MULTIDIMENSIONAL EVALUATION OF SCIENTIFIC INPUTS AND OUTPUT: A STUDY OF ASEAN

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ABSTRACT

This thesis analyzed the importance of scientific research through scientific collaboration, social networking sites and journal impact factors. The rapid growth of science, technology and innovation has inspired scientific publications with international collaborators in high impact journals. Social networking sites are useful as a virtual alternative for expanding research opportunities, though some researchers feel that it is more for social communications. Diachronous impact factor has gained attention among diverse agents as a tool to evaluate significance of Institute for Scientific Information's indexed journals.

Most productive researchers in Malaysia chose the collaborators who have the highest number of scientific publications. Significant differences in both rates and strengths of scientific collaborations were observed among most productive authors except for most productive institutions through Kruskal-Wallis test. The rates of scientific collaboration between the local and international institutions have been low because of poor networking ability among local researchers. Lower research visibility would reduce the demand for scientific collaboration. Scientific collaboration between researchers in Malaysia and the ASEAN countries have been low because of limited talents in writing joint papers.

Socimetrics and Conversational Analysis have reflected significant research conversations among active participants from Malaysia in Facebook. Researchers from Singapore, Thailand, Vietnam, Indonesia and the other ASEAN member states preferred physical instead of virtual medium for research communications. LinkedIn has pointed out limited research communication between researchers from Singapore and Thailand via Socimetrics and Conversational Analysis. It neglects Brunei, Indonesia, Laos and others from the analysis for revealing limited research participations in LinkedIn. There

were also Intellectual interactions between Malaysia, Pakistan, India, the USA and Australia in Facebook and LinkedIn through Socimetrics and Conversational Analysis.

The most suitable measure for evaluating performing Malaysian journals both in the short-term and long-term is diachronous impact factor based on unique citing sources. It has showed the non-overlapping effects (62 percent) in revealing "true" scientific performance and fairness of the journals through forward approach in Malaysia. In Thailand, the diachronous impact factor, based on unique citing subject categories, took the lead to remove the biasness of classical impact factor. In Philippines, Diachronous impact factors based on citing organizations and unique citing sources have removed the biasness of existing impact factors. Diachronous impact factor based on citation concentration index allows both first-comer and latecomer journals in Economics to improve their scientific visibility in a fairer way. It removes the bias in short-term impact factor. The discussions on scientific collaborations, social networking sites and journal impact factors would allow policymakers to maintain the effective resource allocations.

ABSTRAK

Tesis ini menganalisis kepentingan penyelidikan saintifik melalui kerjasama saintifik, laman rangkaian sosial dan faktor-faktor kesan jurnal. Pertumbuhan pesat sains, teknologi dan inovasi telah memberi inspirasi kepada penerbitan saintifik dengan rakan usaha sama antarabangsa dalam jurnal berimpak tinggi. laman rangkaian sosial adalah berguna sebagai alternatif maya untuk mengembangkan peluang-peluang penyelidikan, walaupun beberapa pengkaji merasakan bahawa ia adalah lebih untuk komunikasi sosial. Diachronous faktor impak telah mendapat perhatian di kalangan pelbagai agen sebagai alat untuk menilai kepentingan jurnal institut berindeks maklumat scientifik.

Kebanyakan penyelidik yang produktif di Malaysia memilih rakan usaha sama yang mempunyai bilangan penerbitan saintifik yang tertinggi. Perbezaan yang signifikan dalam kedua-dua kadar dan kekuatan kerjasama saintifik dapat diperhatikan di kalangan penulis yang paling produktif kecuali institusi yang paling produktif melalui ujian Kruskal-Wallis. Kadar kerjasama saintifik antara institusi tempatan dan antarabangsa telah rendah kerana keupayaan rangkaian yang lemah di kalangan penyelidik tempatan. penglihatan penyelidikan yang lebih rendah akan mengurangkan permintaan bagi kerjasama saintifik. kerjasama saintifik antara penyelidik di Malaysia dan negara-negara ASEAN telah rendah kerana bakat yang terhad dalam menulis kertas kerja bersama.

Socimetrik dan Analisis Perbualan telah mencerminkan perbualan penyelidikan yang signifikan antara Ahli Dari Malaysia di Facebook. Penyelidik dari Singapura, Thailand, Vietnam, Indonesia dan lain-lain negara-negara anggota ASEAN pilihan fizikal dan bukannya medium maya untuk komunikasi penyelidikan. LinkedIn telah menunjukkan komunikasi penyelidikan terhad antara penyelidik dari Singapura dan

Thailand melalui Socimetrics dan Analisis Perbualan. Ia abai Brunei, Indonesia, Laos dan lain-lain daripada analisis kerana mendedahkan penyertaan penyelidikan yang terhad di LinkedIn. Terdapat juga interaksi Intelek antara Malaysia, Pakistan, India, Amerika Syarikat dan Australia di Facebook dan LinkedIn melalui Socimetrics dan Analisis Perbualan.

Langkah yang paling sesuai untuk menilai persembahan jurnal Malaysia dalam kedua-dua jangka pendek dan jangka panjang adalah diachronous faktor impak berdasarkan sumber-sumber memetik unik. Ia telah menunjukkan kesan tidak bertindan (62 peratus) dalam mendedahkan prestasi saintifik "benar" dan keadilan jurnal melalui pendekatan ke hadapan dalam Malaysia. Di Thailand, faktor impak diachronous, berdasarkan unik memetik kategori subjek, mendahului untuk membuang prasangka faktor kesan klasik. Di Filipina, faktor-faktor kesan Diachronous berdasarkan organisasi memetik dan sumber memetik unik telah mengeluarkan tindakan berat sebelah faktor impak yang sedia ada. faktor impak Diachronous berdasarkan indeks kepekatan petikan membolehkan kedua-dua pertama-pendatang dan jurnal lewat menceburi Ekonomi untuk meningkatkan keterlihatan saintifik mereka dengan cara yang lebih adil. Ia membuang bias dalam faktor impak jangka pendek. Perbincangan mengenai kerjasama saintifik, laman rangkaian sosial dan faktor-faktor kesan jurnal akan membolehkan pembuat dasar untuk mengekalkan peruntukan sumber berkesan.

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As for any errors or inadequacies that may remain in this work, the responsibility is entirely my own.

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LIST OF ABBREVIATIONS

ASEAN	Association of Southeast Asian Nations
NSB	National Science Board
DIF	Diachronous impact factor
SIF	Synchronous impact factor
SNSs	Social networking sites
DIFCO	Diachronous impact factor based on citing organization
DIFUCC	Diachronous impact factor based on "unique" citing countries
DIFUCS	Diachronous impact factor based on "unique" citing sources
DIFUCSC	Diachronous impact factor based on "unique" citing subject categories
DIFNSC	Diachronous impact factor based on non-self citations
DIFCCI	Diachronous impact factor based on citation concentration index
DIFJEI	Diachronous impact factor based on journal energy index
TC	Total citations
NSC	Non-self citations
TP	Total publications
SC	Self citations
SIF-2	2-year impact factor
SIF-5	5- year impact factor

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CHAPTER 1: INTRODUCTION

1.1 BACKGROUND OF THESIS

The academic research has become more systematic as research assessment controls scientific funds for higher education (Rigby, Burton & Lusk, 2014). Quality research grants depend on the periodic research assessment exercises (REF, 2014; RAE, 2008). Research assessment finds out the research experts in the institutions or countries, and identify fewer often researched topics (Moed, 2005). It also determines the promotion decisions, research funding grants, higher-education reform, and university quality (Moed, 2005; Whitley, 2007).

Scientific publications such as articles, proceedings, book reviews, editorial materials, and poetry have taken the role of knowledge mediators. It transfers the ordinary and critical issues from authors to meso-organizations (government agencies, scientific policymakers, and research communities). Scientific inputs and output can promote funding grants and scientific rankings of universities, industries and researchers (Etzkowitz & Leydesdorff, 2000; Van Damme, 2001; Porter & Rafols, 2009; Druss & Marcus, 2005; Trochim et.al., 2008; Wooding et.al., 2005). ASEAN researchers have published 165,020 articles in ISI (Institute for Scientific Information)-indexed journals from 1991 until 2010. It has represented 0.5 percent of the world scientific output (Nguyen & Pham, 2011). International scholars around the globe have preferred ISI-indexed journals because of the recognition, although ISI database has accounted for 10-12 percent of all peer-reviewed journals (Monastersky, 2005).

Web of Science (WOS) is the most recognized database for classifying scientific journals. It has accounted for 8,073 SCI-Expanded indexed journals across 174 scientific disciplines based on the Journal Citation Report 2010 (Ho, 2013). WOS has recognized over 12,000 high-impact journals worldwide (Reuters, 2012). A wide range

of issues involving ASEAN member states has captured the interest of scholars. Research publications in Science, Technology, and Innovation (STI) promotes the expansion of economic growth by developing skills within human capital (Rodriguez and Soeparwata, 2012). Evaluations of research publications are also useful for implementation and reformation of policies (Fensham, 2009; Miralao, 2004).

The growth of globalization and rapid communication has expanded scientific publications of international collaborators (Low et al., 2014; Prathap, 2013; Wagner, 2008; Wagner & Leydesdorff, 2005). Besides that, the growth of co-authored scientific documents have doubled since the 1990s. It is still growing at an increasing momentum up to now in all disciplines (Prathap, 2013; Wagner, 2008; Wagner & Leydesdorff, 2005; NSB, 2002; Glanzel, 2001; Georghiou, 1998; Dore et al., 1996). Scientific collaboration improves the high-impact publications (Low et al., 2014; Lancho-Barrantes et al., 2013; Chinchilla-Rodriguez et al., 2010; Hsu & Huang, 2010). Adams (2013) highlighted the fourth age of international collaboration and institutions that neglects disenfranchisement of international collaborations (Low et al., 2014). Countries will lose out in scientific collaborative if they do not nurture their intellectual talents (Adams, 2013; Low et al., 2014).

Scientific collaboration in education co-operation is important for strengthening ASEAN community. Educational co-operation is important to develop and integrate human resources, advancement of Science and technology and ASEAN Economic Community (AEC) (ASEAN, 2012). Scientific collaboration is important to speed up the growth of collaboration among pure and social scientists between universities and industries through various initiatives (Katz, 1994). One goal of ASEAN in its "Vision 2020" program is to strengthen scientific integration in Science and technology (S&T) (APAST, 2007). International collaborations have helped institutions and scientists in overseeing the developments, technology tranfer and expertise in plant biotechnology

for developing the research policy (Gibbons et al., 1994; Hagedoon et al., 2000; Royal Society, 2011; National Science Board, 2012; Komen, 1999).

Scientific collaboration has improved research quality and resulted in publishing the scientific thoughts in high-impact ISI journals. Social networking sites (SNSs) act as a virtual medium to expand research opportunities, though some researchers feel it is more for social communications (Holmberg & Thelwall, 2014; Priem & Hemminger, 2010; Weller, 2011; Heinze & Kuhlmann, 2008). Many scientific institutions use various indicators or rankings for bettering the scientific performance (Williams & Van Dyke, 2008). The expansionary effects of scientific knowledge improve diverse trends of scientific publications in journals. Scientific journals link the research involvement of researchers, institutions, and countries to provide research solutions to handle the complexity of real events.

Researchers use journal impact factors to test significance of ISI-indexed journals (Lu et al., 2014). The researchers, librarians, editors, universities and scientific policy makers use impact factors to rank the quality of publications. Editors and publishers have used the impact factor to increase the visibility and reputation of their journals (Sombatsompop, Markpin & Premkamolnetr, 2004).

This thesis discusses the approaches of impact factors: Synchronous impact factors and Diachronous impact factors. Synchronous impact factors measures the citations based on short and fixed periods. Diachronous impact factors refer to impact factors that dealt with citations based on long-term and continuous periods (Glanzel, 2004). Synchronous impact factors used as a benchmark to monitor short-term performance within the ISI-indexed journals based on lagged and fixed time periods. It refers to weaker indicator that can cause the biases to the latecomer journals, and hence younger researchers. Diachronous impact factors act as a measure to see relevance of it

solve the biases caused by the Synchronous impact factors. It offers the opportunity to test the long-term performance of ISI-indexed journals based on present and future periods.

Review of relevant literature has pointed out some missing scientific links. It dealt with the comparison of local and international scientific collaborations between most productive authors, and institutions in Malaysia. This includes the comparison on local scientific collaboration between Malaysia and the other ASEAN member states. This thesis evaluates the need of SNSs as a research medium and approaches of impact factors. For this thesis, local scientific collaboration in Malaysia refers to the scientific collaboration between most productive authors, and institutions in Malaysia. Local scientific collaboration also refers to scientific collaboration between Malaysia and the other ASEAN member states. International scientific collaboration refers to the scientific collaboration between authors and institutions in Malaysia with international collaborators. Scientific collaboration in this thesis deals with collaboration in joint scientific publications.

This leads to a serious urgency to explore different directions of resource allocations and to ensure scientific fairness and true scientific performance of rankings. Therefore, this thesis looks into the notions of local and international scientific collaborations, SNSs and impact factor in ASEAN countries. The thesis takes on to address the research gaps on the collaborations, reflection of SNSs as a research medium and the comparison of the impact factors. It is an economic issue as assessment of scientific inputs and output grant resources, and influence the career trajectories and salaries of researchers (Rigby et al., 2014).

1.2 OVERVIEW OF ASEAN

ASEAN is geopolitical and economic association that consists of ten countries: Malaysia, Singapore, Thailand, Indonesia, Vietnam, Myanmar, Cambodia, Laos, the Philippines, and Brunei Darussalam. Bangkok Declaration has established Malaysia, Singapore, Thailand, Indonesia, and the Philippines as ASEAN-5 on 8 August 1967. The other member states, namely Brunei Darussalam, Myanmar, Laos, and Cambodia joined the association during the period from 1984 to 1999. It is consisted of an area of about 4,494,000 square kilometers with an estimated population of 5,936 million and combined gross domestic product of the USD 3,003 billions.

Malaysia, Singapore, Thailand, Indonesia, Vietnam, Brunei Darussalam, and the Philippines are first comers of scientific publications (Table 1.1) (APPENDIX A). For this thesis, first comers are ASEAN member states that have started publishing scientific papers in 1980. The rests of ASEAN member states such as Cambodia, Myanmar and Laos are latecomers of scientific publications. For this thesis, latecomers are ASEAN member states that have started publishing papers from 1982 onwards. The number of scientific productions among them was low from 1980 to 1983 (Table 1.1) (APPENDIX A).

Thailand was the highest producer of scientific publications while Singapore, Malaysia, Indonesia, Vietnam, Brunei Darussalam, and the Philippines were followers from 1980 to 1983 (Table 1.1) (APPENDIX A). Singapore has dominated ASEAN scientific market through the higher number of scientific publications from 1984 onwards (Table 1.1, Table 1.2, and Table 1.3) (APPENDIX A).

1.3 PROBLEM STATEMENT

The effective sharing of resources, scientific planning on national investment and healthy scientific environment relied heavily on the critical logic of research assessment

(RAE 2008; RAE 2014). Citations within scientific publications are useful for determining research rankings of top universities through the Higher-Education Evaluation and Accreditation Council of Taiwan at different levels. The existing rankings prioritize research visibility through citations from major scientific databases such as WOS and Scopus. It has neglected the drawbacks of classical citations, patterns of scientific collaborations and utilization of SNSs as a research mediator.

Researchers have explored various measurements, and types of collaborations in various countries (Pouris & Ho, 2014; Sahu & Panda, 2014; Mallik & Mandal, 2014; Wang et al., 2014; Abramo et al., 2014). However, this review has noted less attention on the examination on Absolute and relative collaborations of most productive authors and institutions in Malaysia.

Such investigations are necessary to confirm the results of Kumar et al. (2014) on the patterns of local collaborations of ASEAN member states. The investigations will be important to evaluate scientific collaborations on the AEC through scientific integration.

Some researchers have delved into the links between SNSs and research visibility through the growing idea of "Altmetrics" although some users have disputed it (Martin and Irvine, 1983). The growing success of "Altmetrics" needs the active participation of open-minded researchers, sharing of research articles and others. The current database has limited studies on the functions of SNSs in its exposure to research discussions, research visibility, and scientific collaborations in most developed and developing countries, including ASEAN member states. The existing literature has just focused on the relationship between the use of SNSs and expansion of research citations.

Contradictory thoughts on the roles of SNSs exist because of limited awareness on the multidimensional roles of SNSs among research participants. It has reduced the reliability and validity of reflecting SNSs as a research medium. Therefore, it is

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important to verify the validity of SNSs as a research mediator and identifies the influence of SNSs on increasing research exposure among ASEAN research participants.

Gross and Gross (1927) have contributed their ideas on the citation analysis as an indicator of research performance. Garfield (1955), the founder of ISI, is the only one who formulated the two- year impact factor based on Science Citation Index to measure the performance of publications in Sciences. It acts as a proxy for measuring the performance of research publications in all the fields of research, including Social Sciences, Arts, and Humanities. Garfield's two- year impact factor deals with the Synchronous approach on the lagged structure within the fixed timing of citations and publications. The main technical aspect of the measurement is limited as it has the capacity to capture the short-term mode of past performance of authors, journals, institutions, and countries. It may not be a suitable indicator to measure the current trends of research performance of the stated research agents. Most of the existing literatures consider the impact factor, as a proxy for research quality, although Garfield (1955) has refuted the thought.

Impact factor based on citations fails as a proxy of research quality as it neglects citations for different types of research issues, research methods, and keywords. It acts as an indicator to measure visibility of contents within the published scientific documents. Garfield's impact factor evaluates the value of objectivity. However, impact factors will evaluate the scale of subjectivity as it refers to different variations of cognitive perceptions. The current impact factor has failed to measure the performance of research publications or journals fairly as it favors older publications at the expense of newer publications. This is because the two-year citation window will not be able to provide enough space for younger or newer groups of publications and journals to build their citation base. As indicated earlier, impact factor should include multidimensional

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elements as it deals with cognitive structuring of perceptions, and it is not objective. This is consistent with the thoughts supported by Vanclay (2012).

Although Brody (2013) and Vanclay (2012) attempted to look into the imperfection of the impact factor on publications, its computations have several drawbacks. The internal structuring of the measurement increase the biases of the two-year impact factor as it involves the combinations of non-self citations and self-citations. The accumulation of self-citations expands citation stacking as it represents self-visibility or recognitions, and self-plagiarism although some scholars have reflected the rationale of self-citations. Self-citations promote recognition of published works with zero citations over a long time.

A higher dependency on self-citations could lead to a more dubious way of ranking journals. Creation of scientific biasness will reduce the scientific fairness because of unethical practices of some editors of journals. Some editors seek the authors to cite the research publications in their journals for improvisation of rankings. Another example is the scientific proverb "You cite my work. I'll cite yours" that is based on the common benefits of researchers. The unethical practices have affected appreciation of the contents in scientific publications. Therefore, there is a need to propose alternative indicators based on the multidimensional concept based on the diachronous approaches. This will be important to promote the scientific fairness among researchers and journals. Through the diachronous approaches, the researchers can select the journals based on their accurate performance of citations. The latecomer journals will have more time to build up their citation base to gain scientific recognitions.

1.4 THESIS QUESTIONS

Although there are extensive studies on scientific collaborations, SNSs, and journal impact factors, the existing materials do not explain the aggregated and

individual effects of highlighted issues in ASEAN. Therefore, there is a need to look into the thesis gaps in the areas identified above. The thesis therefore addresses the following thesis questions:

(a)   What are the characteristics of rates and strengths of scientific collaborations among most productive authors and institutions in Malaysia and other ASEAN member states?

   (i)   What are the behaviors of rates and strengths of scientific collaborations among most productive authors and institutions in Malaysia?

   (ii)   Are there significant differences in rates and strengths of scientific collaborations between most productive authors in Malaysia?

   (iii)   Are there significant differences in rates and strengths of scientific collaborations between most productive institutions in Malaysia?

   (iv)   What is the behaviors of rates and strengths of scientific collaborations between Malaysia and remaining ASEAN member states?

(b)   Can the SNSs influence research exposure among ASEAN research participants?

(c)   Can the diachronous impact factor be a "complementary" or "substitute" for the synchronous impact factor among ISI-indexed journals owned and utilized by ASEAN member states?

   (i)   Can the Diachronous impact factor be a "complementary" or "substitute" for the Synchronous impact factor among ISI-indexed journals owned by developing ASEAN member states in the Sciences?

   (ii)   Can the Diachronous impact factor be a "complementary" or "substitute" for the Synchronous impact factor among ISI-indexed journals utilized by selected ASEAN member states in Economics?

The first thesis question aims to examine the rates and strengths of scientific collaborations between most productive authors and institutions in Malaysia. This thesis question examines the scientific collaboration between Malaysia and the other ASEAN member states. This thesis question uses the concepts of the First-Latecomer advantages and Matthew Effect. First comers of scientific publications refer to individuals or institutions that have started their scientific publications in 1980. Latecomers of scientific publications refer to individuals or institutions that have started their scientific publications from 1990 onwards. Matthew Effect refers to the higher scientific collaborations between most productive scientific researchers and top collaborators. This chapter organizes the discussions into four different subsections. Firstly, it will identify the behaviors of rates and strengths of scientific collaborations among most productive authors and institutions in Malaysia. Secondly, it will examine the differences in rates and strengths of scientific collaborations between most productive authors in Malaysia. Third, it will examine the differences in rates and strengths of scientific collaborations between most productive institutions in Malaysia. Fourth, it will identify the behaviors of rates and strengths of scientific collaborations between Malaysia and the other ASEAN member states. For the examination on the first thesis question, the focus of this thesis refers to developing ASEAN member states. The first analytical chapter excludes Singapore because of its status as the developed country. The analytical chapter on first thesis question excludes Thailand eventually because of its classification as a "catching up country" of STI performance by Rodriguez and Soeparwata (2012). This chapter considers Malaysia as a sample country because of its status as an upper middle-income country and classification as a "follower" for STI performance by Rodriguez and Soeparwata (2012). Classification of "trailing countries", "follower", and "catching up countries" were made through the average scores of innovation dimensions. Rodriguez and Soeparwata (2012) have classified

Malaysia as a "follower" because of the average innovation score was 0.5. They have classified Singapore as a "leader" because of the average score was 0.6. This has shown that Malaysia is following the similar patterns of STI performance within Singapore and it has higher capacity to build international collaboration with researchers from Japan, China and South Korea (Center for Research and Development Strategy, 2014). Besides that, Malaysia has also been selected for this analytical framework on scientific collaboration because of the strong emphasis on human capital development. Malaysia has recognized highly skilled talent as an important tool to improve the R&D infrastructure and create first class human resources (Kumar and Jan, 2014; Abrizah and Wee, 2011). Therefore, it is important to evaluate the behaviour of scientific collaboration between most productive authors and institutions in Malaysia. It can be used as an indicator to monitor the sustainability of ASEAN Economic Community and STI policy in terms of scientific collaboration.

