] CDM cell, Ministry of Environment, Pakistan (2006), Pakistan National Operational Strategy for CDM
[8] UNIDO (2009), Institutional Capacity Enhancement for CDM in Pakistan, Research Study carried out by UNIDO and Ministry of Environment, GOP (Report Unpublished)
[9] Agenda 21, Chapter 40: Information for Decision-making. (Advanced version of chapter 40 of Agenda 21, as adopted by the Plenary in Rio de Janeiro, on June 14, 1992) weblink: gopher://unephq.unep.org:70/11/un/unced/agenda21

Session of Hospitality and Tourism Management

Comparing Performance of Centralized and Non-Centralized Safety Stock Case Study: Retail Clothing Business

Supreechaya Bunmak[1,*], Nathawan Samakachan[1] and Arisara Thaneerananon[2]

[1] Logistics and Supply Chain Management Program, Faculty of Management Science,
Nakhon Pathom Rajabhat University, Nakhon Pathom 73000, Thailand
[2]Business Education Program, Faculty of Management Science,
Nakhon Pathom Rajabhat University, Nakhon Pathom 73000, Thailand

Abstract

This research aims to develop a model of safety stock for retail clothing business between centralized and non-centralized system. Currently, in a case company that used non-centralized system to control their inventory. The company's central warehouse, when supplier delivered finished goods to the warehouse, warehouse staff will check the products and proceed the inventory information to the company database system. After that, all inventory will be sorting out and distributing to retail stores without stocking inventory in the warehouse. There are some company problems with the inventory such as imbalance among retails store and transferring inventory between retail stores, which have been taken long time. Moreover, waiting period for ordering new products on next period if the retail store can't transfer the inventory to another store. Which may be leads to opportunity lost. In this paper, the researcher emphasizes on the efficiency improvement for safety stock system by modifying the safety stock system to a centralized, the majority of inventory stored at company central's warehouse and small lot stored at the retail stores. As a result, the centralized safety stock system can reduce the quantity of safety stock to 1,344 pieces from 2,224 pieces or reduced 39.57% that compared with non-centralized safety stock system and can reduce production costs down to THB 102,960. In addition, the reshuffle of safety stock system has reduced lead time to 1 week from at least 2 weeks for replenishing the inventory to retail stores. This helps to increase the company's commercial opportunities.

Keywords: Safety Stock, Centralized, Non-centralized, Retail business

1. Introduction

From the current business situation, there is high level of competition and has new entrants to the business in a growing proportion. Each entrepreneur will be develop and implement the new strategies that aims to increase market share than other operators in the same business. For the retail clothing business, based on the economic situation analysis [1] prepared by department of business development, Ministry of commerce on December 2015, the retail clothing business that higher the growth rate to register for start-up company. This is opposed to other type of businesses that trend to decrease.

Due to circumstance, there are many business competitors in retail clothing business. The entrepreneurs need to adapt the business plan following current world economic situation. One of the key factors that entrepreneurs must be prioritize is the effective planning, implementation and management of their resources. For the trading business, the important resources to the performance of an organization are the production and stock keeping. The optimal of production and storage of materials are important to the profitability of the business.

For the retail clothing business, the inventory management is an important because there are many competitors. If prepared the inventory less than demand, the trade opportunities will be lost. In the other hand if prepare the inventory level to high, the entrepreneur must spend a lot of money to investment and risk of loss from sales.

In this paper, the researcher emphasizes on the efficiency improvement for safety stock system in case study of retail clothing business by modifying the safety stock system to a centralized, the majority of inventory is stored at company central's warehouse and small lot stored at the retail stores instead of non-centralized, all the inventory stored at each retail stores without stocking the inventory at the company's central warehouse.
For the research objective as,

1. To study and develop the safety stock model for retail clothing business.
2 Testing results from the model development to compare performance between the current model (Non-centralized safety stock) and the new model (Centralized safety stock)

The researcher has reviewed about the theories and reviewed of the literature as following;

* Corresponding author; e-mail: supreechaya.work@gmail.com

The inventory control system [2], the criteria used to select the inventory control system to suitable the organization's operating strategy. The inventory control system is classified as two types;

Type 1 Continuous inventory system is a system to track the movement of the inventory at all times. This is a system that records the input-output inventory data and represents the current balance of the inventory level on the monitor screen. For a continuous inventory system that is suitable for the high value product and important to the organization to be handled regularly.

Type 2 Periodic inventory system is a system of inventory in which updates are made on period basis, with a set period of the inventory balance check such as weekly, monthly, Quarterly or annual. This system is suitable for the common product and consistent usage product.