The second thesis question deals with the investigation on the influence of SNSs on research exposure among ASEAN research participants. Firstly, it tests the reliability and validity of SNSs as a research mediator among ASEAN participants. Second, it detects the influence of SNSs on research exposure among the targeted participants. The focus of this thesis on the use of SNSs was more on the researchers from all the developed and developing ASEAN member states. This analytical chapter selects all ASEAN member states based on different classification of countries in STI performance by Rodriguez and Soeparwata (2012). Rodriguez and Soeparwata (2012) have classified Brunei Darussalam, Cambodia, Laos, Vietnam, and Myanmar as "trailing countries" or "slow moving" countries. They have identified Indonesia, Philippines, and Thailand as "catching up countries" and Malaysia as "follower." Rodriguez and Soeparwata (2012) have classified Singapore as the leader. Classification of "trailing countries", "follower", and "catching up countries" were made through the average scores of

innovation dimensions. Classification of Malaysia as a follower because of the average score of innovation was 0.5. Singapore was classified as a leader because of the average score of innovation was 0.6. Indonesia, Philippines, and Thailand were classified as "catching up countries" because of the average score of innovation was 0.3 and close to Malaysia. Brunei Darussalam, Cambodia, Laos, Vietnam and Myanmar as "slow moving countries" because of the average score of innovation was 0.2.The purpose of this section within the thesis is to evaluate the nature of ASEAN researchers from different ASEAN member states with different levels of STI performance. This chapter looks at the STI performance by evaluating the use of SNSs and its impact on the research exposure through research visibility, scientific publications and research discussions among ASEAN researchers.

The third thesis question identifies the role of the diachronous impact factors as a complementary or substitute for ISI's impact factor among the ISI-indexed journals owned and utilized by ASEAN members in the Sciences and Economics. Firstly, it tests the strength of associations between diachronous and synchronous impact factors among ISI-indexed journals owned by developing ASEAN members such as Malaysia, Thailand and Philippines in the Sciences. Secondly, it computes the differences between the values and ranks of Synchronous impact factor (SIF) and Diachronous Impact Factor (DIF) among ISI-indexed journals in Economics. The second part of this analytical chapter also looks into the applicability of diachronous impact factors in evaluating the performance of ISI-indexed journals utilized by selected ASEAN member states such as Malaysia, Singapore, Thailand and Indonesia. The focus of this section was on the domestically owned ISI-indexed journals within developing ASEAN countries such as Malaysia, Thailand, and Philippines. This section also looks into the ISI-indexed journals utilized by researchers from ASEAN member states, such as Malaysia, Singapore, Thailand, Indonesia and Philippines for their scientific

publications. Economics journals are selected in this chapter as Economics is one of the important fields of interest among the ASEAN researchers. The investigations of the differences between SIF and DIF among ISI-indexed journals will be useful for ASEAN member states, researchers, policy makers, and governments. ASEAN member states will be able to keep track of the long-term scientific visibility of contents within ISI-indexed journals in the Sciences through the participating authors, institutions, unique citing sources, and others. Diachronous impact factors based on different dimensions will be effective for monitoring the patterns of citations among ISI-indexed journals. Through different diachronous impact factors, researchers will be able to select and decide suitable ISI-indexed journals for their scientific publications. They will be able to evaluate the "true" performance of journals based on fair scientific assessment. The younger researchers will find better options to create their scientific recognitions by building up citation base of contents. Governments will be able to identify capable researchers and experts in the Sciences and Economics through diachronous approach. This is important for fair allocation of grants or funds for the projects of researchers. In this thesis, micro refers to the overall discussions of citations and citers. Meso refers to ISI journals and Macro refers to scientific publications. This will provide scientific evaluation on the interaction between micro and macro through meso.

For this thesis, scientific inputs for further analysis are scientific collaborations, use of SNSs and journal impact factors whereas the scientific output deals with scientific publications. This thesis explores the multidimensional context as it involves various dimensions of measurements and evaluations. It provides the proposals for new measurements at different levels and evaluates usefulness of measurements in overseeing performance of STI within the local and external boundaries. All the three thesis questions intend to analyze the impact of economic integration on scientific inputs and output among ASEAN member states. This thesis differs from previous

research studies that were conducted by Nguyen and Pham (2011), Rodriguez and Soeparwata (2012), Lai and Yap (2004), Sigurdson and Palonka (2005), Dodgson (2000) and Hassan et al. (2012). The latter studies have focused on using research and development spending, total citations, foreign direct investment, patents, total scientific publications as their scientific inputs and output. Most existing studies have ignored the discussions on efficiency of resource allocation, human capital development, subjective Science and Innovation measurements, and knowledge diffusion.

It is not deniable that basic indicators have given a clue on performance of STI among ASEAN member states. However, these indicators only serve as a benchmark for monitoring STI performance. Therefore, there is a need to evaluate patterns of scientific collaborations among most productive authors and institutions in Malaysia. The additional evaluation involves the regional local collaborations between ASEAN member states, SNSs, and journal impact factors. This thesis will examine the links between the mentioned scientific inputs and output as it shall provide the systematic direction in stabilizing and preserving the momentum of STI performance within ASEAN member states. Scientific collaboration promotes the knowledge diffusion and diversification of knowledge in various research issues. It has greater ability of solving complex problems with the involvements of researchers (Hausmann, et.al., 2011; Yu Cheng, et.al., 2013).

Although most discussions on scientific collaborations, SNSs and impact factors of journals deal with various bibliometrics indicators, the average discipline-wise measure the Economics effects within each of the measurements. Knowledge Economic Index (KEI) explains the links between the scientific inputs and Economics. KEI deals with four different pillars: Economic Incentive and Institutional Regime, Education, Innovation, and Information and Communication Technology. It involves the theory of

Innovation diffusion. The focus on economic development establishes the case for the analysis as Economics based.

According to Nguyen and Pham (2011), the direction of KEI is important in detecting different stages of Economics development within ASEAN member states. KEI enhances knowledge-based economy as it deals with the role of knowledge for building scientific resources (scientific collaboration, SNSs, and journal impact factors). This is to uphold the effective allocations of resources in a fairer way. According to Nguyen and Pham (2011), the KEI deals with the elements of technological competitiveness that has been inspired through the combinations of Science and scientific research. The fairer and effective allocations of resources through expansion of scientific collaborations, SNSs, and journal impact factors have promoted the sustainability of STI within ASEAN member states. This is almost consistent with Nguyen and Pham (2011) and King (2004).

In general, Economics is a field of social Science that evaluates the interactions between Economics and humans through examinations on the resource allocations, trade-offs within the resources, and effective movements of resource allocations. Concepts such as free collaboration, Absolute Advantage, and Comparative Advantage explain the connections between scientific collaboration and Economics. All the researchers have the freedom to get into scientific publishing and collaboration, and they have the ability of choosing their collaborators without scientific limits. In the connections between scientific collaborations and Economics, Absolute scientific advantage refers to the scientific advantages of researchers through collaborations of researchers with different areas of expertise. Collaboration rates between researchers and their collaborators reflect the Absolute scientific advantage. Comparative scientific advantage refers to the scientific advantages that can be gained by a researcher based on his or her level of collaboration strength with other researchers. Comparative scientific

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advantage evaluated by comparing the relative scientific collaborations between the researchers.

The connection between the use of SNSs and Economics utilizes knowledge diffusion among intellectual researchers. Most of the researchers have looked into SNSs as a single medium to promote social interactions and entertainment among the social users. None of them has focused on the role of SNSs as a research medium to promote various research interactions in different dimensions.

Researchers, such as PhD students, and academic staffs have increasingly started using SNSs such as Facebook and Twitter to learn and share knowledge. This involves the sharing of various research segments such as statistical techniques, important journals for publications, theories and others. Facebook and Twitter act as a platform for researchers to have discussions on various ordinary and critical discussions. The researchers can use the SNSs to discuss and share various thoughts on emerging research issues such as financial crises, stock markets, list of journals and research techniques with other researchers. In this analytical chapter, ordinary issues refer to issues with basic and known facts. The critical issues refer to the issues based on subjective responses. There are no right or wrong answers within the context of discussions on critical issues.

The economic theory on knowledge diffusion, Uses and Gratification Theory and Technology Acceptance Model explains the interactions between minds of researchers and use of SNSs. It is useful to explain the Innovation diffusion within the use of SNSs from the perspective of Economics. Diffusion refers to the stages of adoption of the original ideas and thoughts, and it deals with the adaptation of ideas to the nature of systems. Various discussions between researchers within SNSs explain the process of diffusion. Retention refers to the process of upholding the ideas and thoughts on the

research issues. The active participation of researchers can be seen within SNSs regardless of geographical positions of researchers. Higher intellectual interactions between researchers within ASEAN member states are able to maintaining the economic development of ASEAN member states through enhancing STI. The theory of positive and normative Economics, theory of social welfare and theory of Pareto efficiency reflect the connections between Economics and journal impact factors. In general, theory of positive Economics deals with the conditions and events on the facts and objectivity of events. Theory of normative Economics deals with the conditions and events on the subjective judgments of people.

Garfield (1955) has created the SIF (e.g. 2-year impact factor) to evaluate performing ISI-indexed journal in Sciences in the 1955. ISI has slowly used 2-year impact factor to rank ISI-indexed journals in both Sciences and Social Sciences. ISI is still classifying the 2-year impact factor as the main source of objective measure in evaluating the performance of ISI-indexed journals. In reality, impact factor of publications within ISI-indexed journals evaluated inappropriately as the single objective measure, and it should consider multidimensional measurements. The current measurement of SIF (2-year impact factor) refers to the positive Economics from the perspective of Economics. The positive Economics of the journal impact factor has suggested the scientific biasness within the scope of performance. The 2-year impact factor has reflected the scientific biasness in which the first comer ISI-indexed journals have dominated the scientific market by not giving the space to latecomer ISI-indexed journals to improve their citation base. Pareto efficiency reflects the biases within journal impact factors. The biasness of the 2-year impact factor has challenged the theory of social welfare. This biasness of 2-year impact factor can be realized within journals both in Sciences and Social Sciences.

The various measurements of DIFs examined the subjective judgments of researchers on the nature of scientific publications. It has the capacity of overseeing scientific performance among ISI-indexed journals in the short run, and long run based on current and future years of citations. Most measurements of DIFs have favored both first comer and latecomer ISI-indexed journals. This reduces the scientific biasness, and it allows the latecomer ISI-indexed journals can increase the citation base over the periods. From the perspective of Economics, DIFs represent normative Economics within the multidimensional context. The multidimensional elements of journal impact factors have supported the effective allocation of resources and theory of social welfare. The opposite side of Pareto efficiency has favored the first comer and latecomer ISI-indexed journals by DIFs. It includes the cognitive structuring of researcher's minds.

The discussions on the connectivity between SNSs, scientific collaboration, and impact factors of ISI-indexed journals have the capability of maintaining the systematic and effective allocation of resources in a fairer way. STI performance is crucial and useful for monitoring the effectiveness of the ASEAN Science policy framework. For STI performance within ASEAN member states, the horizontal dimension refers to the dimension of measurements within SNSs, scientific collaboration, and journal impact factor. The vertical dimension refers to the dimension of scientific inputs within different levels such as researchers, institutions, and ASEAN member states. Researchers with different areas of expertise can use SNSs to have discussions on research issues with other researchers regardless of their geographical locations.

Through intellectual engagements between researchers in SNSs, researchers will be able to identify their collaborators to publish their academic articles in reputable ISI-indexed journals. The use of SNSs will inspire higher local and international collaborations between authors, institutions, and countries regardless of their geographical locations. Through SNSs, researchers will be able to increase the impact of

their publications by sharing their articles with others. All the other researchers will have the opportunity to view their articles free and may cite some of the contents within their shared articles. This will lead to the expansion of citations throughout the period. The process of citation gaining through SNSs is not in an immediate manner, and it may take time for others to cite their works.

1.5 THESIS OBJECTIVES

The general objective of the thesis is to examine the local and international scientific collaborations, and the links between SNSs and research exposure. It confirms and compares the impact factors based on Synchronous and diachronous approaches. The specific objectives of the thesis are as follows:

a) To examine the characteristics of local and international scientific collaborations among most productive authors and institutions in Malaysia and with the other ASEAN member states.

    (i) To examine the behaviors of rates and strengths of scientific collaborations among most productive authors and institutions in Malaysia.

    (ii) To examine the significant differences in rates and strengths of scientific collaborations between most productive authors in Malaysia.

    (iii) To examine the significant differences in rates and strengths of scientific collaborations between most productive institutions in Malaysia.

    (iv) To examine the behaviors of rates and strengths of scientific collaborations between Malaysia and the other ASEAN member states.

(b) To identify the significant influence that SNSs have on improving research exposure among ASEAN research participants.

(c) To compare the Synchronous and Diachronous impact factors among the ISI-indexed journals owned and utilized by ASEAN member states.

(i) To examine the differences between Synchronous and .Diachronous impact factors among the ISI-indexed journals owned by developing ASEAN member states in the Sciences.

(ii) To examine the differences between Synchronous and Diachronous impact factors among the ISI-indexed journals utilized by selected ASEAN member states in Economics.

1.6 SIGNIFICANCE OF THE THESIS

It is an expectation of this thesis to increase the interactional thoughts on the rates and strengths of collaborations between most productive authors and institutions in Malaysia and between Malaysia and the other ASEAN member states. The different modes of scientific directions would expand the effective seeing on the actions and results of scientific spreads. The progress of knowledge diffusion can be monitored through the local and international scientific collaborations at different levels: authors, institution and ASEAN member states. The behaviour of scientific collaboration influences the diversification of knowledge on various research issues to different individuals. It will be very useful to track down the solutions to reduce the complexity of different levels. This thesis will also provide the evaluation on the patterns of scientific collaborations among the first comers and latecomers of scientific publications.

The thesis also provides intellectual views on the role of SNSs to increase research exposure through research visibility, spread of research issues, and scientific collaborations. This evaluates the progress of knowledge diffusion between researchers from ASEAN member states through the discussions on research issues and sharing of research materials within research groups in social networking sites (Facebook and LinkedIn).

This would be useful for scientific policymakers. Scientific discussions through SNSs would be helpful in influencing the scientific ranking and in deciding the Asian Ranking of World Universities (ARWU) or Shanghai Ranking, and QS ranking. This thesis also provides new insights about the multidimensional evaluation of impact factors among the selected ISI-indexed journals. This monitors the scientific visibility of contents within scientific publications through citations and citers. It will also evaluate the subjectiveness of evaluation on the performance of ISI-indexed journals. The discussions on the scientific collaborations, social networking sites and journal impact factors monitor the performance of knowledge based economy and STI policy through the progress of knowledge diffusion, theory of resource efficiency, Pareto efficiency and theory of social welfare.

1.7 CONTRIBUTIONS OF THE THESIS

The thesis contributes to different scientific evaluations. It has proposed additional measurements of scientific collaboration, SNSs and journal impact factors. It looks into the modified Salton's measure and collaboration rates to evaluate scientific collaborations among most productive authors and institutions. It evaluates differences in rates and strengths of collaborations between most productive authors and institutions in Malaysia. Further, it explores and explains the extra measures of SNSs of research visibility, distribution of research issues and scientific publications with the virtual collaboration system.

This thesis deals with the utilization of a pragmatic approach to explore the research discussions within the SNSs. The results on the research influence of SNSs serve as the qualitative baseline for developing virtual collaboration system via webinar and Skype. It serves as a baseline for implementing the research monitoring system within SNSs. The discussions on SNSs evaluate multidisciplinary elements on

confirmations of genre analysis, Technology Acceptance Model and Uses and Gratification Theory within the context of SNSs. Finally, the thesis looks into the comparative analysis of impact factors of domestic ISI journals and the usefulness of this to the scientific planners of publications. This is in line with the motive of developing proposals on impact indicators based on the original version of the diachronous model and deals with the interactions between micro, meso, and macro based citation-citer analysis. These examinations will add values to the existing STI policies for building knowledge-based economy.

1.8 THESIS OUTLINE

The remaining chapters are stated as follows. Chapter two highlights the introductory remarks of the issues and review of relevant thoughts in literature. This involves the reviews on the patterns of collaborations, the links between SNSs and research exposure and the discussions on journal impact factors. It includes some previous studies on ASEAN member states to provide a background into those stated issues in theories, methods or techniques, and empirical results or findings. This chapter discusses the detailed exploration of thesis gaps and questions. The following three chapters are analytical in nature.

Chapter 3 is the first analytical chapter. It covers the discussions on the measurements and behaviors of different types of scientific collaborations, including collaboration rates and relative collaborations. It deals with the scientific collaboration between most productive authors and institutions in Malaysia. This chapter explores the scientific collaboration between Malaysia and other ASEAN member states. This chapter evaluates the scientific collaborations at different levels. This analytical chapter highlights the significant differences in rates and strengths of collaborations between most productive authors and institutions in Malaysia if any. This chapter expresses

detailed descriptions of the sources of data, variables, bibliometrics, and statistical techniques.

Chapter 4 deals with the combinational effects of quantitative and qualitative investigations on the influence of SNSs in increasing research exposure among ASEAN research participants. This chapter explores research exposure through research visibility, research issues, and scientific publications. This chapter explains the full details of selected sources of data, variables, qualitative, and quantitative methods.

Chapter 5 deals with some subsections that connect the diachronous with synchronous impact factors. Firstly, it tests the strength of associations between diachronous and synchronous impact factors among ISI-indexed journals in Economics and domestically owned ISI-indexed journals in developing ASEAN member states. Second, this chapter computes the differences between the values and ranks of Synchronous and DIFs among ISI-indexed journals in Economics.

Chapter 6 presents the conclusions of the thesis. This chapter produces a synthesis of the findings of this thesis. This chapter also discusses the implications of the results towards the existing theories and related policymakers, the limitations of the thesis and recommendations for future research.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

Expansion of scientific publications fuels the interest of scholars to discuss issues and concerns on relevant scientific indicators. This chapter explores various research themes such as scientific collaborations, ASEAN Science policy framework, Salton measure, the role of SNSs as a research mediator and impact factors. This chapter discusses the links between selected themes and thesis questions. The detailed themes deal with reviews of related theories, empirical results and methods or techniques. WOS, Google Scholar, Springer Link, and Taylor and Francis are the main databases for searching and extracting relevant materials randomly. This chapter has identified important string of keywords through the main points within the thesis questions and thesis objectives. Manual checking verifies the likeness of meanings within the keywords for each of the issues. The selected keywords differ in three different areas of interest. Various keywords for promoting the searching of relevant materials are as follows:

(a)   Scientific collaboration = "scientific collaboration," "research collaboration" and "scientific partnership"

(b)   SNSs and research exposure = "social media," "SNSs" and "research visibility"

(c)   Impact factor = "Citations," "impact factor, "journal impact factor," "synchronous impact factors" and "diachronous impact factors"

2.2 SCIENTIFIC COLLABORATION

Edquist (2005) supported the agreement that the main ingredient of the Innovation System is the scientific interaction between the firms and institutions. It showed that the firm-centric view has failed to highlight the significant role of the non-commercial

sectors in research and development activities. It must be included into the Innovation frameworks, especially, for biomedical innovations using mapping analysis (Lander & Atkinson-Grosjean, 2011). The structure of Innovation networks has expanded scientific collaboration.

Gupta and Karisiddippa (1999) explored the possibility of including several collaborators within Lotka's distribution in theoretical population genetics to predict the strata of productivity. They pointed out the number of collaborators may not be an efficient substitute for the number of papers in the context of Lotka's distribution.

Melin (1999) examined the associations between the national size and international research collaboration in Northern European and American universities. The author favored the negative strength of association between national size and international research collaboration in which American universities have more national collaborations and fewer international collaborations compared to European universities. There was no impact of national size on the international scientific collaboration for the case of European universities, although there was not much difference in scientific size.

There are factors that can influence the patterns of scientific collaborations such as the political issues, socioeconomics, resource accessibility and others. Sonnenwald (2007) has stated that scientific collaborations have the capacity to solve scientific complexity, promote sustainable development and Economics integration with political influence. According to Crane (1972), Kuhn (1970), and Latour (1987), the scientific paradigms and patterns of Science policies have motivated scientific collaborations in different directions. Discovery of new knowledge and complexity of Economics has inspired the scientific collaborations. A group of scientists have collaborated to find causes and solutions of diseases after World Health Organization issued a global alert to

the health threat caused by Severe Acute Respiratory Syndrome (Sonnenwald, 2007). Scientific collaborations have provided the heal assistance on post-war wounds through political risk, and it has directed the military research (Arunachalam & Doss, 2000; De Cerreno & Keynan, 1998). Some countries or nations have used scientific collaborations as a tool to promote scientific and political unity within internal or external borders (Banda, 2000). Business organizations can gain the economic benefits from scientific collaborations through research and development tax credits and accessibility of research funding (Lambert, 2003; Autio, Hameri & Nordberg, 1996). Attitude of researchers has produced intellectual publications through scientific collaborations (Newman, 2004). Researchers have selected their collaborators based on similar research interests, and this is in line with Newman (2004). It can maximize the efficiency of resource allocations and knowledge diffusion.

Kim (2001) examined performing local and international collaborations of Korea in Physics from 1994 to 1998. The researcher found that the Korean, Japanese and United Kingdom journals have published Korean authored papers. The international co-authored papers have appeared in German, Dutch, and Swiss journals. Papers by the researchers from the United States (US) and France were cited more often than papers by the Italian, Japanese, Korean, Russian, and German researchers.

Gupta and Dhawan (2003) studied the patterns of research collaborations between India and China in Science and Technology (S & T) from 1994 to 1999. They pointed out that only 11.68 % are considered joint papers, and the remaining 88.32% are multilateral papers that involve more than two countries, including India and China. The co-authored papers were listed under selected broad subject fields such as Physics, Clinical Medicine, Earth and Space Sciences, Chemistry, Biology, Biomedical Research and Engineering and Technology.

Vinluan (2012) examined the patterns of local (authors and institution) and international collaborations in research that are tied to education and psychology in the Philippines from 1966 to 2009. The author suggested that there were more collaborative activities between a local author and an international author. Higher international collaborations were observed between local and international institutions, although there was no significant difference in the number of collaborations between local institutions. Vinluan (2012) observed a weaker scientific integration within ASEAN members, although ASEAN member states have the opportunity to build scientific collaboration with non-ASEAN countries such as the US, Australia, Japan, and Canada.

Hassan et al. (2012) examined the strength of scientific collaboration between ASEAN member states and the European Union (EU), China, the US, and Japan, using conventional Salton measure from 2004 to 2008. They detected the EU as an important scientific collaborative partner of ASEAN member countries. For the case of Thailand and Singapore, the US took the lead as a significant scientific partner.

Gupta and Bala (2012) examined the share of international collaborations and identified major international scientific collaborative partners of Nepal in (S & T) from 2001 to 2010. They classified the US, India, Japan, and the United Kingdom (UK) as the major international collaborative partners with shares of 30.02 percent, 29.91 percent, 18.99 percent, and 16.32 percent, respectively.

Prathap (2013) explained the significant influence of foreign scientific collaborations on institutions through the modified version of Gain in Impact through Foreign Collaboration (GIFCOL). Prathap (2013) used the GIFCOL, index that was developed by Basu and Agarwal (2001), for his efforts to identify the influence of international collaborations on scientific publications and institutional performance.

Prathap (2013) also evaluated the influence of foreign collaboration by using impact factor that was computed based on the performance of publications.

Basu and Agarwal (2001) indicated that the size of foreign collaborations expanded the scientific outputs of the two organizations. The author, however, just looked into the foreign collaborations of participating authors by excluding the participating institutions. The research was also limited to two institutions, and no further discussions were pursued on the intra-inter collaborations between authors and institutions in a group of countries.

Kumar and Jan (2013) examined the patterns of research collaborations in Business and Management among participating researchers in Malaysia from 1980 until 2010, using the Social Sciences Citation Index (SSCI) database of WOS. There were 29 individual papers, 64 papers with two authors, 48 papers with three authors, 17 papers with four authors, one paper with 24 authors, and one paper with 49 authors. Only few authors have scattered their thoughts in many papers, and most authors have published few papers. This is a hint of the 80:20 Rule or Power Law. Using the bi-variate linear regression analysis (the case of two variables), it was found that the patterns of collaborations have a significant impact on the scientific publications. The authors favored the local and international scientific collaborations within research universities in Malaysia and international partners.

Kumar et al. (2014) examined the percentage of international and local collaboration within ASEAN member states and between ASEAN member states and other international countries in Economics using 32-year data (from 1979 to 2010). It was observed that the international collaborations had expanded, whereas the local collaborations shown a decreasing trend over the mentioned periods. They supported that international co-authored papers have been cited twice as often as the locally co-

authored papers in all the selected ASEAN countries except Indonesia and the Philippines. They considered Malaysia as one of the ASEAN countries that has given more priority to international collaboration through its bridging power, and the US is classified as a significant partner of ASEAN member nations. Local collaborations within ASEAN member nations were in a danger zone.

Wang et al. (2014) examined the collaboration network in Dye-Sensitised Solar Cells using scientific data from the Science Citation Index (SCI) Expanded Database (WOS) from 1981 until 2012. The Chinese authors have pushed the collaboration between countries and almost e kind of small network had a top author in it. The modified activity index rank list by author reflected the real research. Besides, the pattern of author collaboration has been impacted and extended to some degrees by the different kinds of institutions.

Garg and Kumar (2014) elaborated on the patterns of collaborations among scientists in Life Sciences using multidimensional levels of Collaboration Coefficients, by Ajiferuke et al. (1988). Based on the Collaboration Coefficients, it was illustrated that both male and female scientists have contributed 47% of the total scientific publications. The female scientists preferred to work in small teams that had less exposure to international visibility. The citations and impact factor on the publications of female scientists were low compared to male scientists. Although the authors have attempted to look into the multidimensional levels of collaborations, they have not captured the patterns of collaborations among the institutions.

Low et al. (2014) highlighted the patterns of research collaborations and trends of scientific publications (articles and reviews) in Clinical Medicine from 2001 and 2010, using the SCI-Expanded. It was noted that the articles and reviews in Clinical Medicine showed a positive indication with an increment from 4.5 percent in 2001 to 23.9 percent

in 2010. The top contributors were from those who dealt with Pharmacology and Pharmacy, General and Internal Medicine and Tropical Medicine. Among all the institutions in Malaysia, University of Malaya was noted as the best contributor of selected scientific publications. The percentage of local collaborators was more than the contributions of international collaborators. The local collaborators accounted for 60.3 percent whereas the foreign or international collaborators accounted for 39.7 percent. It can be seen that the higher journals' impact factors consisted of articles with international collaborations and are cited more often than articles with local collaborations. The variations of international co-authorships can be clearly seen across the disciplines, but they are reflected as the prominent contributing asset in the natural Sciences (Luukkonen et al., 1992). Further international research collaborations have their own internal dynamics that are different from the flow of their national systems (Leydesdoff & Wagner, 2008). The national systems can still remain in touch with the mediating role for inspiring better scientific voices through their effective collection of institutions and policies (Leydesdoff & Wagner, 2008). Discussions on local collaborations between the authors in Malaysia and international partners are limited.

Payumo and Sutton (2015) examined different types of scientific collaborations (domestic, regional, and international) of ASEAN member states on the discussions of plant biotechnology from 2004 to 2013. They supported the increasing trend of scientific collaboration in plant biotechnology over the selected periods as plant biotechnology is considered one of the main areas of co-operation between ASEAN member states. The direction on the limited scope of research collaboration within ASEAN member states is almost consistent with Kumar et al. (2014). There was no influence on domestic collaborations for lower income countries such as Myanmar, Brunei Darussalam, Cambodia, and Laos.

There are some missing elements on the individual effects of scientific collaborations between most productive authors and institutions in Malaysia at the basis of aggregation. There is still a need to explore different behavior of rates and strengths of scientific collaborations among most productive authors and institutions in Malaysia individually based on an aggregated approach. There are some studies that have looked into the limited scope of scientific collaborations between ASEAN member states in some research areas and disciplines.such as Economics, Plant Biotechnology and others. However, The strength of local scientific collaborations between Malaysia and the other ASEAN member states at the aggregated level is still unclear.

All the reviewed studies such as Kumar et al. (2014), Wang et al. (2014), Garg and Kumar (2014), and others have given some clues on the nature of scientific collaborations. Studies by Low et al. (2014), Hassan et al. (2012), Vinluan (2012), and Leydesdoff and Wagner (2008) have pointed out the dynamic nature of scientific behaviors at different levels. It is expected that there are some differences of rates and strengths of local and international scientific collaborations between most productive authors and institutions in Malaysia. The focus of this chapter on scientific collaboration is more on developing ASEAN member states. Singapore has been excluded from this research because of its status of a developed country. In the beginning of this thesis, Malaysia and Thailand were selected based on the status of upper middle-income countries and developing countries. Later, Thailand was excluded from this chapter because of its classification as a "catching up country" for STI performance by Rodriguez and Soeparwata (2012). Malaysia was used as a sample country due to its classification as a "follower" in terms of STI performance by Rodriguez and Soeparwata (2012) and has been known as an upper middle-income country. It is also the interest of this thesis to look into the nature and strategies of scientific collaboration among productive researchers and institutions in Malaysia.

Based on the review of Kumar et al. (2014), Payumo and Sutton (2015), it has indicated that there is a limited aspect of local scientific collaborations within ASEAN member states in Economics and plant biotechnology. The first analytical chapter used studies by Kumar et al. (2014) and Payumo and Sutton (2015) as a benchmark to develop the third hypothesis. This id to test if it follows the similar trend of limited local scientific collaboration between Malaysia and the remaining ASEAN member states in an aggregated approach. Because of that, it is an expectation that there are limited trends of local scientific collaborations between ASEAN member states. Therefore, three hypotheses are generated as follows:

H_1: There are significant differences in rates and strengths of scientific collaborations between most productive authors in Malaysia.

H_2: There are significant differences in rates and strengths of scientific collaborations between most productive institutions in Malaysia.

H_3: There is limited scope for local scientific collaborations between Malaysia and the other ASEAN member states.

2.3 SOCIAL NETWORKING SITES AND RESEARCH EXPOSURE

The idea of impact measures beyond citation analysis emerged before the arrival of social media (Martin & Irvine, 1983). Altmetrics is in the preliminary stage but some works had already been done (Zahedi, Costas & Wouters, 2014). The term "Altmetrics" was introduced later than "usage metrics" (Priem et al., 2010; Priem & Hemminger, 2010). The former refers to the alternative tool of traditional citation metrics. Altmetrics deals with metrics on mentions and captures of links, bookmarks, storage and conversations within social media or SNSs (Glanzel & Gorraiz, 2015; Fenner, 2014). Altmetrics is a promising approach to efforts to find appropriate measures for assessing research in Social Sciences and Humanities (Tang et al., 2012). Recent studies have

focused on disciplinary differences in Mendeley (Mohammadi & Thelwall, 2013), and Twitter (Holmberg & Thelwall, 2013). Holmberg and Thelwall (2014) examined the variations in scientific communications among researchers and scholars from 10 different disciplines. The disciplines were Astrophysics, Biochemistry, Digital Humanities, Economics, History of Science, Cheminformatics, Cognitive Science, Drug Disco, Social Network Analysis (SNA), and Sociology. They have generated the data from 4 March 2012 to 16 October 2012 and examined it through exploratory and quantitative analysis such as Chi-Square test. The authors collected 81,836 tweets on Cheminformatics, 59,742 tweets on Astrophysics, and remaining tweets on different disciplines.

Based on the analysis of Chi-Square test, it was found that there are differences or variations in tweets between the 10 selected disciplines. About 42 percent of the tweets were re-tweeted compared to 18.5 percent and 33.5 percent in the disciplines of Digital Humanities and Cognitive Science. Tweets from both Digital Humanities and Cognitive Science were 38 percent, and Astrophysics (31.5 percent), History of Science (28.5 percent), SNA (27.5 percent), Drug Disco (26.5 percent), Biochemistry (16 percent) and Economics (16 percent). It was the first attempt to look into the scientific communication among scholars through a use of the social networking site (Twitter). It was limited to the discussion on the variations of tweets between disciplines. There was no connectivity between the internal aspects of SNSs and research visibility. There were also no discussions on the embedded groups in the SNSs.

Holmberg and Thelwall (2014) showed that SNSs can increase the research visibility of research members. They did not test the association between the utilization of Twitter and research visibility. Social media offers a potential opportunity for the promotion of research funding. It has referred social media as an important platform in linking article's citation rate with its publishing journal (Lozano, Lariviere & Gingras,

2012). Tweets containing a link to an article or "tweetations" have predicted highly cited articles within the first three days after publication (Eysenbach, 2011).

Selected articles through SNSs (Twitter, Facebook and LinkedIn) were viewed and downloaded more frequently (Allen, Stanton & Pietro, 2013). Thelwall, Haustein and Lariviere (2013) showed a positive correlation between Altmetrics and eventual citations, with the strongest evidence for articles posted on Twitter, Facebook's wall posts, and blog entries. Haustein, Peters and Sugimoto (2014) identified fewer robust correlation between tweets and citations and this metrics represent the complementary measures of an article's value.

Despite benefits of social media engagement for researchers, social media in academia has been slow. Fewer than 3% of scientists are active Twitter users (Priem, Costello & Dzuba, 2010). It has shown that the rate of tweets increased substantially within 1.4 million scholarly articles from 2.4% in 2010 to 20.4% in 2012 (Haustein, et al., 2014). General Science and medicine journals such as Nature and the New England Journal of Medicine enjoy a greater number of followers. Most journals (67%) have less than 20% of their content tweeted (Haustein, et al., 2014).

Most researchers have used Uses and Gratification Theory to explain the needs through the use of SNSs among the users (Cantril and Allport, 1935; Cantril, 1942; Klapper, 1960; McQuail, 1994; Raacke & Bonds-Raacke, 2008). Raacke and Bonds-Raacke (2008) have examined the Uses and Gratification Theory to evaluate the attitude and nature of friend-Networking Sites (Facebook and MySpace) use among college students. They have suggested that college students favored the use of Facebook and MySpace to fulfill their social needs. Shao (2009) has used Uses and Gratification Theory to examine the interaction between the human needs and the use of user-generated media such as YouTube, MySpace and Wikipedia. Shao (2009) has shown

that people prefer to deal with media like YouTube, MySpace and Wikipedia to fulfill their information, entertainment and mood management needs. Urista, Dong and Day (2009) have asserted that the young adults prefer to use the SNSs such as Facebook and MySpace within the Internet to increase the fulfillment of entertainment and information.

Smock, Ellison, Lampe and Wohn (2011) have used the Uses and Gratification Theory to explain the nature of Facebook's use among social users. They have evaluated the features of Facebook such as status updates and wall posts and interaction of it with the needs of social users in increasing the collection of information. Park, Kee, and Valenzuela (2009) have utilized Facebook as a medium of communication among users to improve the levels of socialization, entertainment, self-status seeking and information. This has been realized using Uses and Gratification Theory. Larose, Mastro and Eastin (2001) have examined the interaction between human needs and the use of internet sites. Through Larose et al. (2001), it has been revealed that social cognitive of users can improve the positive use of internet sites through Uses and Gratification Theory. Cheung, Chiu and Lee (2011) classified social related factors as important element that can motivate the use of SNSs through Uses and Gratification Theory.

Davis (1986, 1989), Davis et al. (1989), Fishbein and Ajzen (1975), Chin and Todd (1995), and others have verified the applicability of Technology Acceptance Model (TAM) within Information Communication and Technology (ICT) through various quantitative techniques. The TAM was developed based on the subjective judgment and cognitive structuring of human minds. There are two embedded branches that can be realized within the scope of TAM: Perceived Usefulness (PU) and Perceived Ease of Use (PEU). It was introduced earlier by Davis (1986, 1989) and Davis et al. (1989) to explain the connection between humans and information systems. Figure 2.1

explains the tri-dimensional connectivity between PEU, PU, and intention to use systems. PEU refers to a "degree to which a person believes that using a particular system would free from effort" (Davis, 1989). PU refers to a "degree to which a person believes that using a particular system would improve his or her job performance" (Davis, 1989).

Based on Figure 2.1, the positive expansion of PEU and PU will lead to the increasing intention to use the system among the system users. In the context of system or Internet sites, the PEU refers to the users' perception on the features and technicality of Internet sites. PU refers to the users' perception of the usefulness of Internet sites or the total benefits that have been gained from the system. This will inspire the positive intention of users to use the systems or Internet sites. Wu and Wang (2005) have proposed the extended version of TAM through the incorporations of Innovation diffusion theory, perceived risk and perceived cost. They have suggested that the PU influences the intention to use the systems or sites in a significant manner. Lederer, Maupin, Sena and Zhuang (2000) have supported the positive link between PEU, PU and intention to use the systems or sites. It motivates the directions of intention to utilize the sites. Venkatesh and Bala (2008) have supported that improvement of human views on the technical flexibility and usefulness of the Internet systems leads to the expansion of human intention to use the Internet systems. This is consistent with the thoughts by Davis (1986, 1989), Davis et al. (1989), and Lederer et al. (2000). Most of the existing studies have discussed various parts of Uses and Gratification Theory and TAM.
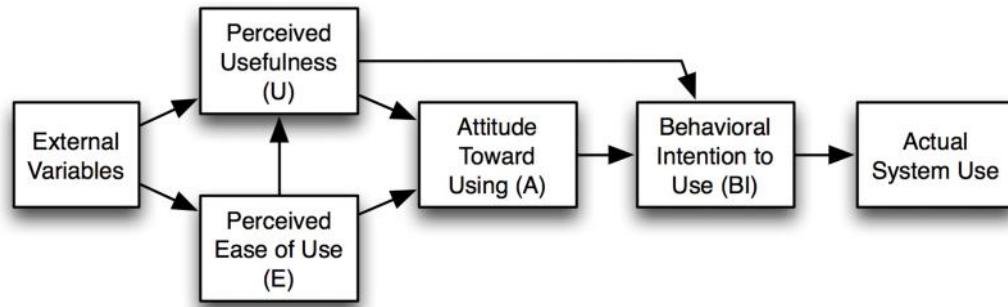
Figure 2.1: Original version of Technology Acceptance Model

Source: (Davis, 1986; Davis et al., 1989)

The deployment of Uses and Gratification Theory and TAM will be useful for building up the extension of Altmetrics in the form of Socimetrics. The use of Uses and Gratification Theory has the capacity of providing the direction of the attitude of researchers and various needs of researchers by using SNSs. In a way, Uses and Gratification Theory can be used as a benchmark to evaluate the selection of ASEAN researchers for further investigation on the extension of Altmetrics. Through the utilization of TAM, the PEU refers to the technical features of SNSs such as the search function and the download function. TAM has been used for evaluating different directions of research conversations. PU refers to the research benefits that have gained from the use of SNSs such as the sharing of research materials, collaborative activities and others.

The use of ideas on PU and PEU was used to measure different levels of research conversations within SNSs based on the likes, comments and views. This will be useful for extending Altmetrics through Socimetrics. "Altmetrics" is a new field of research, and it has not been explored fully as the focus of existing literatures has been limited to the connectivity between SNSs and research visibility. It can be gained through improvement of citations, and the investigations have only been applied to the general audiences.

There is a serious need to evaluate the influence of SNSs in improving research exposure through the virtual collaboration system based on the combined Uses and Gratification Theory and TAM. It is an expectation that the utilization of SNSs can increase research exposure among ASEAN research participants, as there are many possibilities for it. The next thesis hypothesis is formulated as follows:

H4:   The utilization of SNSs increases research exposure among ASEAN research participants.

2.4 IMPACT FACTOR

The occurrence of citations refers to the process where published works cite or refer to another published work, including the full reference of the latter within a reference list. The gathered list of citations enables research authors to recognize their intellectual debts. Generally, the origins of citations are from journal articles, but it can also be obtained from books, publications of governments, professional documents, Msc and PhD theses, web articles, newspapers and magazine articles. The research reputation of ISI-indexed journals is determined by various forms of impact values that are tied to different patterns of citations and citing agents (Glanzel & Moed, 2002; Lu et al., 2014). According to Merton (1973), citations have two main roles. Firstly, researchers use citations to shed some lights on the works that have influenced the interesting features of their research (Chan et al., 2015). Second, researchers use citations to reduce the intellectual debt by increasing the popularity of cited authors and the contents of their thoughts (Chan et al., 2015).

Gross and Gross (1927) were the first to use citation counts to evaluate the importance of scientific works. Journal impact factor has gained the attention of researchers (Moed et al., 1999). Besides that, different proposals on the measurements of the journal impact factors are available in non-bibliometrics scholarly journals. The

journals were Allergy, British Medical Journal, Journal of Epidemiology and Community Health, and others (Seglen, 1997; Porta, 1996; Dubin & Arndt, 1995; Hansson, 1995; Saha et al., 2003).

Journal impact factor (JIF) refers to quantitative measurement of visibility among ISI-indexed journals in various disciplines. JIF is published by ISI in the Journal Citation Reports (JCR) section, and it is used to evaluate the status of scientific journals. For technical definition, impact factor of ISI-indexed journal in the year T refers to the number of citations of documents published in years (T-1) and (T-2). It is a tool to evaluate the significance of ISI-indexed journals (Lu et al., 2014). Journals published in narrower or more specialized research areas tend to be cited more often simply because they are the principal source of knowledge in that area (Ratnavelu, Fatt & Ujum, 2012).

The impact factor has been widely used by researchers, librarians, editors, universities and scientific policy makers to rank the quality of publications. Editors and publishers have used the impact factor as a promotional tool to increase the visibility and reputation of their journals (Sombatsompop, Markpin & Premkamolnetr, 2004). Academic and research institutions have used citations as a proxy to assess national Science policies and disciplinary development (Lewison & Dawson, 1998; Oppenheim, 1995, 1997; Tijssen, van Leeuwen, & van Raan, 2002). It is also used for evaluation on the performance of individual scientists (Cole & Cole, 1973; Garfield, 1970) and journal purchases (Archambault & Lariviere, 2009).

Using JIF to evaluate the quality of research has been questioned as the derivation of JIF scores from the ISI database are riddled with flaws. Rice, Borgman, Bednarski, and Hart (1989) identified errors in journal-to-journal citations such as discrepancies between citing and cited data, changed or deleted journal titles, and variations in shortening journal titles. Moed et al. (1999) linked the faults of the JIF with inaccurate

definition of citable documents. They have pointed out the variations in impact on different types of published documents for 40 leading medical periodicals. As been argued by many scholars, the impact factor should not be viewed monothistically because of the subjective nature of quality, which requires that it must be based on multidimensional elements (Vanclay, 2009; LLunh, 2005). In addition, the most widely used measure of the impact factors is not a true measure of a journal's quality as it represents a single factor that deals with citations alone. It has been classified as a tool to measure the visibility of the contents within the sets of publications in the scientific journals.

The other disadvantages of the JIF are-

(a) High levels of authors' self-citations and journals self-citations deal with the expansion of the JIF.

(b) High-impact articles influences JIF for a partial journal (Seglen, 1997).

(c) Reviewed papers are often cited and contain many citations, and ontribute to the high-impact factor for a journal (Cameron, 2005: Kurmis, 2003; Seglen, 1997).

(d) JIFs through research fields tend to be higher with broader interest in basic research, but lower for more specific or clinical research fields (Seglen, 1997).

(e) JIFs may not reflect the quality of research for clinicians who publish in peer-reviewed journals less often. They are not given the opportunity to select articles, with great relevance and use in practical settings (Jette, 2005). This is relevant in more clinically based fields like nursing and midwifery.

(f) Lack of citations for articles advancing knowledge provide guidelines for practical application-may not be widely cited, in Clinical Medicine (Cameron, 2005).

Pendlebury and Adams (2012) argued that the term "impact" does not reflect the scientific excellence because of the subjective judgments of humans. Hemmingsson (2002) and Smith (1997) pointed out the existing method used has led to its manipulation by resulting in distortion of rankings.

The two-year and five-year impact factors that are used now by WOS are only able to capture short-term visibility of the journals; therefore, the rankings from these results could easily be manipulated (Krishna, et.al., 2015). However, the argument does not end there. It can also be argued that short-term assessments may be important for deciding certain outlines of rankings (Krishna et al., 2015). Della Sala and Grafman (2009) and Swartz (2009) argued that the limited two- year citation would favor older journals at the expense of the newer ones. The provision of a short timeline for new or latecomer journals would reduce their potential to build their citation base (Krishna et al., 2015).

There are two types of impact factors, i.e., complementary impact factors and substitute impact factors. For this thesis, complementary impact factors refer to impact factors that have similar length and levels of citations. Substitute impact factors refer to impact factors that have longer or different length and levels of citations compared to complementary impact factors. In certain cases, a type of DIF can be said to be complementary to SIF when there are no differences in rankings between the two approaches. A type of DIF can be said to be substitute to SIF when there are differences in rankings between two approaches.

The original calculations of Synchronous and DIFs were as follows:

$$SIF_{t,m}(Y) = \sum_{i=1}^{t} TC(Y, Y-i) / \sum_{i=1}^{t} TP(Y-i)$$

Where, *SIF* represents the Synchronous impact factor, $TC(Y, Y-i)$ represents total citations for publications in the year Y in the selected fixed years, *TP(Y- i)* represents total publications in the selected fixed years, *t* represents the year of publication, and *m* represents ISI-indexed journals in the selected subject categories. It was adopted from Garfield (1955).

$$DIF_{t,m}(Y) = \sum_{i=p}^{p+t-1} TC(Y+i, Y) / TP(Y)$$

Where, *DIF* represents Diachronous impact factor, *TC(Y+i, Y)* represents total citations for publications in the year Y in the same year and subsequent years, *TP(Y)* represents total publications in the year Y, *t* represents the total number of publication years, and *m* represents ISI-indexed journals in the selected subject categories.It was adopted from Ingwersen et al. (2001).