For the safety stock inventory system, the product that the organization has calculated for backup stock in cases the product has a higher volume to use than expected, or other unexpected situation. The key factors in determining the quantity of the safety stock inventory that consist of the accuracy forecast, the service level target of the organization, the frequency of replenishment, lead time and other variability.

Service level [4] is an important factor for determining amount of inventories that an organization will reserve to prevent lose any opportunity to sell. However, if the organization has set a high service level, the cost will be high following target level. Therefore, the organizations must be carefully about data analyze and plan strategies.

The concept of risk pooling [5] is an important concept for the supply chain management process. The concept of risk pooling as demand fluctuation will be lower level if aggregate demand from different sources are combined. By reducing such fluctuate, the amount of safety stock inventory of the organization will be reduce. This will be beneficial to the organization in terms of reducing inventory cost. Risk pooling can be accomplished in several methods including consolidating of inventory storage locations to the center warehouse, product integration, consolidation of distribution points.

The research of Sri Krishna Kumar and M.K Tiwari [6] has designed the supply chain system by using the risk pooling technique. In case study is a comparison between the performances of the retailer that independent of each other and retailer work with distribution center. This research method using mix integer nonlinear programming as an implementation tool. The result of the research concluded that the retailer work with distribution center can reduce the total operating cost up to 8.25%

The research of Peter L. Jackson, John A and Muckstadt [7] has studied the impact of inventory system between several retailers and warehouse. The researcher has set the retailer's order cycle twice time by using the risk pooling model. The results of the research showed that the impact on the second order of the product. The effect that the researchers has developed to determine the optimal of the demand for each product in the store. In additional, this research also aims to develop a computer system for the operation of controlling distribution system to retailers.

The research of Z. Kevin Weng [8] has studied the impact of risk pooling which is caused by demand uncertainty. This research study the layout of warehouse and n retail stores. The inventories at the warehouse are include many products of retailers and studied the impact of operation costs, opportunity cost, cost of inventory and ordering cost. The results of the research showed that many retailers use the safety stock inventory to reduce the cost of their products.

2. Materials and methods

For company information, in case study is fashion clothing company under their own brand. The company has fashion designers to design product including men's clothing, women's clothing and accessories. There are 10 branches in Bangkok. Target customers of this brand are during adolescence and working age. The highlight of company case study that there are a variety of clothing styles and accessories for the customers to view and select products, so it is attracting a large number of customers to shopping at stores.

In the first step, researcher study of the company's business model. The product that the researcher interested is a T-shirt for men in black and white colour. For the T-shirt for men is available product throughout the year and generates revenue for the company. In product details; each color is available in 5 size as XS, S, M, L, XL. For the production order period of the T-shirt. The company has set an order cycle every four months; the company takes about 1 month to analyze the sales data before ordering and the factory will take 3 months to order production.

Table 1 The period of T-shirt production and delivery

Month in which the company ordered to factory production	January	May	September
Month at the factory delivery finish goods to company center warehouse	March	July	November

After the factory delivers the finish goods to company central warehouse and warehouse staff will be check the order, counting products and data entry into the warehouse inventory system. Then all the stock are sorting by the number assigned by sales department in each branch and shipping all the product to the store without stock keeping at the warehouse. In case of any branch store requires additional product, they will need to contact other branches to transfer stock and the warehouse will be the operator to transfer the stock between the stores.

For each production order cycle, the sales department will record the sales report in each period of each branch stores and analyze the data and decide the order quantity to production.

For the data analysis consist of 2 parts as

Part 1 Analysis of sales quantity for next period sales forecast data.

Part 2 Analysis for the safety stock volume in each color, size to storage in each branch store.

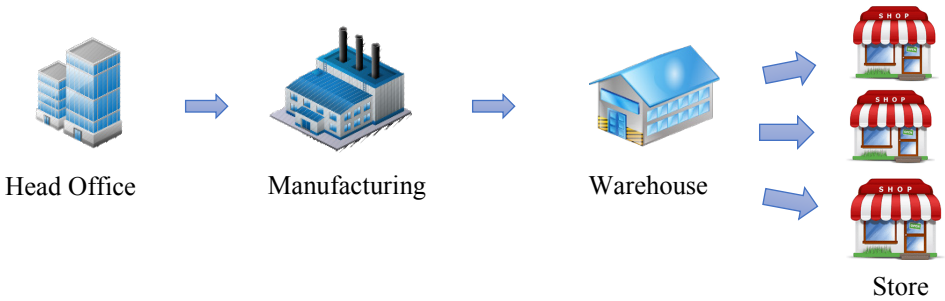


Figure 1 Process flow of ordering and shipping information

Based on the operating model of the case study company can be encountered the problem as follow;

For the product distribution method of the company's case study to all branch stores without some stock backups stored at the company central warehouse. If any branch stores need to transfer the stocks between Branch stores will take a minimum of two week to complete process. Due to the company central warehouse will begin to transfer from one branch and back to warehouse to carry out the paperwork before shipping to other branches. In the other hand, if any branch store do not transfer the products to another store. The branch store will have to wait for the order in the next cycle order, which will take a long time.