SIF was measured by adding up the total citations for past years and dividing it with total publications. 2- year ISI's impact factor refers to SIF. DIF was measured by adding up the total citations for current year and subsequent years and dividing it with total publications for the current years. The important idea of Synchronous approach can be characterized by the notion of half-life that has been taken from nuclear Physics within a model that was proposed by Burton and Kebler (1960). Wallace (1986) followed the similar directions by classifying the association between journal productivity and obsolescence. The researcher has noted the exponential distributions between them and asserted that ageing is similarly related to the radioactive decay that has been characterized by the median of the distribution (half-life nature).

Nakamoto (1988) also looked into the dual forms of Synchronous and diachronous citations within a single graph. Figure 2.2 has explained the directions of Synchronous and diachronous citations. Based on Figure 2.2, it can be seen that

Synchronous citations refer to the citations that have been gathered in the past years, and it is more to retrospective citations. It can be also inferred that Synchronous distributions followed the directions from right to the left, in which it is paying attention to the past citations in the lagged time periods (past time periods). Concerning reference to Figure 2.2, it can be said that diachronous citations refer to the citations that are gathered within the present time of publications and future years. It is more to prospective citations. Diachronous citations follow the directions from right to right, and it moves ahead without breaks.

Synchronous and diachronous approaches of citations were also examined by Stinson and Lancaster (1987), Barnett et al.(1989), Rousseau (1994), Burrell (2002), and Yu and Li (2007). Stinson and Lancaster (1987) have supported that diachronous citations are the substitute to the Synchronous citations through the differences between them in the study of obsolescence. Egghe (2010), Yang et al. (2010) and Lariviere et al. (2008) have supported the increasing age of cited references through Synchronous approach. It is consistent with model by Bouabid (2011) in which it fits well with the observed Synchronous citation distribution. Costas et al. (2010), Leimu and Koricheva (2005), and Aksnes (2003) have supported that the total proportion of self-citations based on diachronous approach was higher in the first few years. Leblond (2012) has stated that the journals with higher of impact factors have higher proportions of Synchronous and diachronous self-citations.
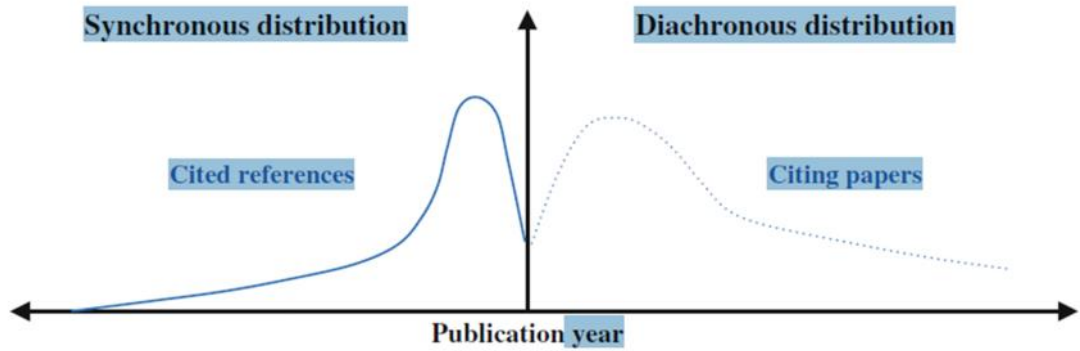
Figure 2.2: Graphical illustrations of Synchronous and Diachronous citations distributions

Source: Bouabid and Lariviere (2013)

Glanzel et al. (2004) used a pragmatic approach to show the flexibility of the SIF as it does not require large observations in the citations' window. They argued that it could not serve as a substitute for the diachronous approach. While the SIF is a backward approach, the DIF is a forward approach. The former uses' citations of publications of journals in a mentioned lagged year (Ingwersen et al., 2001; Ingwersen, 2012). It is also known as a retrospective approach (Glanzel et al., 2004; Bouabid & Lariviere, 2013). The DIF focuses on the continuous years of citations' window (continuous movement of citations over time), and considers citations in the current and future years. This refers to the prospective approach (Glanzel et al., 2004; Bouabid & Lariviere, 2013). Glanzel et al. (2004) argued that the diachronous approach is the most suitable to highlight the characteristics of the citation in the real context.

Table 2.1: Number of ISI-indexed papers in Economics published by researchers from ASEAN member states

ASEAN member states	Number of ISI-indexed papers in Economics
Malaysia	1958
Singapore	2774
Thailand	893
Philippines	624
Indonesia	711
Myanmar	2
Brunei	10
Vietnam	223
Cambodia	20
Laos	14

Source: WOS

Table 2.2: Selected Economics journals utilized by researchers from ASEAN member states

ASEAN member states	ISI-indexed journal
Malaysia	Value in Health
	American Journal of Agricultural Economics
	Hitotsubashi Journal of Economics
	Ecological Economics
	Technological and Economic Development of Economy
	Economics Letters
	Applied Economics
	Singapore Economic Review
Singapore	American Economic Review
	Journal of Finance
	Journal of Financial Economics
	Journal of Econometrics
	Journal of Public Economics
	Journal of Monetary Economics
	Small Business Economics
	Journal of International Economics
	Journal of Risk and Uncertainty
	Mathematical Finance
	Journal of Economic Theory
	European Economic Review
	Applied Economics
Thailand	Journal of Banking & Finance
	Value in Health
	Ecological Economics
	Applied Economics
	Journal of Monetary Economics
Philippines	Journal of Post Keynesian Economics
	Economic Systems Research
	Journal of Economic Surveys
	Oxford Review of Economic Policy
	European Journal of Health Economics
Indonesia	Applied Economics
	Ecological Economics
	American Journal of Agricultural Economics

Source: WOS

The selection of Economics journals is important to this thesis, as Economics is considered as a fast-growing field of interest among researchers from developed and

developing countries, especially researchers from ASEAN member states. The importance of Economics can be realized through the number of papers published in Economics by researchers from ASEAN member states. Researchers from Malaysia, Singapore, Thailand, Philippines and Indonesia have published more than 500 papers in Economics in various Economics journals (Table 2.1). Researchers from Malaysia, Singapore, Thailand, Philippines and Indonesia have shown the importance of Economics and its journals through the number of Economics papers in various Economics journals (Table 2.1). They have published their works in various journals such as Singapore Economic Review, Applied Economics Letters, Value in Health, Journal of Econometrics, Applied Economics and others (Table 2.2). In reality, Economics deals with various issues ranging from financial issues to developmental issues. It is an important subject that can serve as a benchmark for all the existing multidisciplinary areas of interest, and for the assessment of economic development. ISI's JIF (2-year impact factor) has been used to examine the short-term scientific performance of ISI-indexed journals in Economics based on lagged two periods. However, the current ISI's JIF may not capture the "accurate" short-term scientific performance of ISI-indexed journals in Economics based on current trends. According to Kumar et al. (2014), Economics has been considered as the most precious and important field within the scope of Social Sciences. This has been observed by Kumar et al. (2014) through the number of paper that has been indexed as SSCI index for ISI WOS. The examinations on the differences between Synchronous and DIFs on ISI-indexed journals in Economics are very useful for researchers to make a decision on the selection of journals based on appropriate measurements. It will be also important for governments to evaluate the capacity of ASEAN researchers who are publishing papers in Economics journals to facilitate the allocation of funds in a fairer way.

Various citation measures based on diachronous approach have the capacity of evaluating the short-term and long-term visibility of issues within the scientific articles in ISI-indexed journals based on the current and future scientific trends. According to Harzing (2013), ISI-indexed journals can still be utilized in this thesis, although there is room for alternatives such as Scopus, and Google Scholar because of its majority votes of popularity. Adler and Harzing (2009) have suggested that the academic reward depends heavily on the number of papers and citations within ISI WOS. Web of Science (WOS) is the most recognized database for classifying scientific journals. It has accounted for 8,073 SCI-Expanded indexed journals across 174 scientific disciplines based on the Journal Citation Report 2010 (Ho, 2013). In 2012, WOS recognized over 12,000 high-impact journals worldwide (Reuters, 2012).

Through the evaluation of relevant published works, there has been no attempt to examine the differences between Synchronous and DIFs among ISI-indexed journals in Economics based on First-Latecomer advantages. There is a need to evaluate applicability of diachronous approaches among ISI-indexed journals owned by developing countries, namely Malaysia, Thailand and the Philippines in Sciences. Two hypotheses are therefore generated as follows:

H$_5$:   The diachronous impact factor serves as a "substitute" for the synchronous impact factor among ISI journals in Economics.

H$_6$:   The diachronous impact factor serves as a "substitute" for the synchronous impact factor among domestically owned ISI-indexed journals in developing ASEAN member countries.

2.5 SALTON MEASURE

Most researchers have looked at the Salton's framework to evaluate the strength of local and international scientific collaborations at different levels (Salton and MacGill, 1983; Liang and Zhu, 2002; Zhang et al., 2014; Hassan et al., 2012). Salton's measure can also be known as the co-operation index, and it can be used to examine the local and international collaborations between two nodes such as authors, institutions, and countries in a network. The calculation of Salton's measure is as follows:

$$R_{ab} = \sum_{i=p} (P_{ab} / \sqrt{(P_a . P_b)})$$

Where, R_{ab} represents relative scientific collaboration between author or institution or country 1 and author or institution or country 2, P_{ab} represents the number of scientific co-publications between author or institution or country 1 and author or institution or country 2, P_a represents the number of scientific publications by author or institution or country 1, and P_b represents the number of scientific publications by author or institution or country 2.

Arunachalam et al. (1994), Dastidar (2004), Glanzel and Schubert (2001), Glanzel and Winterhager (1992), Luukkonen et al. (1993) and others have supported the positive strength of relative collaboration between two countries. Chang and Huang (2014) have favored stronger strength of scientific collaborations between Brandon University in Canada and Citadel in the US, Newcastle University in the UK and others. The stronger form of associations between the institutions can be observed in the astronomical research. Liang and Zhu (2002) have suggested the negative power function of collaboration strength between regional scientific productivity within China. Hassan et al. (2012) have used Salton's measure to evaluate the scientific publication volumes of EU and ASEAN member countries in measuring the collaboration strength between them. Hassan et al. (2012) have stated that the higher collaboration strength can be

observed between EU and ASEAN member states in the areas of Environment, Energy, Food, Agriculture and Biotechnology.

Finnardi (2015) has captured the dynamics of scientific collaboration between five BRICS countries (Brazil, Russia, India, China and South Africa) by its strengths through Salton's measure. Finnardi (2015) has stated that the growth of scientific publications in its absolute number should not be a reliable indicator of collaboration strength. The fraction of scientific collaboration with other BRICS countries by each of the countries should be classified as a suitable proxy of collaboration strength. Based on the review, it can be identified that none of the studies have focused on the patterns of collaboration strength among authors, institutions, and countries over the time. The proposal on the modified Salton measure with time factor will be useful to evaluate the strength of scientific collaborations. The measure is important in evaluating the strength of scientific collaborations between most productive authors and institutions in Malaysia. It also detects the local scientific collaborations between Malaysia and other ASEAN member states.

2.6 ASEAN SCIENCE POLICY

Most researchers have looked into the different versions of the ASEAN Science policy framework in STI policy, KEI, and others. The consistency of STI policy can be seen through the evaluation of three different dimensions: horizontal, vertical and temporal (Rodriguez and Soeparwata, 2012). Horizontal Dimensions refer to the building and coordination of individuals, sectors, and policies to increase the achievement of goals (Remoe, 2005). Vertical Dimension dealt with the consistency between the public outputs and purpose of policy makers. Temporal Dimension refer to a necessary dimension that is needed to ensure the effectiveness of current policies in the future (Remoe, 2005).

Rodriguez and Soeparwata (2012) classified the horizontal dimension as the needs of governing and coordinating various policy domains. They have defined the vertical dimensions as the relationships among different layers of government institutions. They have classified temporal dimension as a dimension that deals with the deadlines and follow-up of programmes. Rodriguez and Soeparwata (2012) used innovation indicators such as percentage of researchers, research and development spending, total graduates in Science, Engineering, Manufacturing and Construction, patent applications, intellectual assets, economic size such as gross domestic product per capita, governance indicators such as rule of law, control of corruption and government effectiveness to oversee the performance of STI within each of ASEAN member states. Through the calculation of composite innovation indexes, the scholars have classified Brunei Darussalam, Cambodia, Laos, Vietnam and Myanmar as "trailing countries" or "slow moving" countries. They have identified Indonesia, Philippines, and Thailand as "catching up countries" and Malaysia as "follower." Rodriguez and Soeparwata (2012) classified Singapore as the leader. Classification of "trailing countries", "follower", and "catching up countries" were made through the average scores of innovation dimensions. Classification of Malaysia as a follower because of the average score of innovation was 0.5. Singapore was classified as a leader because of the average score of innovation was 0.6. Indonesia, Philippines, and Thailand were classified as "catching up countries" because of the average score of innovation was 0.3 and close to Malaysia. Brunei Darussalam, Cambodia, Laos, Vietnam and Myanmar as "slow moving countries" because of the average score of innovation was 0.2.

Researchers like Remoe (2010), Lai and Yap (2004), Sigurdson and Palonka (2005), and Dodgson (2000) have evaluated the performance of STI on certain ASEAN member states by using various indicators within various sectors such as scientific publications, number of researchers, research and development spending, foreign direct

investment, human capital, S&T parks, patents and others. Hassan et al. (2012) have explored the performance of STI on ASEAN member states by using seven areas of Seventh Framework Program (FP7) such as Nanotechnology, Energy, Health, Environment, ICT, Industrial Technology, Food, Agriculture and Biotechnology from 2000 to 2008. The investigation on the STI performance was made through Salton's measure. They have identified that Thailand was the most important scientific collaboration partner for EU countries in the areas of Health, Environment, Energy, Food, Agriculture and Biotechnology. Singapore has higher collaboration strength with EU countries in Nanotechnology whereas the rests of the ASEAN member states were still lacking behind in this area from 2000 to 2008.

Nguyen and Pham (2011) have taken the initiative to look into the STI performance through the investigation of the association between scientific output and KEI within all the 10 ASEAN member states from 1991 to 2010. The investigation was made through a linear regression model. KEI refers to the weighted average score of four indices (economic institution and incentive, education, Innovation and ICT). They have favored a strong link between scientific output and knowledge economic and Innovation indices through the linear regression model. They have also made up some points that scientific production of ASEAN member states was low and collaboration among them was modest from 1991 to 2010. They have agreed to the point that the use of citations may not be the best proxy to measure the quality of scientific productions.

Payumo and Sutton (2015) studied the STI performance of all the 10 ASEAN member states in plant biotechnology using number of research papers, number of unique names of scientists, types of scientific publications, most productive institutions, number of citations, compound annual growth rate of publications, and the intensity of scientific collaborations at different levels (domestic, regional and international) from 2004 to 2013. They reported that countries with higher income have received more

citations compared to countries with lower income. Singapore's scientific publications were cited more often in plant biotechnology and the patterns of citations were followed by Malaysia, Thailand and Philippines. They have asserted that the patterns of collaborations within the scope of ASEAN member states were low and it is consistent with the findings of Nguyen and Pham (2011).

Although researchers have looked into the STI performance within ASEAN member states using various indicators such as number of researchers, patent applications, research and development spending, KEI, number of citations, technology transfer, foreign direct investment and others, there are still some missing scientific holes within the discussions of STI performance. It will be a better idea to look into strategies and strengths of scientific collaborations between most productive researchers and collaborators at various levels of authors, institutions, and regional states instead of just looking into the patterns of scientific collaborations among all the researchers at different levels using a modified Salton's measure.

A Modified Salton's measure will be useful for evaluating the strength of scientific collaborations between most productive authors and institutions within Malaysia with their top collaborators in Malaysia and international countries and between Malaysia and other remaining ASEAN member states over the time (from the beginning of ISI publications in 1980 up to 2013). This is because the technical measurement of current Salton's measure does not consider the time factor. The discussion of the patterns of collaborations through the quantitative measures (modified collaborations rate, and modified Salton measure), and qualitative technique (Structured Interview) will serve as a holistic approach to identify the scientific fairness within the part of scientific collaboration between first comers and latecomers and it will be useful for the improvisation of existing ASEAN scientific policy framework.

The second consideration is more on the use of SNSs as a virtual medium for promoting the knowledge diffusion and research exposure among ASEAN researchers. There is a need to look into the role of SNSs as a research medium within the scope of ASEAN researchers, such as Payumo and Sutton (2015), Nguyen and Pham (2011) and others have made up the point that ASEAN member states are still lacking behind the scope of Innovation and knowledge sharing and it is maybe because of they don't have the proper research medium to fulfill their research needs. The current ASEAN Science policy framework does not look into the role of SNSs as a research medium and that reflects the weakness of existing ASEAN Science policy framework in deciding the sources of knowledge diffusion among researchers.

The discussions on the association between the use of SNSs and research exposure among ASEAN researchers through various quantitative measures (extension of Altmetrics and Socimetrics) and qualitative measures (content analysis and conversational analysis) will be useful for the improvisation of current ASEAN Science policy framework. It acts as a benchmark in providing a modified form of research that measures can be examined by policy makers to oversee the research activities or discussions within SNSs like Facebook and LinkedIn among ASEAN researchers. The ASEAN policymakers can also use the measures to evaluate the behavior of local and international scientific collaborations of ASEAN researchers within SNSs.

The third consideration is on the various measurements of JIFs among domestically owned ASEAN ISI-indexed journals in the Sciences and utilized journals in Economics. Citations have been used as a proxy to calculate the JIFs and the citation based impact factors have been classified as a proxy to measure the quality of ISI-indexed journals. As indicated earlier in the review section of JIFs, impact factors should not be used to evaluate the quality of scientific articles within the journals, as it does not distinguish the citations based on the issues, methods, and internal contents.

Some of the researchers have used the total citations as an objective measure to evaluate the STI performance within the context of the ASEAN Science policy framework, but the evaluation will be biased as the total citations should viewed as a subjective measure because of it is based on the cognitive evaluation of human minds that vary from one to another. Various measures of JIFs based on diachronous approach should be included within the scope of ASEAN Science policy as it provides more systematic and robust evaluations of the present and long-term performance of ISI-indexed journals within ASEAN member states.

2.7 SUMMARY

Although there is an enormous number of studies on various elements of scientific inputs and output such as h-index, m-index, gh-index, citation indexes, TAI, collaborations, SNSs, scientific publications and others, using the meta-physical approach, there are however several concerns on the following aspects of research:-

(a)   Rates and strengths between the types of collaborations through individual effects based on an aggregated approach within and between ASEAN member states

(b)   Multidimensional research effects of SNSs, such as, Facebook and LinkedIn in ASEAN member countries

(c)   Confirmation and comparison of impact factors based on Synchronous and diachronous approaches in ASEAN member states

These thesis gaps have formed three different thesis questions:-

(a)   What are the characteristics of rates and strengths of scientific collaborations among most productive authors and institutions in Malaysia and the other ASEAN member states?

(i)   What are the behaviors of rates and strengths of scientific collaborations among most productive authors and institutions in Malaysia?

(ii)   Are there significant differences in rates and strengths of scientific collaborations between most productive authors in Malaysia?

(iii)   Are there significant differences in rates and strengths of scientific collaborations between most productive institutions in Malaysia?

(iv)   What are the behaviors of rates and strengths of scientific collaborations between Malaysia and the other ASEAN member states?

(b)   Can the SNSs influence research exposure among ASEAN research participants?

(c)   Can the diachronous impact factor be a "complementary" or "substitute" for the synchronous impact factor among ISI-indexed journals owned and utilized by ASEAN member states?

(i)   Can the Diachronous impact factor be a "complementary" or "substitute" for the Synchronous impact factor among ISI-indexed journals owned by developing ASEAN member states in the Sciences?

(ii)   Can the Diachronous impact factor be a "complementary" or "substitute" for the Synchronous impact factor among ISI-indexed journals utilized by selected ASEAN member states in Economics?

Six hypotheses are developed from the noted thesis gaps and thesis questions as follows:

H_1:   There are significant differences in rates and strengths of scientific collaborations between most productive authors in Malaysia

H_2:   There are significant differences in rates and strengths of scientific collaborations between most productive institutions in Malaysia

H₃: There is limited scope for local scientific collaborations between Malaysia and the other ASEAN member states.

H₄: The use of SNSs increases research exposure among ASEAN research participants.

H₅: The diachronous impact factor serves as a "substitute" for the Synchronous impact factor among ISI journals in Economics

H₆: The diachronous impact factor serves as a "substitute" for the synchronous impact factor among domestically owned ISI-indexed journals in developing ASEAN member states

The next three chapters are analytical chapters, providing answers to the thesis questions by testing the selected thesis hypotheses.

CHAPTER 3: SCIENTIFIC COLLABORATIONS AMONG PARTICIPATING ASEAN AUTHORS, INSTITUTIONS AND MEMBER STATES

3.1 INTRODUCTION

This chapter analyses the behaviors of rates and strengths of scientific collaborations between most productive authors and institutions in Malaysia. Besides that, this chapter also analyses the behaviors of the rates and strengths of scientific collaborations between Malaysia and the other ASEAN member states. This chapter examines the differences in rates and strengths of scientific collaborations between most productive authors and institutions in Malaysia.

This chapter has testes the following hypotheses:

H_1: There are significant differences in rates and strengths of scientific collaborations between most productive authors in Malaysia

H_2: There are significant differences in rates and strengths of scientific collaborations between most productive institutions in Malaysia

H_3: There is limited scope for local scientific collaborations between Malaysia and the other ASEAN member states.

The conceptual framework, methodological arguments, results and analysis on the types of scientific collaborations are also highlighted here. The rest of this chapter is organized as follows. Section 3.2 presents the analytical framework to explain the types and differences of scientific collaborations between authors and institutions in Malaysia and with the other ASEAN member states for the selected sampling years (1980-2013). Section 3.3 explores relevant bibliometrics and statistical techniques to test the hypotheses. Section 3.3 also describes the use of qualitative techniques to verify the rationale in selecting scientific collaborators. Section 3.4 analyses and discusses the

results on the behaviors of and differences in rates and strengths of scientific collaborations between most productive authors and institutions in Malaysia. Section 3.4 analyzes the behaviors of rates and strengths of scientific collaborations between Malaysia and the other ASEAN member states using selected bibliometrics and statistical techniques. Section 3.5 summarizes the overall findings on the rates and strengths of scientific collaborations between most productive authors and institutions in Malaysia and the other ASEAN member states.

3.2 ANALYTICAL FRAMEWORK

Figure 3.1 explains the two types of scientific collaboration – rates of scientific collaborations and relative scientific collaborations, among most productive authors (MPA) and institution (MPI) in Malaysia and between Malaysia and the other ASEAN member states. The rate of scientific collaboration among the selected authors was computed by dividing the number of collaborating publications with total publications of the authors and multiplying the value by 100, while the rate of scientific collaboration (CR) among institutions was measured by dividing the number of collaborative publications with total publications of institutions and multiplying it by 100.

The rate of scientific collaboration between Malaysia and the other ASEAN member states was measured by dividing the number of collaborating publications with total number of publications in Malaysia. Relative scientific collaboration refers to strengths of scientific collaborations among most productive authors and institutions in Malaysia and between Malaysia and the other ASEAN member states. Rates of scientific collaboration between most productive authors and institutions in Malaysia deal with local and international scientific collaborations. Rates of scientific collaboration between Malaysia and the other ASEAN member states deal with local

scientific collaborations. Relative scientific collaboration among selected authors was measured by dividing the number of collaborating publications with the square root of multiplication between number of publications by authors and collaborators. Relative scientific collaboration among selected institutions was computed by dividing the number of collaborating scientific publications with the square root of multiplication between number of scientific publications by institutions and collaborators. Relative scientific collaborations (RC) between most productive authors and institutions deal with local and international scientific collaboration

A relative local scientific collaboration between Malaysia and the other ASEAN member states was calculated by dividing the number of collaborating publications with the square root of multiplication between number of publications in Malaysia and collaborators. This section looks into the differences in rates and strengths of scientific collaborations between most productive authors and institutions in Malaysia.
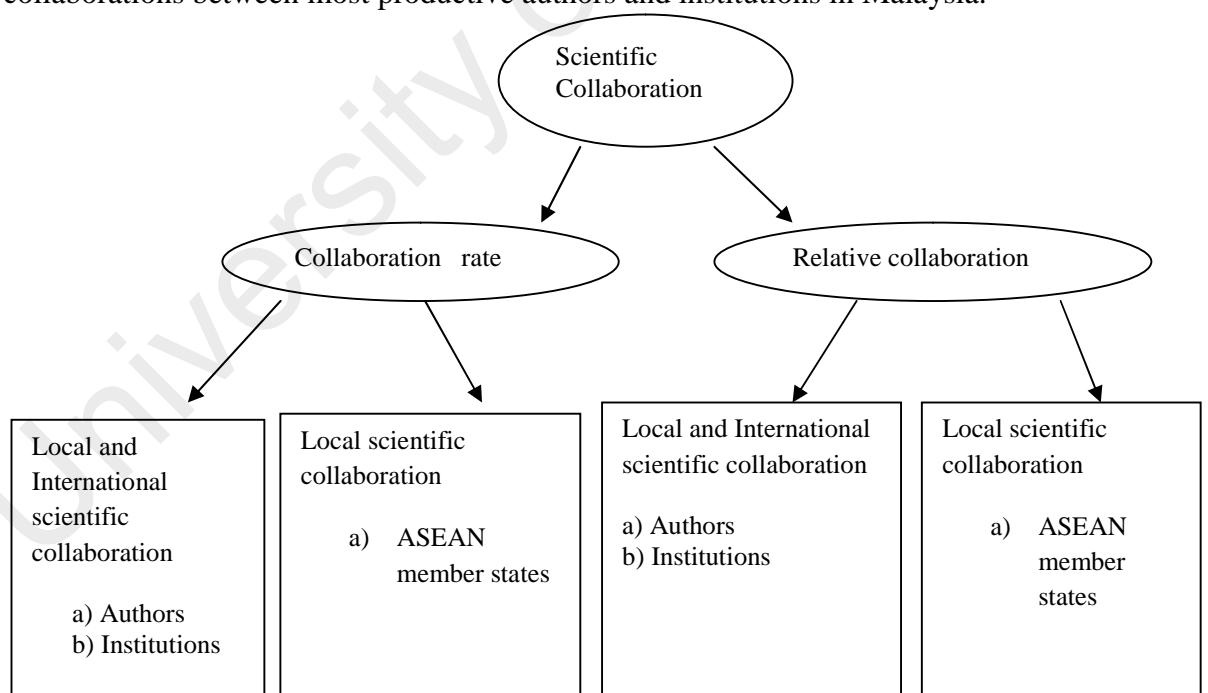
Figure 3.1: Local and international scientific collaborations between authors, institutions, and ASEAN member states

Source: Author

3.3 METHODOLOGY AND DATA

Data on the numbers of ISI publications, participating ASEAN countries, top 10 participating authors, and institutions in Malaysia from 1980 to 2013 were collected from the ISI, and WOS. A Metaphysical Quantitative method was used in this analytical chapter. The quantitative measurements include rates of collaborations, Modified Salton's measure, normality tests, Kruskal-Wallis non-parametric version of Analysis of Variance (ANOVA) (if the variables were found to be not normally distributed) or ANOVA (Analysis of Variance) (if the variables were normally distributed). Kruskal-Wallis or ANOVA can be used as it deals with the identifications of the differences in means ranks of selected research variables.

3.3.1 QUANTITATIVE TECHNIQUES

This section utilizes both bibliometrics and statistical techniques to provide relevant answers to the main and sub-thesis questions:

(a) What are the characteristics of local and international scientific collaborations among most productive authors and institutions in Malaysia and between Malaysia and the other ASEAN member states?

   (i) What are the behaviors of local and international scientific collaborations among most productive authors and institutions in Malaysia?

   (ii) Are there significant differences in rates and strengths of local and international scientific collaborations between most productive authors in Malaysia?

   (iii) Are there significant differences in rates and strengths of local and international scientific collaborations between most productive institutions in Malaysia?

(iv)   What are the behaviors of rates and strengths of local scientific collaborations between Malaysia and the other ASEAN member states?

This chapter uses bibliometrics techniques, namely measurements of collaboration rate and modified Salton's measure to analyze the behaviors of rates and strengths of local and international scientific collaborations between most productive authors and institutions in Malaysia using top ten collaborators. It also analyses the behaviors of local scientific collaborations between Malaysia and the other ASEAN member states. This examines one of three hypotheses in this chapter on whether there is a limited scope of local scientific collaborations between Malaysia and the other ASEAN member states. Then, it utilizes statistical tests, namely normality tests and test of mean differences to:

(i)   Examine significant differences in rates and strengths of local and international scientific collaborations between most productive authors in Malaysia

(ii)   Examine significant differences in rates and strengths of local and international scientific collaborations between most productive institutions in Malaysia

The following hypotheses are analyzed in this chapter:-

H_1:   There are significant differences in rates and strengths of local and international scientific collaborations between most productive authors in Malaysia

H_2:   There are significant differences in rates and strengths of local and international scientific collaborations between most productive institutions in Malaysia

H_3:   There is limited scope for local scientific collaborations between Malaysia and the other ASEAN member states.

3.3.1.1 COLLABORATION RATE

3.3.1.1(A) Introduction

The rates of scientific collaboration were computed using the data on the number of co-publications between most productive authors in Malaysia, institutions in Malaysia and between Malaysia and the other ASEAN member states and total publications of authors, institutions, and ASEAN member states. It was divided into three main stages of collaboration rates of most productive participating authors and institutions in Malaysia and between Malaysia and the other ASEAN member states. It is based on the life expectancy of collaborating scientific publications. The life expectancy of collaborated scientific publications was calculated through the differences between starting year (1970) and threshold year of collaborated scientific publications (2013). The focus of this section is mainly on Malaysia.

3.3.1.1(B) Rates of local and international scientific collaborations of authors

The local and international scientific collaborations between Malaysian authors and collaborators are based on the measurement that deals with top 10 individual authors and collaborators. It is calculated using the below equation:

$$CR_{ab} = \sum_{i=p}^{t} (P_{ab} / TP_a)$$

Where, CR_{ab} represents scientific collaboration rate between author 1 and author 2, P_{ab} represents number of scientific co-publications between author 1 and author 2, and TP_a represents total scientific publications of author 1.

3.3.1.1(C) Rates of local and international scientific institution collaborations

The local and international scientific collaborations between Malaysian institutions and collaborators are based on the measurement that deals with top 10 individual institutions and collaborators. It is calculated using the below equation:

$$CR_{cd} = \sum_{i=p}^{t} (P_{cd} / TP_c)$$

Where, CR_{cd} represents scientific collaboration rate between institution 1 and institution 2, P_{cd} represents number of scientific co-publications between institution 1 and institution 2, and TP_c represents total scientific publications of institution 1.

3.3.1.1(D) Rates of local scientific collaborations between Malaysia and the other ASEAN member states

The local scientific collaborations between Malaysia and the other nine ASEAN member states is measured based on the number of published scientific documents with the collaborators from ASEAN member states. It is calculated using the below equation:

$$CR_{ef} = \sum_{i=p}^{t} (P_{ef} / TP_e)$$

Where, CR_{ef} represents scientific collaboration rate between country 1 and country 2, P_{ef} represents number of scientific co-publications between country 1 and country 2, and TP_e represents total scientific publications of country 1.

3.3.1.2 MODIFIED SALTON MEASURE

Modified Salton's measure was developed based on the original Salton's measure that was introduced by Salton and Bergmark (1979). It is based on the life expectancy of collaborating scientific publications. The life expectancy of collaborating scientific publications was computed through the differences between starting year (1970) and threshold year of collaborated scientific publications (2013).

3.3.1.2(A) Introduction

Modified Salton's measure was used as a bibliometrics technique to examine the strengths of the three stages of scientific collaborations between most productive authors and institutions in Malaysia and between Malaysia and ASEAN member countries. Salton's measure calculates the share of co-publications between most productive authors and institutions in Malaysia and between Malaysia and the other ASEAN member states of the overall scientific publications of the respective authors, institutions, and countries.

3.3.1.2(B) Relative local and international scientific collaborations of authors

The local and international scientific collaborations between authors in Malaysia and collaborators is measured based on the number of published scientific documents by top 10 authors, their collaborators and number of collaborating publications. It is computed using the below equation:

$$R_{ab} = \sum_{i=p}^{t} (P_{ab} / \sqrt{(P_a.P_b)})$$

Where, R_{ab} represents relative scientific collaboration between author 1 and author 2, P_{ab} represents number of scientific co-publications between author 1 and author 2, P_a represents a number of scientific publications by the author 1, and P_b represents number of scientific publications by the author 2.

3.3.1.2(C) Relative local and international scientific institution collaborations

The local and international collaborations between top 10 institutions in Malaysia and institutional collaborators is measured based on the number of published scientific documents by researchers from Malaysian institutions, their institutional collaborators and the number collaborated scientific publications. The second stage of relative local and international scientific collaborations is calculated using the below equation:

$$R_{cd} = \sum_{i=p}^{t} (P_{cd} / \sqrt{(P_c . P_d)})$$

Where, R_{cd} represents relative scientific collaboration between institution 1 and institution 2, P_{cd} represents a number of scientific co-publications between institution 1 and institution 2, P_c represents a number of scientific publications by institution 1, and P_d represents a number of scientific publications by institution 2.

3.3.1.2(D) Relative local scientific collaborations between Malaysia and the other ASEAN member states

The local scientific collaborations between Malaysia and the other ASEAN member states is measured based on the number of published documents in Malaysia and the other ASEAN collaborators. It is calculated using the below equation:

$$R_{ef} = \sum_{i=p}^{t} (P_{ef} / \sqrt{(P_e . P_f)})$$

Where, R_{ef} represents relative scientific collaboration between country 1 and country 2, P_{ef} represents a number of scientific co-publications between country 1 and country 2, P_e represents a number of scientific publications by country 1, and P_f represents a number of scientific publications by country 2.

3.3.1.3 NORMALITY TESTS

Normality tests are considered as compulsory tests that need to be done before conducting parametric or non-parametric analysis, such as correlation tests, tests of mean differences, regression analysis, Structural Equation Modeling. Combinations of graphical and quantitative forms of normality tests were used to identify the distributions in the rates and strengths of local and international scientific collaborations between most productive authors and institutions in Malaysia. Graphical normality tests are illustrated using Normal Quantile-Quantile (Normal Q-Q) plot.

The quantitative normality tests dealt with Shapiro-Wilk, and Kolmogorov-Smirnov tests. These are based on the null hypothesis that the variable is normally distributed and the alternative hypothesis that the variable is not normally distributed. If the p-value is greater than the level of significance (0.05), then, the null hypothesis will not be rejected and the variable is said to be normally distributed and vice versa.

3.3.1.3(A) Graphical forms of normality tests

In this thesis, Normal Q-Q plots were used to verify and confirm the distributions in the rates and strengths of local and international scientific collaborations between most productive authors and institutions in Malaysia. Graphical normality tests were used as one of the benchmarks to decide the test of means differences in the rates and strengths of local and international scientific collaborations between most productive authors and institutions in Malaysia.

3.3.1.3(A1) Normal Q-Q plot

The normal Q-Q plot is considered as the graphical views of normality that is plotted based on the quantiles. It refers to the plot that explains the distributions of the selected variables through a straight line that divides the horizontal and vertical axes.

If the value of the variable lies within or nearer to the straight line, then, it is normally distributed; if the gap of divergence between the values and the straight line is high, then, the variable is not normally distributed.

3.3.1.3(B) Quantitative forms of normality tests

In this thesis, Shapiro-Wilk and Kolmogorov-Smirnov tests were utilized to decide the distributions in the rates and strengths of local and international scientific collaborations between most productive authors and institutions in Malaysia. Quantitative normality tests are used as one of the benchmarks to decide the test of

means differences in the rates and strengths of local and international scientific collaborations between most productive authors and institutions in Malaysia.

3.3.1.3.2(B1) Shapiro-Wilk test

Shapiro-Wilk test is another version of normality test that measures the distribution of a variable in a dataset. Samuel Sanford Shapiro and Martin Wilk developed it. The formula for it is shown as below:-

$$W = (\sum_{i=1}^{n} a_i x_{(i)})^2 / \sum_{i=1}^{n} (x_i - \bar{x})^2$$

Where, W refers to Wilk, $x_{(i)}$ represents ith order statistic (ith-smallest number in the sample), $\bar{x} = (x_1 + ... + x_n)/n$ –sample mean, a_i refers to Constant value, $a_i,..., a_m$ represents $m^T V^{-1}/(m^T V^{-1} V^{-1} m)^{0.5}$, $m = (m_1,...,m_n)^T$, $m_1,...,m$ represents expected values of order statistic, V represents a covariance matrix

Null and alternative hypotheses as follows:-

H_o: The variable is normally distributed

H_1: The variable is not normally distributed

If W is greater than critical value or if p-value of the Shapiro-Wilk is less than the level of significance, then, the null hypothesis will be rejected. It can be concluded that the variable is not normally distributed and vice versa. It can be used for a sample that is less than 2000.

3.3.1.3(B2) Kolmogorov-Smirnov test

Kolmogorov-Smirnov test refers to the normality test that is based on the empirical cumulative distribution function (ECDF). It is based on N ordered data points $(Y_1, Y2, YN)$. $ECDF = n (i)/N$

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Where, $n(i)$ represent the number of points that are less than Y_i, and Y_i represents ordered from smallest to largest values.

Null and alternative hypotheses are as follows:-

H_0: The data follow a mentioned distribution or the variable is normally distributed

H_1: The data do not follow a mentioned distribution or the variable is not normally distributed.

Kolmogorov-Smirnov normality test (D)

$$D = max \ (1 \quad i \quad N) \ [F \ (Y_i) - (i\text{-}1/N), \ i/N - F \ (Y_i))$$

Where, i represent the position of values of a variable

If D is greater than the critical value of   (level of significance), then, the null hypothesis will be rejected and it can be concluded that the variable is not normally distributed and vice versa. The Kolmogorov-Smirnov test can be used if a sample is greater than 2000.

3.3.1.4 PARAMETRIC AND NON-PARAMETRIC INDEPENDENT SAMPLE TESTS

Parametric tests of differences are used to identify the significant differences between the means of the continuous variables and categorical or dichotomous variable if the dependent variables are normally distributed and the categorical variable consists of non-normal distribution and vice versa. The non-parametric tests on mean differences will be used instead of the parametric version if the dependent variables are found to be not normally distributed and there is the existence of a non-normal form of categorical variables. Parametric tests on mean differences consist of Levene's version of t-test or independent sample t-test, ANOVA, and Multivariate analysis of variances (MANOVA). The non-parametric tests on mean differences consist of Mann-Whitney rank and Kruskal-Wallis rank tests.

If the dichotomous or categorical variable consists of two groups, then the Levene's version of t-test (normal distribution among the dependent variables) or Mann-Whitney rank test (non-normal distribution among the dependent variables) is used. If the dichotomous or categorical variable consists of three and more groups, then, the parametric version of ANOVA (normal distribution among the dependent variables) or Kruskal-Wallis rank test (non-normal distribution among the dependent variables) is used.

3.4 RESULTS AND ANALYSIS

This section present and discuss the results on the behaviors of and differences in the rates and strengths of scientific collaborations between most productive authors and institutions in Malaysia, This section also analyses the behaviors and strengths of local collaborations between Malaysia and the other ASEAN member states.

3.4.1 Local and international scientific collaborations of authors

Table 3.1 (APPENDIX A) shows the number of scientific publications by top 10 authors, number of collaborating publications with top 10 collaborators, and collaboration rates of the most productive authors in Malaysia. The highlighted collaborators are the major contributors of the scientific publications of the top 10 Malaysian authors. All the most productive authors were affiliated with research institutions in Malaysia, namely University of Malaya (UM) and University of Science Malaysia (USM) except Abdullah, S and Rusop, M who are affiliated with the University of Technology MARA. All the most productive authors are divided into first comers, second comers, and latecomers. Ng, SW is a first comer of scientific publications followed by Fun, HK and Tieknik, ERT as the second comers, Ismail, H, Abdullah, S, Chantrapromma, S, Ahmad, H, and Hassan, Z are latecomers. Top 10 collaborators consist of local and international authors who are affiliated to Malaysian

and international institutions. Duplications within the values of collaborating publications and names of authors were checked, verified, and removed manually.

Through the numerical calculations, the major collaborators of Fun, HK were Chantrapromma, S, and Razak, IA with the collaboration rates of 21.4 percent and 11.9 percent. Fun, HK has produced 760 scientific papers through research collaborations with Chantrapromma, S and Razak, IA, equivalent to 33 percent of scientific publications by Fun, HK. This might be because of Fun, HK's choice in selecting local researchers from similar research category (Crystallography) as his main collaborators to increase the scientific publications. This dominates the effective easing of knowledge diffusion locally as the mixed collaboration with local and international collaborators is low. Fun, HK might have chosen the major collaborators based on their research visibility in citations for contents within the scientific publications as the number of citations for Chantrapromma, S and Razak, IA from 1980 to 2013 is 2,872 and 1,903. The behavior of scientific collaborations between Fun, HK, Chantrapromma, S, and Razak, IA was verified through the highest strength of collaborations between the collaborations, at 0.5 and 0.3 (Table 3.2) (APPENDIX A).

Gao, S is the only major scientific partner that contributed heavily to the scientific publications of Ng, SW through collaboration rate of 8.2 percent. Ng, SW has given equal scientific preferences to Lo, KM and Tiekink, ERT through the collaboration rates of 6.4 percent and 6.5 percent, respectively. Higher collaboration rate between Gao, S and Ng, SW seems to be influenced by similar research category (Crystallography), and research visibility of Gao, S. The research visibility of Gao, S can be seen through the citations of scientific contents, which are about 119,025. Highest scientific collaborator of Ahmad, H in scientific publications is Harun, SW with a collaboration rate of 73.6 percent. Harun, SW has produced 405 joint publications with Ahmad, H as it overlaps with the research interest of Ahmad, H on Optics; the citation of Harun, SW is 2,894.

Chantrapromma, S has published 482 scientific documents with Fun, HK that provides the collaboration rate of 99%. This shows that Chantrapromma, S heavily depended on Fun, HK as a significant and influential scientific partner throughout the period from 1980 to 2013 in Crystallography. The choice of Fun, HK as a collaborator might be because of the total citations of contents in scientific publications of 13,061 citations. Abdullah, S contributed 22.1 percent to the scientific publications of Rusop, M by producing 110 publications with Abdullah, S in both Multidisciplinary Sciences and material Science. A significant scientific collaboration between Abdullah, S and Rusop, M was captured through the number of citations gained by Rusop M, totaling 1,175.

Collaboration rate between Tiekink, ERT and Ng, SW is about 30.2 percent and Tieknik, ERT has published 134 publications with Ng, SW in Crystallography. Ahmad H recorded the highest number of collaborating scientific publications with Harun, SW of 406 publications and 94 percent scientific collaboration rate. Abu Hassan, H contributed 37.1 percent of collaboration with co-author, Hassan, Z. It is illustrated that the highest collaborative partner of Ismail, H for scientific publications is Ahmad, Z with 38 joint publications and 9 percent collaboration rate. Abdullah, S is the only one who has produced 110 publications with Rusop, M. In general, the strength of scientific collaborations between the selected authors and collaborators is low and moderate (Table 3.2) (APPENDIX A).

The distributions among the rates and strengths of collaborations between most productive authors were checked using the Shapiro-Wilk and Kolmogorov-Smirnov normality tests. The results of normality were then verified by using Normal Q-Q plots. The distributions among the research variables should be determined before deciding on the test of means differences.