From this issues, the researcher is interested to improve the safety stock model in a new format by adjusting the safety stock system from the currently method as non-centralized safety stock to the new method as centralized safety stock system by using risk pooling concept, is to store safety stock inventory at the company central warehouse.

The research process as follow;

Step 1 Determining the amount of safety stock level to reserve in various places with lead time. Lead time is the deciding factor. For the new safety stock model will be stored in two locations as

- One part of safety stock inventory will be stored at company central warehouse, by the time taken for calculating the safety stock inventory a total 4 months or 16 weeks as current operation.

- One part of safety stock inventory will be stored at branch stores. The researcher has added the condition about replenish stock at branch store, each branch stores can request to fill the stock from the company central warehouse on time per week. After company central warehouse received the request they will deliver the products to the branch store at the same day in the week later. So, lest time to calculate for the safety stock level of and branch store is one week.

For the both stock locations use the method of safety stock calculating from the formula.

$$\left(\sqrt{L} \times \sigma\right) \times z \tag{1}$$

The explanation of the variable in equations;

L = Lead time for products delivery from source location to destination

Z = Customer service level, the organization is set at 97%

σ = Standard deviation of weekly sales report that separate by branch stores, color, size

Standard deviation calculated from the formula as

$$\sigma = \sqrt{\frac{\sum(x-\bar{x})^2}{N}} \tag{2}$$

x = T-shirt's weekly sales report

$\bar{x}$ = Average sales of all T-shirt

N = Amount of week

Step 2 Calculate the summary of safety stock by using centralized inventory concept; the result obtained from the calculation of safety stock that stored at the company central warehouse and the amount of safety stock that stored at each branch stores.

Table 2 Total amount of safety stock on the period of sales from December 2015 to March 2016 (Period 1) by using centralized inventory concept

Color	Size	Safety Stock		
		At Warehouse	At Store	Total
Black	XS	19	5	24
	S	65	17	82
	M	72	18	90
	L	24	6	30
	XL	17	5	22
White	XS	21	6	27
	S	99	25	124
	M	67	17	84
	L	31	8	39
	XL	13	4	17
Grand Total		**428**	**111**	**539**

Table 3 Total amount of safety stock on the period of sales from April to July 2016 (Period 2) by using centralized inventory concept

Color	Size	Safety Stock		
		At Warehouse	At Store	Total
Black	XS	29	8	37
	S	63	16	79
	M	51	13	64
	L	28	7	35
	XL	14	4	18
White	XS	35	9	44
	S	57	15	72
	M	55	14	69
	L	39	10	49
	XL	16	4	20
Grand Total		**387**	**100**	**487**

Table 4 Total amount of safety stock on the period of sales from August to November 2016 (Period 3) by using centralized inventory concept

Color	Size	Safety Stock		
		At Warehouse	At Store	Total
Black	XS	15	4	19
	S	29	8	37
	M	28	7	35
	L	22	6	28
	XL	12	3	15
White	XS	23	6	29
	S	44	11	55
	M	41	11	52

Color	Size	Safety Stock		
		At Warehouse	At Store	Total
	L	27	7	34
	XL	11	3	14
Grand Total		**252**	**66**	**318**

3. Results and discussion

The researcher compared the efficiency of safety stock level between the current pattern as non-centralized and new concept as centralized concept the store main safety stock of T-shirt at company central warehouse, the result are as follow

Table 5 Total amount of safety stock based on sales report from December 2015 to March 2016 (Period 1)

Color	Pattern	Safety Stock						No. Diff	% Diff
		XS	S	M	L	XL	Total		
Black	As-is of period 1	40	111	113	54	39	357	-109	-30.53
	To be of period 1	24	82	90	30	22	248		
White	As-is of period 1	56	138	112	69	27	402	-111	-27.61
	To be of period 1	27	124	84	39	17	291		

Table 6 Total amount of safety stock based on sales report from April to July 2016 (Period 2)

Color	Pattern	Safety Stock						No. Diff	% Diff
		XS	S	M	L	XL	Total		
Black	As-is of period 2	57	111	106	85	32	391	-158	-40.41
	To be of period 2	37	79	64	35	18	233		
White	As-is of period 2	61	144	131	87	34	457	-203	-44.42
	To be of period 2	44	72	69	49	20	254		

Table 7 Total amount of safety stock based on sales report from August to November 2016 (Period 3)