Table 3.3: Distribution of collaboration rates among most productive authors in Malaysia

	Kolmogorov-Smirnov		Shapiro-Wilk	
	Statistical value	P-value	Statistical value	P-value
CR				
Fun HK	0.30**	0.01	0.69**	0.00
Ng SW	0.16	0.20	0.94	0.51
Ahmad H	0.44**	0.00	0.44**	0.00
Chantraproma S	0.38**	0.00	0.52**	0.00
Abdullah S	0.32**	0.01	0.66**	0.00
Tiekink ERT	0.31**	0.01	0.77**	0.01
Harun SW	0.44**	0.00	0.43**	0.00
Hassan Z	0.25	0.08	0.84**	0.04
Ismail H	0.16	0.20	0.94	0.50
Rusop M	0.24	0.12	0.80**	0.02

** Significant at 5%

Source: Author's computations

Table 3.4: Distribution of relative collaboration among most productive authors in Malaysia

	Kolmogorov-Smirnov		Shapiro-Wilk	
	Statistical value	P-value	Statistical value	P-value
RC				
Fun HK	0.28**	0.03	0.84**	0.04
Ng SW	0.37**	0.00	0.75**	0.00
Ahmad H	0.26	0.05	0.75*	0.00
Chantraproma S	0.23	0.15	0.93	0.41
Abdullah S	0.28**	0.02	0.89	0.17
Tiekink ERT	0.33**	0.00	0.66**	0.00
Harun SW	0.16	0.20	0.94	0.58
Hassan Z	0.29**	0.02	0.89	0.15
Rusop M	0.29**	0.02	0.89	0.15

** Significant at 5%

Source: Author's computations
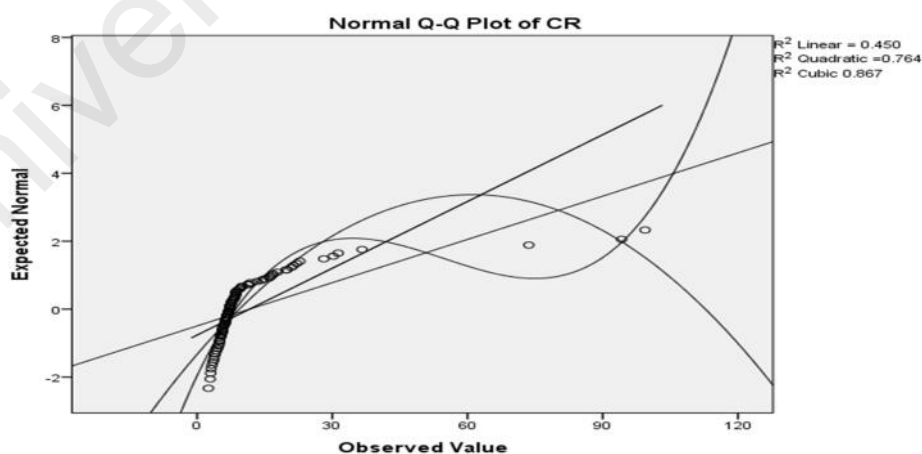
Figure 3.2: Normal Q-Q plot of collaboration rates between most productive authors in Malaysia
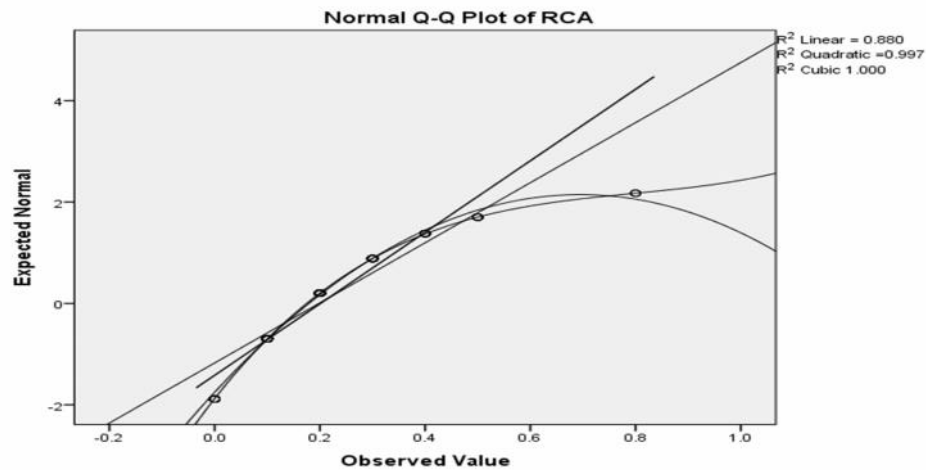
Source: Author

Figure 3.3: Normal Q-Q plot of relative collaboration between most productive authors in Malaysia

Source: Author

Table 3.3 and Table 3.4 shows mixed results of normal and non-normal distributions among the rates and strengths of local and international collaboration of the most productive authors in Malaysia through the continuous variations within the values of probabilities. The results were verified through Normal Q-Q plots as in Figures 3.2 and 3.3. The rates and strengths of collaborations between the local and international authors are inconsistent with the linear curve as it favors both quadratic and cubic functions. The non-linear selection of effective local and international collaborators, scientific recognition of collaborators and variations of research categories caused the non-normal distributions of collaborations in its rates and strengths, although there were similarities within some of the scientific researchers in selecting their local and international scientific collaborative partners through the same research categories.

Kruskal-Wallis test was used to examine the differences in rates and strengths of scientific collaborations between most productive Malaysian authors if any since the values of CR between most productive authors and co-authors were not normally distributed. Most productive Malaysian authors were classified as the categorical variable and independent variable, whereas the values of local and international

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collaborations in terms of its rates and strengths were the continuous variable and dependent variable.

Table 3.5: Differences of collaboration rates between most productive authors in Malaysia

	Kruskal-Wallis test		
	Mean of ranks	Mean	P-value
CR			0.00**
Fun HK	48.50	8.53	
Ng SW	19.60	4.71	
Ahmad H	47.40	13.61	
Chantraproma S	60.05	19.08	
Abdullah S	40.50	7.58	
Tiekink ERT	53.30	10.89	
Harun SW	64.00	17.15	
Hassan Z	71.75	14.96	
Ismail H	25.25	5.29	
Rusop M	74.65	14.49	

** Significant at 5%
Source: Author's computations

Table 3.6: Differences of relative collaboration between most productive authors in Malaysia

	Mean of ranks	Mean	P-value
RC			0.00**
Fun HK	65.95	0.25	
Ng SW	29.15	0.11	
Ahmad H	48.15	0.22	
Chantraproma S	54.65	0.21	
Abdullah S	45.10	0.16	
Tiekink ERT	41.50	0.15	
Harun SW	45.80	0.21	
Hassan Z	69.35	0.28	
Ismail H	24.50	0.10	
Rusop M	80.85	0.32	

** Significant at 5%,; Differences of relative collaboration was conducted through Kruskal-Wallis test
Source: Author's computations

Table 3.5 and Table 3.6 highlights the significant differences in rates and strengths of scientific collaborations between most productive authors in Malaysia throughout the periods from 1980 to 2013 through lower probability values. Chantraproma, S has the highest mean of collaboration rate, whereas Ng, SW has the lowest mean of collaboration rate. Chantraproma, S has the Absolute scientific advantage in knowledge diffusion compared to all other most productive authors in Malaysia. Rusop, M has the highest mean of RC, whereas Ismail, H has the lowest. Rusop, M has the comparative scientific advantage in transferring the knowledge on

various research issues within the specific research category compared to the other Malaysian authors. The rates of scientific collaborations have indicated that most productive Malaysian researchers prefer to get in touch with researchers with highest number of scientific publications.

3.4.2 Local and international institution collaborations

Table 3.7 (APPENDIX A) shows the number of scientific publications by top 10 institutions, number of collaborating publications with top 10 institutional collaborators, and CR of most productive institutions in Malaysia. The highlighted collaborators are the major contributors of the scientific publications with top 10 Malaysian institutions. All the most productive institutions refer to research institutions in Malaysia, namely UM, USM, University Putra Malaysia (UPM), National University of Malaysia (UKM) and University of Technology Malaysia (UTM) except University of Technology MARA (UiTM), Multimedia University (MU), University Malaysia Pahang (UMP), University of Technology Petronas (UTP), and International Islamic University of Malaysia (IIUM). All the most productive institutions were divided into first comers, second comers, and latecomers. UM, USM, UPM, UKM, and UiTM were the first comers of scientific publications followed by UTM that was the second comer, IIUM, MU, UMP, and UTP were the latecomers. Top 10 collaborators consist of local and international institutions that are located in Malaysia and international countries. Duplications within the values of collaborating publications and names of institutions were checked, verified, and removed manually.

Table 3.7 (APPENDIX A) shows that the major collaborators of UM were UPM and UKM with an equal CR of 3 percent. UM has produced 1,158 scientific papers through scientific collaborations with UPM and UKM at 6 percent. This has been influenced by the researchers from UM in selecting local institutional collaborators

from similar research category (Crystallography) as main collaborators to dominate the effective facilitation of knowledge diffusion and flow of knowledge locally; scientific collaboration with the other local and international collaborators is low. The behavior of scientific collaborations between UM, UPM and UKM was verified through the highest strength of collaboration between the institutional collaborators, at 0.04 (Refer to Table 3.8) (APPENDIX A).

UKM was the only major scientific collaborative partner that has contributed heavily to the scientific publications of UPM through collaboration rate of 6.1 percent and UPM has given moderate scientific preference to UM through the collaboration rate of 4.9 percent. Higher collaboration rate between the UPM and UKM was influenced by overlapping research categories (Biochemistry and Molecular Biology). The highest scientific collaborator of USM in terms of scientific publications throughout the periods from 1980 to 2013 was Prince of Songkla University with the collaboration rate of 3.1 percent. USM has produced 466 joint publications with Prince of Songkla University as it was overlapping with the research interest of USM on Crystallography.

UKM has published 711 scientific documents with UPM, which provides a collaboration rate of 6.5 percent. Through the high level of collaboration rate between UKM and UPM, it is shown that UKM was heavily depending on UPM as an influential scientific collaborative partner throughout the periods from 1980 to 2013 in Biochemistry and Molecular Biology. In this case, UPM can be considered as a collaborative leader for UKM and UKM has acted as follower in the context of scientific collaborations. UM has contributed 2.7 percent to the publications of UTM by producing 169 scientific publications with University of Technology Malaysia in various research categories, such as Optics, Energy Fuels, Mechanics, Electrochemistry, Crystallography, Applied Physics, Telecommunications, Polymer Science, and others.

A highest collaboration rate between UiTM and UM was about 8.7 percent and the University of Technology MARA has published 348 publications with UM Most of the collaborated scientific publications comprised various issues on Optics, Material Science, Multidisciplinary Sciences, Applied Physics, Energy fuels, Engineering, Electrical and Electronics, and Electrochemistry. MU has the highest number of collaborating publications with UM. It has 197 collaborated publications and collaboration rate of 7 percent. Most of the collaborated scientific publications with UM deal with issues on Optics, Applied Physics, Engineering, Electrical and Electronics, Material Sciences, and Multidisciplinary Sciences. The UMP has published 1,023 scientific publications with IIUM in Material Sciences and Multidisciplinary Sciences. The highest collaboration rate between UMP and IIUM was about 44.7 percent.

The highest collaborative scientific partner of UTP in the context of scientific publications was USM with 46 joint publications and 3 percent of collaboration rate. The focus of joint publications was more on Environmental Sciences, and Environmental Engineering. The UMP was the only major institutional collaborator that has produced 1,023 scientific publications with IIUM in Materials Sciences, Multidisciplinary Sciences, and Manufacturing Engineering. The highest collaboration rate between IIUM and UMP was 68 percent.

The distributions among the rates and strengths of collaborations between most productive institutions were checked through Shapiro-Wilk and Kolmogorov-Smirnov normality tests. The results of normality were then verified through the utilization of Normal Q-Q plots. The distributions among the research variables should be determined before deciding on the test of mean differences.

Table 3.9: Distribution of collaboration rates among most productive institutions in Malaysia

	Kolmogorov-Smirnov		Shapiro-Wilk	
	Statistical value	P-value	Statistical value	P-value
CR				
UM	0.27**	0.04	0.79**	0.01
UPM	0.28**	0.02	0.75**	0.00
USM	0.20	0.20	0.94	0.52
UKM	0.27**	0.04	0.77**	0.01
UTM	0.26	0.06	0.81**	0.02
UiTM	0.28**	0.02	0.81**	0.02
MU	0.30**	0.01	0.69**	0.00
UMP	0.44**	0.00	0.49**	0.00
UTP	0.34**	0.00	0.67**	0.00
IIUM	0.41**	0.00	0.59**	0.00

** Significant at 5%

Source: Author's computations

Table 3.10: Distribution of relative collaboration among most productive institutions in Malaysia

	Kolmogorov-Smirnov		Shapiro-Wilk	
	Statistical value	P-value	Statistical value	P-value
RC				
UM	0.28**	0.03	0.82**	0.02
UPM	0.43**	0.00	0.59**	0.00
USM	0.52**	0.00	0.37**	0.00
UKM	0.52**	0.00	0.37**	0.00
UMP	0.45**	0.00	0.44**	0.00
IIUM	0.47**	0.00	0.53**	0.00

** Significant at 5%

Source: Author's computations
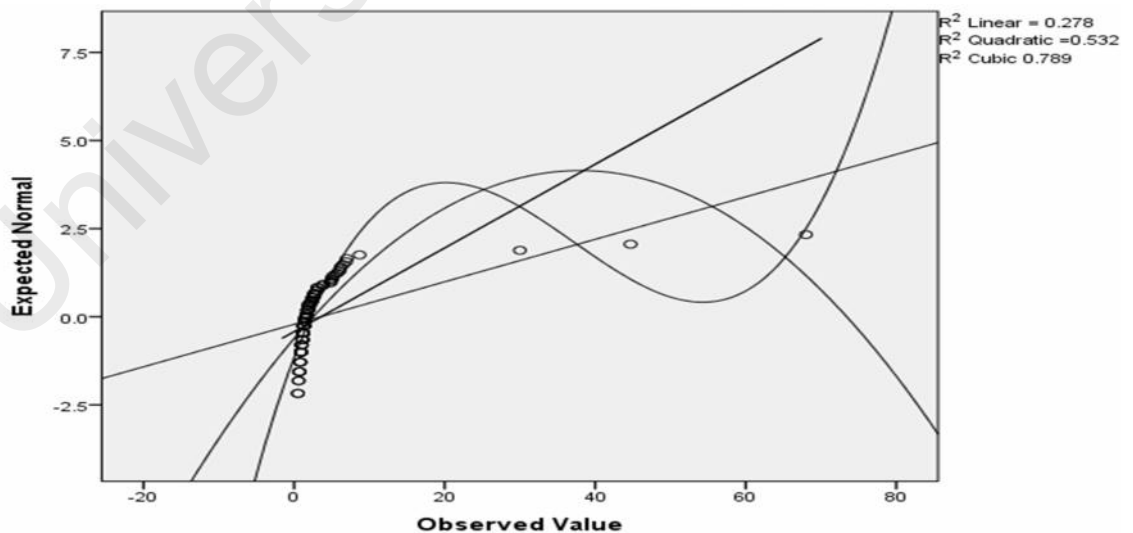
Figure 3.4: Normal Q-Q plot of collaboration rates among most productive institutions in Malaysia
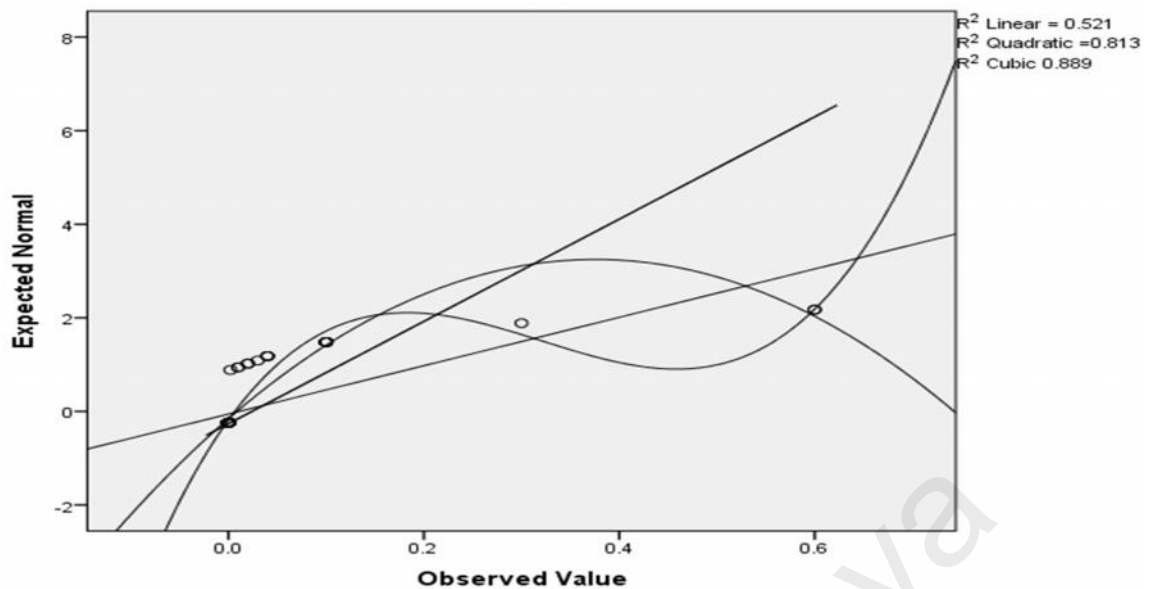
Source: Author

Figure 3.5: Normal Q-Q plot of relative collaboration among most productive institutions in Malaysia

Source: Author

Table 3.9 and Table 3.10 shows mixed results of normal and non-normal distributions among the rates and strengths of local and international collaboration of most productive institutions in Malaysia through the continuous variations within the values of probabilities. The results were verified through Normal Q-Q plots as in Figures 3.4 and 3.5. The rates and strengths of scientific collaborations between the local and international institutions were inconsistent with the linear curve as it favors both quadratic and cubic functions. The non-linear selection of effective local and international institutional collaborators, scientific recognition of collaborators and variations of research categories caused the non-normal distributions of collaborations in terms of its rates and strengths, although there were similarities within some scientific researchers from local Malaysian institutions in selecting their local and international scientific collaborative partners through the same research categories.

Kruskal-Wallis test was used to examine the differences in rates and strengths of scientific collaborations between most productive Malaysian institutions, if any, since the values of CR and relative collaborations between most productive institutions and institutional collaborators were not normally distributed. Most productive Malaysian

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institutions were classified as the categorical variable and independent variable, whereas the values of local and international collaborations in terms of its rates and strengths were as the continuous variable and dependent variable.

Table 3.11: Differences of collaboration rates between most productive institutions in Malaysia

	Mean of ranks	Kruskal-Wallis test Mean	P-value
CR			0.09
UM	49.65	1.72	
UPM	57.30	2.43	
USM	49.30	1.72	
UKM	48.85	2.34	
UTM	47.30	1.66	
UiTM	44.35	3.08	
MU	53.65	2.25	
UMP	66.05	7.26	
UTP	23.9	1.16	
IIUM	64.65	11.96	

Source: Author's computations

Table 3.12: Differences of relative collaboration between most productive institutions in Malaysia

	Mean of ranks	Kruskal-Wallis test Mean	P-value
RC			0.00**
UM	86.8	0.031	
UPM	56.9	0.030	
USM	46.3	0.01	
UKM	46.3	0.01	
UTM	41	0.00	
UiTM	41	0.00	
MU	41	0.00	
UMP	52.15	0.07	
UTP	41	0.00	
IIUM	52.55	0.09	

** Significant at 5%

Source: Author's computations

Table 3.11 highlights the insignificant differences in scientific CR between most productive institutions in Malaysia throughout the periods from 1980 to 2013. Table 3.12 shows the significant differences in strengths of scientific collaboration between most productive institutions in Malaysia. IIUM has the highest mean of collaboration rate, whereas UTP has the lowest mean of collaboration rate. This shows that researchers from most productive institutions have been given equal importance to their institutional collaborators by maintaining the same number of scientific publications.

IIUM has the highest mean of relative collaboration whereas UTM, UiTM, MU and UTP have the lowest mean by relative collaboration.

Through the mean of relative collaborations, it can be stated that the researchers from IIUM have the comparative scientific advantage in transferring the knowledge on various research issues within specific research categories compared to the other Malaysian institutions. Highest mean of relative collaboration has indicated that IIUM has the highest collaboration strength with both local and international collaborators. In other words, it has the highest capacity and privilege in disseminating the issues with scientific collaborators both locally and internationally.

The implicit meaning of institutional collaboration indicates that the researchers from most productive Malaysian institutions prefer to build scientific co-operation with researchers from institutions that are known for their sources of funding and scientific rankings. Researchers from top performing institutions only collaborate with first comers and latecomers that have gained a higher level of research visibility and this creates scientific biases that can penalize and prevent the low performing institutions from being institutional collaborators. This is almost in line with Low et al. (2014) and Hsu and Huang (2010).

Besides that, rates and strengths of collaborations between the local and international institutions and industries are still critically low because of poor networking capacity and practical exposure among researchers from local institutions. Lower research visibility definitely reduces the demands for collaborators. Although research institutions have the capacity to produce an enormous number of scientific publications, some of them still prefer to prepare their papers without the inclusion of scientific collaborators.

3.4.3 Local collaboration between ASEAN member states

Table 3.13: Local collaboration rates between ASEAN member states

ASEAN country	Scientific publication by countries	Collaborators	Collaborated Scientific publications	Collaboration rate (%)
Malaysia	88609	Singapore	1761	2
		Thailand	1407	0.02
		Indonesia	1143	1
		Philippines	471	1
		Vietnam	255	0.3
		Cambodia	80	0.1
		Brunei Darussalam	68	0.1
		Myanmar	35	0.04
		Laos	28	0.03

Source: Authors' computations

Table 3.13 illustrates the number of collaborating scientific publications and rates of scientific collaborations between Malaysia and the other nine ASEAN member states. Patterns of scientific collaborations between Malaysia and the other ASEAN member states are low and weak. This is because the rates of scientific collaborations between Malaysian and other ASEAN member states: Laos, Myanmar, Vietnam, Cambodia, Brunei Darussalam, Myanmar and Laos were between 0.03 and 0.1. It is not in line with the efforts of ASEAN member countries to improve the levels of knowledge integrations in scientific writings. This might be due to the lack of talents' identifications in terms of collaborative paper writing.

Table 3.14: Local relative collaboration between ASEAN member states

ASEAN country	SP by Malaysia	Collaborators	COSP	SP by CO	RCS
Malaysia	88609	Singapore	1761	165617	9.7
		Thailand	1650	86383	7.2
		Indonesia	1143	21935	4.4
		Philippines	471	19094	6.4
		Vietnam	255	18828	8.6
		Cambodia	80	1733	4.7
		Brunei Darussalam	68	1203	4.2
		Myanmar	35	981	5.3
		Laos	28	1125	6.3

Note: SP refers to scientific publications, COSP refers to collaborated scientific publications, CO refers to collaborators, and RCS refers to strength of collaboration.
Source: Authors' computations

Table 3.14 shows mixed strengths of scientific collaborations between Malaysia and the other ASEAN member countries on average from 1980 to 2013. It deals with the minimum relative scientific collaboration of 4.2 to maximum relative scientific collaboration of 9.7. The relative scientific collaboration between Malaysia and Singapore is the highest and it deals with the positive flow of scientific publications between them compared to the other ASEAN member states as the latter has moderate strength of scientific collaborations with Malaysia. Table 3.14 captures the higher strength of scientific collaborations between Malaysia, Singapore, Thailand and Vietnam. Kumar et al. (2014) support the positive strength of scientific collaboration between Malaysia and Singapore, although they investigated the specific strength of local and international scientific collaborations between ASEAN member countries and non-ASEAN countries in Economics. The higher strength of scientific collaborations between Malaysia and the other ASEAN member states, namely Singapore, Thailand and Vietnam, is because of their overlapping research interests, research expertise, available financial resources and their advantage of being the first comers of scientific publications. Malaysia has a comparative scientific advantage with Singapore, Thailand.

This is consistent with the general thought of the Matthew Effect, in which the highly progressing ASEAN member states will always deal with top scientific collaborators to speed up the facilitation of knowledge transfer within the member states and with non-ASEAN countries. This reveals that Malaysia is not fully open to all the ASEAN member states; it has a wider scope of collaboration with non-ASEAN countries.

Limited and moderate opportunities of scientific strength between Malaysia, Indonesia, Cambodia, Brunei Darussalam, the Philippines, Myanmar and Laos highlighted by variations of RC within Table 3.14. This is consistent with Kumar et al. (2014) and Payumo and Sutton (2015). This is due to the limited scope of scientific

publications in similar research areas as most of the stated developing countries are concentrating more on the issues related to basic Social Sciences rather than the Sciences. Besides that, the visibility of collaboration in Cambodia and Laos is at a critical stage because there is a lack of effective networking capacity and higher degree of knowledge vulnerability among the existing researchers. It is also in line with the lack of financial and skilled human resource to facilitate knowledge diffusion (TIME, 2016). This has been verified through Human Capital Index (2015) that has ranked Cambodia and Laos in the bottom of the 124 countries.

This can be realized through the number of collaborating papers between Cambodia, Laos and Malaysia. This has also indicated that the resources were not fully utilized and it deals with the inefficiency of resource allocations. Some of the researchers were having the trouble in gaining the funding supports to finance their research projects and scientific publications. Resource inefficiency within Laos and Cambodia has inspired ASEAN Economic Initiative to offer funding opportunities to researchers through ASEAN Development Bank or World Bank in order for them to expand their investments within their research projects (Lexology, 2016). Australian professional services firms have decided to organize trainings for researchers within countries like Myanmar, Cambodia, and Laos in order to maximize the effective resource allocations (Lexology, 2016).

This has been confirmed through an article on the discussions of Asia-Pacific, Australia, OECD on the 10th of May, 2016 (Lexology, 2016).This is more of a fact in which non-ASEAN country like Australia is helping out the ASEAN member states and it refers to external social contributions. The scientific conditions within Cambodia and Laos will definitely create a difficult platform for Malaysian researchers to share the flow of knowledge on various research issues with other researchers from Cambodia and Laos. This can be strengthened by forming research forums on scientific

publications in each of the ASEAN countries. The organization of trainings, forums and seminars on the scientific buildings should be initiated by the ASEAN Economic Initiative to promote scientific integrations among them.

3.5 SUMMARY

This analytical chapter seeks to answer these thesis questions:-

(a)   What are the characteristics of rates and strengths of scientific collaborations among most productive authors and institutions in Malaysia and the other ASEAN member states?

  (i)   What are the behaviors of rates and strengths of collaborations among most productive authors and institutions in Malaysia?

  (ii)   Are there significant differences in rates and strengths of scientific collaborations between most productive authors in Malaysia?

  (iii) Are there significant differences in rates and strengths of scientific collaborations between most productive institutions in Malaysia?

  (iv)   What are the behaviors of rates and strengths of scientific collaborations between Malaysia and the other ASEAN member states?

These thesis questions generated the following thesis hypotheses:-

H_1: There are significant differences in rates and strengths of scientific collaborations between most productive authors in Malaysia

H_2: There are significant differences in rates and strengths of scientific collaborations between most productive institutions in Malaysia

H_3: There is limited scope for local scientific collaborations between Malaysia and the other ASEAN member states.

From the internal examination of local and international scientific collaborations of Malaysia, it can be inferred that the nature of collaboration depends heavily on the attitude of of researchers and institutions. The expansion of scientific collaboration promotes the growth of Absolute and comparative advantages. A weaker form of research visibility will definitely reduce the demands for scientific partnership. Lower level of scientific interaction between ASEAN member states will lead to the failure of the AEC in terms of scientific collaboration. Two of the three thesis hypotheses are supported and there is no difference in rates of scientific collaborations, although there is a slight difference in strength of scientific collaborations between most productive Malaysian institutions.

CHAPTER 4: SOCIAL NETWORKING SITES AND RESEARCH EXPOSURE

4.1 INTRODUCTION

This analytical chapter examines the significant influence that SNSs have on the enhancement of research exposure among ASEAN research participants. Firstly, it deals with the qualitative and quantitative examinations of reliability and validity of SNSs as research mediator. Then, it illustrates different directions on the influence of SNSs on the enhancement of research exposure among ASEAN research participants. The stated directions of this research were investigated by developing an analytical framework, and methodological arguments on the pragmatic techniques. The following hypothesis was tested in this analytical chapter:-

H₄: The utilization of SNSs enhances research exposure among ASEAN research participants.

Facebook and LinkedIn were chosen for this thesis mainly due to their popularity for research engagements and active research participations among heterogeneous agents such as PhD students, academic staffs, and researchers within embedded research groups.

Facebook is the largest social networking site that was launched on 4 February 2004 by Mark Zuckerberg, Eduardo Saverin, Andrew McCollum, Dustin Moskovitz and Chris Hughes. It facilitates discussions on various issues of interest such as family matters, political engagements, research communication, virtual academic teaching and others. According to Global Alexa page ranking, Facebook is considered as a highly influential site with the second highest social ranking. LinkedIn is another highly reputable site that was launched on 5 May 2003 with the main function of boosting and disseminating business and career opportunities to the users. Besides that, LinkedIn has also opened up various spaces for research interactions. The focus of analytical

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discussions in this chapter is just limited to, research discussions, although there are many other branches and issues in the SNSs.

Methodological arguments, results and analysis of the modes of SNSs are also highlighted here. The rest of this chapter is organized as follows. Section 4.2 presents the analytical framework to verify the reliability and validity of SNSs as a research mediator and examine the significant influence that SNSs have on the enhancement of research exposure among ASEAN research participants. Section 4.3 explores relevant qualitative and quantitative techniques to test the stated hypotheses. Section 4.4 analyses and discusses the results of the reliability and validity of SNSs as a research mediator. It also examines significant role of SNSs in enhancing research exposure among ASEAN research participants. Section 4.5 summarizes the overall findings on the significant role of SNSs on the enhancement of research exposure. All the ASEAN member states were included in the analytical chapter. This analytical chapter evaluates the reliability and validity of Facebook and LinkedIn as research mediums for researchers from all the ASEAN member states to expand their research exposure. Then, it detects the influence of Facebook and LinkedIn in improving research exposure among active researchers from ASEAN member states based on the effectiveness of research conversations.

4.2 ANALYTICAL FRAMEWORK

In this thesis, the analytical framework is based on the combinations of existing theories and concepts that are much related to the virtual research system and nature of qualitative research, although it involves minor quantitative descriptions (Table 4.1) The selections of SNSs (Facebook and LinkedIn), research conversations, research groups and research sample are mainly based on the modified internal structure and

assumptions of the Uses and Gratification Theory (UGT). The modified assumptions of the UGT are as follows:-

(a)   Research based communications or conversations

(b)   Only involves active participants

(c)   The active participants decide their own actions and consequences

(d)   Healthy competition of research sharing among participants

(e)   Research participants will have the awareness of the contents of the media, their interests, and the linkages between two elements.

(f)   Cognitive values of contents within SNSs can only be assessed by audiences.

Heterogeneous agents refer to agents that have variations of characteristics in terms of their positions in research institutions. The sample of this thesis refers to heterogeneous agents comprising local and international research participants who are affiliated with various research institutions. They are local and international PhD students and academic staffs. In this context, academic staffs consist of lecturers cum researchers. The selected PhD students were taking up the dual roles of students and researchers. Selected local PhD students and academic staffs refer to research agents that were located within ASEAN member states. The names of institutions and ASEAN member countries were detected through the function of location detector within Facebook and LinkedIn. All the selected local research agents were affiliated with institutions or organizations that are located within ASEAN member states.

The selection of ASEAN member states was heavily depending on the number of research conversations that have been observed within Facebook and LinkedIn. Selected international PhD students and academic staffs refer to research agents that were located within non-ASEAN member states such as the UK, Australia, US, and others. All the selected international research agents were affiliated to international institutions or organizations that are located within non-ASEAN member states such as the UK,

Australia, US and others. Research groups are the embedded subsets of SNSs that have motivated an enormous number of research communications. Two different branches of the TAM, i.e., PEU and PU were utilized to evaluate the influence of SNSs on the enhancement of research exposure. In this context, research exposure refers to the extent of research facilitation, which is divided into three different elements, namely research visibility, research issues and scientific publications.

Research visibility refers to the coverage and exploration of research acknowledgement that can be evaluated through the request for articles, (views, likes, and comments) on the uploaded articles, downloads of articles, notification of workshops, and conference proceedings. Research issues refer to research discussions that are based on ordinary and critical research elements; ordinary research elements involve direct responses and explicit meanings; while critical research elements involve indirect responses and implicit meanings.

In this analytical chapter, scientific publications refer to collaborated publications that can be generated through the virtual collaboration system, involving video calls and interaction through Skype. PEU deals with the cognitive perceptions of research participants on the friendly nature of the system and flexibility of usage. It is divided into the flexibility of the system and posting strategies. The flexibility of system deals with the systematic usage of the system through friendly search functions, download options and others.

The posting strategies involve strategies that are tied to the functions of likes, comments, views and others. The expansion of PEU influences and has a direct impact on the expansion of PU. PU refers to the benefits that can be gained by research participants through the usage of SNSs such as Facebook and LinkedIn. PU is strongly linked to three different types of research exposure that are consistent with research

visibility, research issues and scientific publications. Figure 4.1 illustrates the overall structure of the virtual system that can speed up the process of research catch up among ASEAN research participants in a qualitative nature. This analytical framework facilitates the two phases of investigations on the reliability and validity of the research function within the selected SNSs and the research influence on the SNSs.

The reliability and validity of selected research conversations were re-checked using modified strategies of genre analysis developed by Bhatia (1993, 2004). The modified strategies are as follows:-

(a) Identification and placement of genre-text within the situational context

(b) Refining the situational analysis

(c) Selection of corpus

(d) Evaluation of the intertextual perspectives

(e) Ethnographic analysis

(f) Studying institutional context

Genre within the textual data refers to research conversations and situational analysis refers to occurrence of research conversations within research groups that are located in SNSs. Situational analysis also involves consideration of the cultural variations and structuring of embedded elements such as the style of communications, variations of research issues, designation of research participants, ASEAN member countries, non-ASEAN countries, salutation, and types of research conversations. A corpus of 100 to 200 research conversations on various types of research exposure were extracted from Facebook and LinkedIn based on a random selection. The movements of textual conversations were evaluated carefully before the final selection of conversations.

The ethnographic nature of this thesis refers to the focus on ASEAN research participants and institutional context deals with the environment of selected SNSs.

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Initially, a small focus group discussion was conducted to detect the reliability of SNSs as research mediator and nearly 60 percent have advocated the research influence of SNSs. The validity and reliability of SNSs were further checked with the productive research groups, number of active members, Altmetrics indicators (number of likes, number of comments, share of ordinary and critical issues, a number of research participants, and indicators of research exposure), and research features of SNSs.
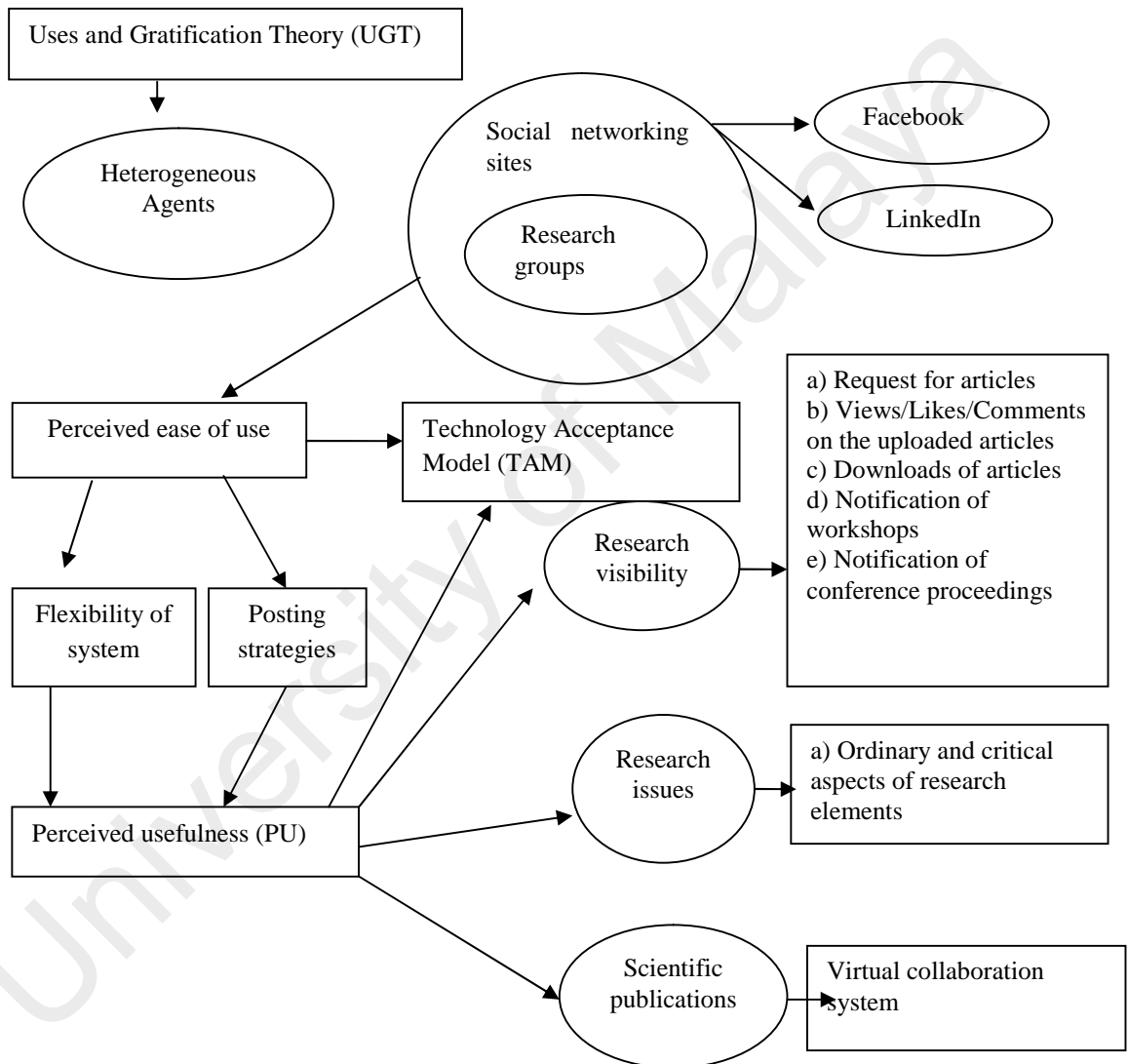
Figure 4.1: Link between the use of social networking sites and research exposure
Source: Author

4.3 METHODOLOGY AND DATA

Quantitative form of Socimetrics (measurement of SNSs involving Facebook and LinkedIn),Qualitative form of investigation (Conversational Analysis), Qualitative and

Quantitative Content Analysis were used to identify the interactional effects between elements of conversations (likes, comments, issues, views and others) and number of ASEAN participants. Qualitative and Quantitative Content Analyses were used to detect the reliability and validity of SNSs as research mediator. Data on the number of active research groups, number of active participating ASEAN scholars, number of likes, and number of comments, and internal structure of research exposure were extracted from Facebook and LinkedIn groups. Comments, and likes on different types of the research exposure were selected from Facebook and LinkedIn.

For this purpose, research groups like Research Scholars, Claudia Hunt's Research and PhD links, Qualitative Research Group, Research professionals and the International Collaborative Research Group were selected from Facebook. Akadeus.com, ARTNeT group, AnalyticBridge, Behavioral Economics and EDiNEB were selected from LinkedIn. Research groups were identified using keywords in the search function in Facebook and LinkedIn. They were selected through selection criteria that required them to be active research users of SNSs (Facebook and LinkedIn) and they should have higher level of research interests. This was detected through three stages of sampling approaches, namely, purposive sampling, snowball sampling, and simple random sampling. The sample of research participants were selected based on a purpose (purposive sampling) that have growing effects of scientific communications (snowball sampling). It has been selected randomly. The sample of participants based on snowball sampling increases with the growing research conversations.

4.3.1 CONTENT ANALYSIS

Content Analysis is the analytical textual analysis (Cavanagh, 1997) that was first used at the beginning of the 20th century (Barcus, 1959) in the US. It deals with the nature of subjectivity and analytical approaches such as systematic and strict textual analyses (Rosengren, 1981).

In this thesis, content analysis was utilized as a qualitative communication of textual data (Budd et al., 1967; Lindkvist, 1981; McTavish and Pirro, 1990; Tesch, 1990) due to its wide application and popularity (Nandy and Sarvela, 1997). Textual data were available in different forms such as verbal, print or virtual direction that were gathered from narrative responses, open ended survey questions, focus groups, and print media such as articles, books, manuals, websites and newspapers (Kondracki & Wellman, 2002). Qualitative content analysis refers to the process of examining tone of language and classification of large data into different sets of categories to produce similar presentation of thoughts (Weber, 1990).

4.3.2 CONVERSATIONAL ANALYSIS

Conversational Analysis is a type of qualitative method inspired by the Harold Garfinkel's ethno methodology and Erving Goffman's conception about interactions. The sociologist, Harvey Sacks and his friends (Emanuel Schegloff and Gail Jefferson) in the late 1960s and early 1970s have developed conversational analysis. Its origin is based on the social interactions between groups of members in certain fields of communications that are tied to sociolinguistics, discourse analysis, and psychology.

Conversational Analysis can be used to monitor and evaluate the production of interactions from various perspectives that are tied to the participants' own reasoning and subjective arguments. It is also known to be a useful method to understand and predict their future directions of communications. Conversational Analysis has been used in thesis to examine if there is any significant form of influence between SNSs and research exposure.

4.4 RESULTS AND ANALYSIS

Firstly, this section analyses the reliability and validity of selected SNSs (Facebook and LinkedIn) through numerical and qualitative evaluations of the active members, issues, modified strategies of genre analysis, productive research groups,

number of active members, Socimetrics indicators (number of likes, number of comments, share of ordinary and critical issues, number of research participants, and indicators of research exposure), and research features of SNSs. Secondly, it examines the significant role of SNSs on the enhancement of research exposure among ASEAN research participants via modified strategies of genre analysis and research conversations.

Table 4.1: Selected research groups in Facebook and the number of members within the groups

Research group within Facebook	Number of members
PhD discussion room	1890
ASEAN University network	12061
Indian research scholars organization	5636
ATLAS-ti Researchers group	859
Research Proposal and Theses	7279
Claudia Hunt's Research and PhD links	768
Analytical Researchers of Ancient Kingdoms, Records and Relics	1759
Writers	3238
IPTA-Ipad (&Tablets) for Academician	657
Bioinformatics	7451
Writers helping writers	6146
Virtual Learning Environmental	267

Source: Compiled from Facebook website

Table 4.1 illustrates the selected research groups within Facebook and numbers of active members within the research groups. Research groups in Facebook were selected randomly based on the number of discussed issues and number of members within the groups. The selection of research groups was made through the search function located on Facebook. The keywords for the searching of research groups were "research", "research conversations", "research discussion", "virtual research communication", "PhD research," and "PhD."

The relevant keywords were identified through the main points that have been reflected within the structure and themes of research discussions within the selection of research groups that are located in Facebook. The selection of keywords was tied up with the nature of designing thesis question and objective. All the selected keywords were tied up with research communications. Similarity of meanings within the keywords for each

of the issues was verified through manual checking. All the 12 research groups were selected based on the structure of keywords within the contents of discussions among researchers.

Table 4.2: Selected research groups and estimated ASEAN members within groups in Facebook

Selected research group	Estimated ASEAN members (%)
PhD discussion room	Malaysia (80-85%)
	Singapore & non-ASEAN countries (10%)
	Thailand, Philippines, and Vietnam (5%)
ASEAN University network	Malaysia (60-65%)
	Singapore (25%)
	Thailand, Philippines, Vietnam, & non-ASEAN countries (10%)
Indian research scholars organization	Malaysia (20%)
ATLAS-ti Researchers group	Malaysia (80-90%)
Research Proposal and Theses	Malaysia (80-90%)
	Singapore (5-10%)
Claudia Hunt's Research and PhD links	Malaysia (80-85%)
	Non-ASEAN countries (10-20%)
Analytical Researchers of Ancient Kingdoms, Records and Relics	Malaysia (3-5%)
	Non-ASEAN countries (80-90%)
Writers	Malaysia (3-5%)
	Non-ASEAN countries (80-90%)
IPTA-Ipad(&Tablets) for Academician	Malaysia (90-95%)
	Singapore & Non-ASEAN countries (5%)
Bioinformatics	Malaysia (2-3%)
	Non-ASEAN countries & Singapore (95%)
Writers helping writers	Malaysia (2-3%)
	Non-ASEAN countries & Singapore (95%)
Virtual Learning Environmental	Malaysia (2-3%)
	Non-ASEAN countries & Singapore (95%)

Sources: Author's computation and Facebook website

The numerical values in the parenthesis refer to the total active members from various developing and developed countries such as Malaysia, Singapore, Thailand, the Philippines, Vietnam, the US, the UK, Japan, China, and India. Table 4.2 shows the total estimated active ASEAN research members within the selected research groups in Facebook. In general, research groups such as PhD discussion room, ATLAS-ti Researchers group, Research Proposal and Theses, Claudia Hunt's Research and PhD links, and IPTA-Ipad (&Tablets) for Academician comprised the highest share of active research members from Malaysia, ranging from 80 percent to 95 percent. The

participations of research members from the other ASEAN member states in the specified research groups is at a critical stage, ranging in shares from 7 percent to 10 percent.

The moderate share of active members from Malaysia was observed from the ASEAN University network in Facebook. The participations of research members from Singapore, Thailand, the Philippines, and Vietnam in research groups, namely ASEAN University network, and Research Proposal and Theses was low and at 5 percent to 10 percent. A lower number of research members were observed in the Indian research scholars organization, Analytical Researchers of Ancient Kingdoms, Records and Relics, Writers, Bioinformatics, Writers helping writers and Virtual Learning Environmental. The remaining research groups such as ASEAN University network, Indian research scholars organizations, Analytical Researchers of Ancient Kingdoms, Records and Relics, Writers, Bioinformatics, Writers helping writers, and Virtual Learning Environmental have been excluded from further evaluation of Conversational Analysis because the estimated number of active members is less than 80 percent. Various conversations on various research elements and issues were extracted from research groups such as PhD discussion room, ATLAS-ti Researchers group, Research Proposal and Theses, Claudia Hunt's Research and PhD links and IPTA-Ipad (&Tablets) for Academician.

It can be inferred that only research participants in Malaysia have expressed their research interests through active virtual engagements on research based communication in research groups in Facebook. Various ordinary and critical issues were identified through the observations of research conversations in the selected groups. Ordinary communication refers to issues that deal with direct posts and responses or answers, while critical issues refer to issues that deal with indirect posts and responses or answers. Critical communication is subject to subjective and cognitive structure of thinking. There is no "right" or "wrong" answer in the critical issues compared to ordinary issues.

Ordinary communication refer to issues on the posting of explicit research questions, suggestions on selection of journals for publications, notification of workshops, notifications of conference proceedings, questions about research tools and requests for articles. Critical communications refer to communications on the implicit differences within scientific terms, indirect questions, and others. Some of the ordinary issues are stated below:

(a)*"What is your research framework?"*

(b)*"What do you mean by independent and dependent variables?"*

Some of the critical issues are stated as below:

(a)"How do you define the relevant theories of research?"

(b)*"Is the term "independent" and "dependent" variables applicable in research"?*

Rhetorical moves of research conversations within research groups such as PhD discussion room, ATLAS-ti Researchers group, Research Proposal and Theses, Claudia Hunt's Research and PhD links and IPTA-Ipad (&Tablets) for Academician were divided into "Request", "Starting with pleasantries", "Ending with pleasantries", "Sharing of research materials", "Downloads", "Notification of workshops", and "Notification of conferences" would probably regarded as textual data on the combinations of rhetoric and core moves as the selected research conversations have influenced and controlled the significant aspects of research visibility, discussions on various issues and scientific collaboration through virtual system of SNSs, namely Facebook and LinkedIn. Some statements were extracted from the research conversations in the Facebook research groups to test the reliability and validity of SNSs as research mediator and to examine the significant influence the selected sites have on the enhancement of research exposure among research participants in ASEAN member countries.