Color	Pattern	Safety Stock						No. Diff	% Diff
		XS	S	M	L	XL	Total		
Black	As-is of period 3	44	79	84	52	26	285	-151	-52.98
	To be of period 3	19	37	35	28	15	134		
White	As-is of period 3	69	86	91	72	14	332	-148	-44.58
	To be of period 3	29	55	52	34	14	184		

Based on the analysis from sales report of three period that can show the safety stock comparison between non-centralized and centralized concept as follow

Table 8 The result of safety stock based on three period of sales report

Color	Pattern	Safety Stock						No. Diff	% Diff
		XS	S	M	L	XL	Total		
Black & White	As is	327	669	637	419	172	2,224	-880	-39.57
	To be	180	449	394	215	106	1,344		

And can be summarized as a chart

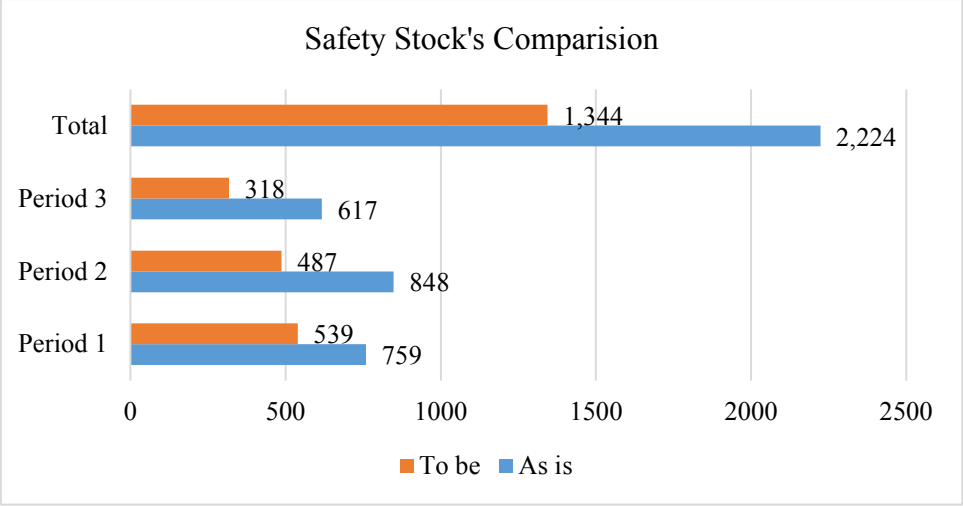


Figure 2 Result of safety stock's comparison between non-centralized and centralized concept

By the improvement of safety stock model, the centralized concept can reduce the total of production cost by comparing as follows

Table 9 The result of production cost

Period	Reduce (/pcs.)	Cost (baht/pcs.)	Cost saving(baht)
Period 1	220	117	25,740
Period 2	361	117	42,237
Period 3	299	117	34,983
Total	880	117	102,960

In additional, from the improvement of safety stock concept to the centralized model. This approach can reduce the waiting time for replenishment of a branch store in case the product is sold out and the branch store requires additional stock, which takes time to synchronize with other stores, and centralized warehouse reduce to one week instead of 2 week for coordinate shipping between branch stores and the company central warehouse

4. Conclusions

From this research, Comparing Performance of Centralized and Non-Centralized Safety Stock Case Study: Retail Clothing Business can be summarized that the method of safety stock in a centralized concept has decrease in the total amount of safety stock inventory up to 39.57%. Moreover, the new safety stock pattern will also help the replenishment process in branch store that take time on processing less than current approach at the same time it also increased the company's business opportunities.

References

[1] Department of Business Development. DBD Journal. 36th Issue. Bangkok: Ministry of Commerce; 2016.
[2] Amornsiri Dissorn. Inventory Management. Bangkok: Odian Store Limited Partnership; 2007.
[3] Kumnai Apiprachyasakul. Purchasing Principle. : 4th ed. Bangkok: Focusmedia and Publishing Company Limited; 2015.
[4] Pipop Lalitaporn. Inventory Management. Bangkok:Technology Promotion Association (Thailang-Japan); 2009.
[5] Chaiyot Chaimankong, Mayukapan Chaimankong. Logistics and Supply Chain Strategy Competing in the Global Market. 2nd ed. Nonthaburi: Vision Prepress Company Limited; 2007.
[6] Sri Krishna Kumar, M.K. Tiwari. Supply chain system design integrated with risk polling. Computer & Industrial Engineering. 2013, 64 (2): 580-588
[7] Peter L. Jackson & John A. Muckstadt. Risk Pooling in a two-period, two-echelon inventory stocking and allocation problem. Naval Research Logistics. 1989, 36 (1): 1-26
[8] Z. Kevin Weng. Risk Pooling over demand uncertainly in the presence of product modularity. International Journal of Production Economics. 1999, 62 (1-2): 75-8