Some investigated research conversations in the selected Facebook research groups were based on the requests for responses to the online questionnaires and research materials such as research articles, research books, PhD and Master theses and others. Different structures of statements within the research conversations such as "help to retrieve…," and "help to download…" were consistent with the request move and it dealt with the request for research materials directly and indirectly. The selected Facebook conversations were in English and Malay languages. There was no translation of language within related research conversations to reveal the internal meaning of the research communications.

The numerical classifications of statements from (1) to (24) (APPENDIX D) refer to the statements that deal with the combinations of greetings and request move. Statements (1), (9), (11), (12), (14), (18), and (20) (APPENDIX D) deal with the tri-dimensional combinations of greetings, request and appreciations. The greetings that were observed through the statements within the research conversation were "*Salam and Hi...*", "*assalamualykum, hai...*", "Assalamualaikum…", "Salam…", "Assalam…", "Asalamualikum and Good Afternoon…", "Hi all…", "Hi,…", "Salam All…", "aslm and hi to al…", "Dear All,…", "Hello…", "Salam & Hi All…", and "Assalam…". The appreciations that were observed through the statements within the research conversations were "Thank you…," "Thank you so much|…", "many thanks in advance|…", "Thanks in advance…", "Thanks…", and "Thanks in advanced…" The overall combinations of greetings and appreciations represent the politeness of statements with "request" move and it has facilitated the effective interactions between the utilization of Facebook and research visibility in terms of "request" among the users especially ASEAN research participants.

The statements within research conversations highlight the research motives of some researchers in Malaysia and non-ASEAN countries such as the US and the UK, in

using Facebook to access various research materials for the preparation of their scientific papers, theses, and project papers. The research participants could enhance different types of research visibility, namely visibility of research issues (research topics, and research keywords), visibility of requested research materials, and visibility of online questionnaires. The proxy on the request for scientific articles in Facebook among Malaysian research participants has expanded the reliability and validity of Facebook as a research mediator to enhance the visibility of their research interests and the requested materials through the request for scientific materials This has also increased the visibility of requested scientific articles and it will inspire the citations of contents within scientific articles. Some research conversations within Facebook groups have generated continuous comments and likes on various research subjects and it has attracted the research attention of research participants particularly, Malaysian participants. Visibility of research issues such as research terms, strategies of reviewing literatures, research journals, and others have been observed through the intellectual interactions between researchers such as PhD students, and academic staffs within Facebook. This has enhanced the process of knowledge diffusion among selected researchers such as PhD students and academic staffs.

The second rhetorical move that was observed through the research conversations within Facebook refers to "sharing of research materials." "Sharing of research materials" refers to sharing of research attachments and research terms between research members. "Sharing of research materials" deals with the process in which the research participants will share their research materials such as articles, books, manuals, and magazines with others through Facebook groups. Through the uploading of research materials into the research groups in Facebook using the technical function, other research participants have the chance to view and download the shared research articles and books. The greetings within the research statements on Facebook were "Dear all,", and "Salam…" It was

observed that the flow of knowledge diffusion has moved locally and globally between ASEAN and non-ASEAN participants within the research groups. This will increase the research visibility of shared research documents through the views and downloads of relevant research materials by research participants, particularly ASEAN participants Statements from (25) to (29) (APPENDIX D) indicated the positive association between utilization of Facebook and enhancement of research visibility through the sharing of research materials.

The third rhetorical move within the selected research conversations refers to "notification of workshops". Notification of workshops refers to various announcements of workshops, online lectures, PhD clinic and webinars on research tools such as workshop on Advance Microsoft Word, workshop on Thesis Proofreading, workshop on Research Methodological Approach, workshop on SmartPLS, workshop on Qualitative Data Analysis using ATLAS-ti, webinar on "How to transcribe using ATLAS-ti", webinar on "Debunking Myths about transcription of focus data", workshop on Biomolecular Interactions, online lectures for scientists and researchers, PhD clinic on case study approach, webinar on Detection of Structural Variants in Targeted Sequencing, virtual lecture on "How to start writing", DSG webinar on Introduction to SPSS (Basics) and Mendeley Focus workshop.

The research tools that were communicated through the announcements were Microsoft Word, Statistical Package for Social Sciences (SPSS), tools for proofreading and Mendeley. The notification of various workshops on research tools has guided the research participants to explore the available research tools for their preparation of research projects and scientific papers. Through the notification, the research visibility through workshops could be observed clearly and research participants will be fully aware of the existence of research workshops. Statements from (30) to (44) (APPENDIX D) provide the non-verbal evidence that Facebook has influenced research visibility

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among Malaysian research participants significantly through the notification of workshops.

The fourth rhetorical move within the selected research conversations refers to notification of conferences. Notification of conferences can be realized through various statements such as "Submit your research work…", "Call for paper…", "The 1st International JIMF Call for Papers …" Through the notification, the research visibility in terms of conferences could be observed clearly and research participants will be fully aware of the existence of research conferences. Statements on "notification of conferences" are from (45) to (53) (APPENDIX D).

The fifth rhetorical move within the selected research conversations refers to "notification of submission through research journals". Through the notification, the research visibility in terms of article submission could be observed clearly and research participants will be fully aware of the existence of research journals as a medium for the submission of journal papers. Statement on "notification of submission through research journals" refers to (54). (APPENDIX D).

Discussions of issues within the research conversations refers to different types of discussions such as discussions of various issues and questions on research techniques and modeling, statistical tools, research terms, and research data. The statements on the discussions of various issues are from (55) to (67). (APPENDIX D).

Table 4.3: Analysis of Socimetrics based on Facebook network through Content Analysis

ASEAN countries	Engaging values (Likes, Comments and Views)
Malaysia	(80-90)%
Singapore	(20-25)%
Thailand	(10-18)%
Vietnam	(10-12)%
Indonesia	(5-10)%
Cambodia, Myanmar, Laos, Philippines, and Brunei	(10-15)%

Source: Author's computation

Higher interaction effects were observed among the active participants from Malaysia and weaker levels of engagements were among research participants from Singapore, Thailand, Vietnam, Indonesia and the other ASEAN member states in Facebook (Table 4.3). Through the rising patterns of active research members and research issues, it was confirmed that SNSs have expanded the research exposure among ASEAN members. It can be inferred that Facebook is not a reliable source of research communication between researchers from Singapore, Thailand, Vietnam, Cambodia and others.

The weaker levels of research engagements are because they do not prefer to get in touch with the virtual communication and prefer to go for physical research exchanges. In general, the interaction effects on issues between the participants of ASEAN countries were at the lower boundary except for Malaysia.

Table 4.4: Selected research groups in LinkedIn and the number of members within the groups

Research group within LinkedIn	Number of members
Akadeus.com	426
ARTNeT	89
AnalyticBridge	4985
Behavioural Economics	12735
CEIC Data	926
Economists Professional Network	10558
EDiNEB	602
Econometrics	3584
Economics & Finance: Jobs, Courses and Conferences	4628
Economist of the world	8251
Education Technologists in Asia	145
Financial Economists	8955

Source: Compiled from LinkedIn website

Table 4.4 shows selected research groups within LinkedIn and the number of active members within each of the selected research groups. Research groups in LinkedIn were selected randomly based on the number of discussed issues, facilitation of research exposure and number of members within the groups. The selection of research groups was made through the search function in LinkedIn. The keywords for the searching of

research groups were "research", "research conversations", "research discussion", "virtual communication", "Econometrics" and "scientific research."

Table 4.5: Selected research groups and estimated ASEAN members within groups in LinkedIn

Selected research group	Estimated ASEAN members (%)
Akadeus.com	Malaysia (10-20%)
	Non-ASEAN countries (80-90%)
ARTNeT	Malaysia (5-10%)
	Non-ASEAN countries (80-85%)
	Singapore and Thailand (10-15%)
AnalyticBridge	Malaysia (5-8%)
	Non-ASEAN countries (85-88%)
	Singapore and Thailand (8-12%)
Behavioural Economics	Malaysia (5-10%)
	Non-ASEAN countries (80-85%)
	Singapore and Thailand (10-15%)
CEIC Data	Malaysia (5-10%)
	Non-ASEAN countries (80-85%)
Economists Professional Network	Malaysia (5-10%)
	Non-ASEAN countries (80-85%)
	Singapore and Thailand (5-15%)
Econometrics	Malaysia (5-10%)
	Non-ASEAN countries (80-85%)
	Singapore and Thailand (10-15%)
Economics & Finance: Jobs, Courses and Conferences	Malaysia (50-60%)
	Non-ASEAN countries (20-30%)
	Singapore and Thailand (10-15%)
Economist of the world	Malaysia (5-10%)
	Non-ASEAN countries (80-85%)
	Singapore and Thailand (10-15%)
Education Technologists in Asia	Malaysia (60-65%)
	Non-ASEAN countries (20-30%)
	Singapore and Thailand (10-15%)
Financial Economists	Malaysia (5-10%)
	Non-ASEAN countries (80-85%)
	Singapore and Thailand (10-15%)

Source: Author's computations and LinkedIn website

The relevant keywords was identified through the main points that have been reflected within the structure and themes of research discussions on various aspects such as statistical techniques, robust reviews and others within the selection of research groups that are located in LinkedIn. The selection of keywords was also tied up with the nature of designing thesis question and objective. All the selected keywords are fully tied up with research communications. Similarity of meanings within the keywords for each of the issues was verified through manual checking. All the 12 research groups were selected based on the keywords within the contents of research discussions within

LinkedIn. The numerical values in the parenthesis refer to the total active members from various developing and developed countries such as Malaysia, Singapore, Thailand, the Philippines, Vietnam, the US, the UK, Japan, China, India, and others. Table 4.5 shows the total estimated active ASEAN research members within the selected research groups in LinkedIn.

In general, research groups such as Economics and Finance jobs, courses and conferences, and Education Technologists in Asia consist of a moderate share of active research members from Malaysia, ranging from 50 percent to 65 percent. The active participations of research members from Malaysia, Singapore, and Thailand in other research groups, namely Akadeus.com, ARTNeT, Analyticbridge, Behavioural Economics, CEIC Data, Economists Professional Network, Econometrics, Economist of the world, and Financial Economists were low and the shares ranged from 5 percent to 15 percent.

Highest shares of active members of non-ASEAN member countries, namely the US, the UK, and India were observed from Akadeus.com, ARTNeT, AnalyticBridge, Behavioural Economics, CEIC Data, Economists Professional Network, Econometrics, Economist of the world, and Financial Economists. The shares ranged from 80 percent to 85 percent. The participations of research members from non-ASEAN countries in Economics and Finance jobs, courses and conferences, and Education Technologists in Asia were low, ranging from about 20 percent to 30 percent. The other remaining research groups within LinkedIn such as Akadeus.com, ARTNeT, AnalyticBridge, Behavioural Economics, CEIC Data, Economists Professional Network, Econometrics, Economists of the world, and Financial Economists were excluded from further evaluation of the Conversation Analysis because the estimated number of researchers from ASEAN member states was less than 50 percent. Research conversations were only

extracted from two research groups: Economics & Finance: Jobs, Courses and Conferences and Education Technologists in Asia.

Rhetorical moves of research communication within Economics & Finance: Jobs, Courses, Conferences, and Education Technologists in Asia can be divided into "Request", "Sharing of relevant materials", "Discussion of issues" "Notification of workshops", "Notification of conferences", and "Ending with pleasantries" would probably regard as a textual data on the combinations of rhetoric and core moves.

Request within the research conversations on LinkedIn refers to different types of research requests such as request for research help, request for research suggestions, request for articles and others. In certain cases, "Request" move can also be tied up with the "Ending with pleasantries" and it refers to (68) (APPENDIX D).

Discussions on issues within the research conversations on LinkedIn refers to different types of discussions such as discussions on various issues and questions on research techniques and modeling, statistical tools, research terms, and research data. The statements on the discussions of various issues are from (69) to (97) (APPENDIX D).

Sharing of relevant research materials within the research conversations in LinkedIn refers to different types of research sharing such as sharing of research tips on statistical packages, research programs, research jobs, research books, research practices, and research articles. The statements on the sharing of research materials are from (98) to (149). (APPENDIX D) Notification of workshops within the research conversations in LinkedIn refers to different types of research workshops such as notifications of workshop and summit. The statements on the notification of workshops are from (150) to (151). (APPENDIX D).

Table 4.6: Analysis of Socimetrics based on active LinkedIn network through Content Analysis

ASEAN countries	Engaging values (Likes, Comments and Views)
Malaysia	(60-70)%
Singapore	(20-30)%
Thailand	(15-20)%

Source: Author's computations

Socimetrics is an extended version of Altmetrics as it captures different levels of research exposure, such as research visibility, discussion of research issues, scientific publications and the possibility of collaborative activities among researchers from ASEAN member states. Socimetrics deals with the measurement of likes, comments, and views on various types of statements that are tied up with the selected rhetorical moves of research communications. Measurements of likes, comments, and views of the relevant statements, among the selected ASEAN researchers within Facebook and LinkedIn were summed up to compute the Socimetrics and the values were reflected within the lower and upper boundary (interval estimation). This can be seen through Table 4.3 and Table 4.6.

Sharing of research materials and request for scientific articles through Facebook and LinkedIn has the capacity of increasing the scientific publications among ASEAN research participants, but the effects of scientific publications were lower among ASEAN research participants. The scientific collaboration between virtual participants was implemented through Skype and webinar. This thesis is different from Zahedi et al. (2014), Fenner (2014) and Tang et al. (2012) in terms of research focus, research sample, and variables, but all the stated scholars have advocated the research function of SNSs.

Table 4.7: Technical and non-technical features of Facebook and LinkedIn

Features	Facebook	LinkedIn
Research profiles		
Research pages		
Research groups		
Search function		
Video call		
Posting strategies (Likes, comments, Views, and others)		
File sharing		
Notifications of publications		
Download function		

Source: Author's analysis

There was a lower momentum of interaction effects between the participating countries of Singapore and Thailand through LinkedIn (Table 4.6). The other countries, Brunei Darussalam, Indonesia, Laos, Vietnam, Myanmar, the Philippines, and Cambodia were excluded from the analysis, as they have not shown active participations in the LinkedIn network.

Table 4.7 illustrates the qualitative description of technical and non-technical features of Facebook and LinkedIn. The features of SNSs are divided into research profiles, research pages, research groups, search function, video call, posting strategies, file sharing, notifications of publications, and download function. The illustrations of features have inspired the expansion of the PEU through the friendly and flexible nature of the system has influenced the expansion of PU directly. This can be seen through the case in which the features have attracted the attention of researchers in utilizing the SNSs for building up the intellectual and critical research discussions within the virtual system. In general, the usage of qualitative and quantitative content analysis have shown that the SNSs, Facebook and LinkedIn are reliable and valid research mediators that can be used to enhance different types of research exposure.

Although earlier developments in conversational analysis have been undertaken to identify the social interactions between the members in different mediums of networks such as Twitter, Facebook, Slideshare and others, this thesis has focused only on the

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major scientific conversations (research conversations) between the participants from Malaysia and non-ASEAN participants because of the other ASEAN participants have mixed levels of moderate and weaker research conversations compared to Malaysia.

As mentioned earlier, the evaluations of scientific conversations focused on critical aspects of research elements, research software, and qualitative measurements of research visibility (notifications of workshops on subject matters and research software, notification of conference proceedings) and qualitative measurement of scientific publication (notification of conference proceedings). About 200 conversations from some selected researchers have been used for investigations.

It has been stated that higher intellectual interactions between Malaysia and non-ASEAN countries (Pakistan, India, the US, Australia) can be seen clearly through the conversations on various issues. This has given rise to internal forms of discussions on two types of conversations (conversations with continuity and conversations without continuity). Conversations with continuity refer to the questions or statements that were raised by the scholars with the follow up of responses and subjective arguments, while conversations without continuity refer to the questions or statements that were posed by research scholars without any follow up.

Higher levels of conversations with continuity can be observed by referring to the selected conversations in terms of the critical aspects of research elements, and research software only, while higher portions of conversations without continuity can be seen through conversations in terms of research visibility and scientific publications. In other words, high utilization of SNSs (Facebook and LinkedIn) among active research users does not have significant influence on enhancement of research visibility and scientific publications,; however, it does affect variables of interest in a positive direction and the effects of it are not so strong. The latter statement is in line with major thoughts of

scholars that SNSs may not be the effective instrument to improvise research visibility and increase scientific publications although some may have used it for that purpose.

Through the Content Analysis and Conversational Analysis, it can be inferred that there was no active participations on the research discussions within Facebook and LinkedIn among researchers from Thailand, Singapore and other ASEAN member states such as Vietnam, Myanmar, Indonesia, Cambodia, Laos, Brunei Darussalam, and the Philippines. It is because most of the ASEAN researchers may not find SNSs as a reliable platform for research sharing as the information can be exposed to the unrelated third parties. After careful analysis was done, the minimal level of research conversations that were tied up to researchers from Thailand, Singapore and other ASEAN member states such as Vietnam, Myanmar, Indonesia, Cambodia, Laos, Brunei Darussalam, and the Philippines were omitted from the sample conversations.

Through intellectual interaction between some researchers, it has been observed that the ASEAN researchers, especially, researchers from Thailand and Singapore used to have their research discussions within other social and academic networking sites such as Twitter, Research Gate, and Academia. Edu. The generalization of results within this section might not be possible due to the limited number of participants and conversations. However, the results on the positive influence on the usage of SNSs in increasing the research exposure can only be used as benchmark to indicate the point that the usage of SNSs can influence the research visibility among researchers from ASEAN member states especially, Malaysia. It has been stated that Facebook and LinkedIn are not reliable research mediums for researchers from other ASEAN member states such as Thailand, Singapore,Vietnam, Laos, Cambodia, Indonesia, Philippines and others.

4.5 SUMMARY

This analytical chapter seeks to answer the following thesis question:-

(a) Can SNSs influence research exposure among ASEAN research participants?

The thesis question has formulated the following thesis hypothesis:-

H_4: The utilization of SNSs enhances research exposure among ASEAN research participants.

The growing trend of technological advancement has inspired the utilization of SNSs as a virtual hub of research communication. The view that "SNSs can only be used as a medium for social interaction" has lowered the possibility of research opportunities that is gained via SNSs. SNSs have the full capability to increase research exposure through the expansion of research visibility, research issues, and scientific publications among participants with the assurance that cognitive attitude is tied to the research actions of participants. SNSs increase various research opportunities and reduce the physical costs of gaining research knowledge. It has supported the research hypothesis through the indication of the significant influence that SNSs have on the enhancement of research exposure.

CHAPTER 5: COMPARATIVE ANALYSIS OF IMPACT FACTORS AMONG ISI JOURNALS

5.1 INTRODUCTION

This chapter discusses and compares the Synchronous and DIFs among the domestically owned ISI-indexed journals in developing ASEAN member countries, namely Malaysia, Thailand and, Philippines and ISI-indexed journals in Economics. The following hypotheses in this chapter are as follows:

H_5:   The diachronous impact factor serves as a "substitute" to the synchronous impact factor among ISI journals in Economics.

H_6:   The diachronous impact factor serves as a "substitute" to the Synchronous impact factor among domestically owned ISI-indexed journals in developing ASEAN member states.

The rest of the chapter is organized as follows. Section 5.2 describes the relevant quantitative and qualitative techniques to test the above stated hypotheses. Section 5.2 explains the sources of data on bibliometrics variables and approaches of impact factor. Section 5.3 presents and discusses the results in the domestically owned ISI journals in the Sciences by developing ASEAN member states. Section 5.4 presents and discusses the results on the ISI-indexed journals in Economics. Section 5.5 summarizes the overall discusses on the applicability of impact factors for ISI journals in Sciences and Economics. This analytical chapter focuses on the ISI-indexed journals owned by developing ASEAN member states in the Sciences. Selection of Malaysia, Thailand and Philippines was based on the status of developing countries. This analytical chapter also focuses on ISI-indexed journals in Economics as a general guideline. Then, it focuses on some of the ISI-indexed journals that were utilized by researchers from Malaysia, Singapore,Thailand, Philippines, and Indonesia in Economics. Selection of Malaysia,

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Singapore, Thailand, Philippines, and Indonesia was based on the higher number of published papers in Economics (more than 500 papers) in Economics journals.

5.2 METHODOLOGY AND DATA

5.2.1 Analytical   Framework
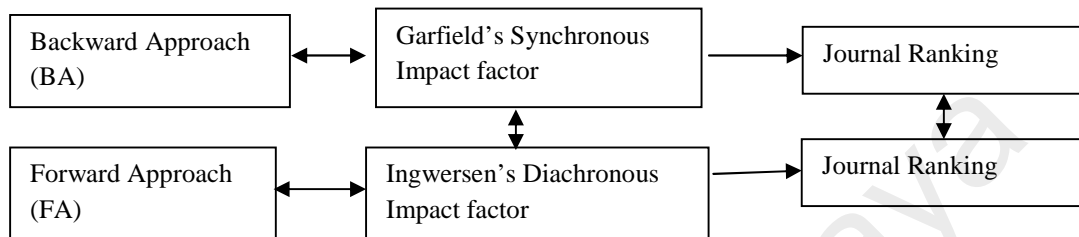
Figure 5.1: Interaction effects between Synchronous and Diachronous impact factors

Source: Author

Figure 5.1 elucidates the differences between Garfield's SIF (two-year and five-year impact factors) and Ingwersen's DIF. It is highlighted through the changes of journal ranking with the assistance of the Backward Approach (BA) and Forward Approach (FA). SIF refers to the impact factor that follows fixed years of citation window. It deals with the state of homogeneity over periods (fixed variations of the impact factor of selected journals).

Glanzel et al. (2004) used the pragmatic approach to indicate the flexibility of the SIF as it does not require large observations on the citation window. He added that the Synchronous approach could not serve as a substitute for the diachronous approach. The former follows the BA, by which it refers to the observations on citations and publications of a journal in a specified lagged year (Ingwersen et al. 2001; Ingwersen 2012). It is also known as a retrospective approach (Glanzel et al. 2004). The DIF is tied to the continuous years of citation window (continuous movements of citations over time). It follows the FA, by which it refers to the observations on cited publications in the current and future years.

5.2.2 Explanations on the Synchronous and diachronous versions of impact factors

Ingwersen et al. (2001), Ingwersen (2012) and Sanni et al. (2014) highlighted the association between publications and citations through Table 5.1 and Table 5.2. Table 5.1 and Table 5.2 can be used as a guideline to explain the directions of calculations for SIFs and DIFs. Table 5.1 shows the publication-Citation matrix for a journal (e.g. Journal A) based on DIF. With the use of Table 5.1, it can be observed that the important preference was given to the current publication year, current and future citations for the scientific publications within Journal A. DIFs refers to the impact factor that are based on the citations for publications in a year that have been gained starting from the same year of publications to future years (Table 5.1).

In general, DIFs were computed by summing up all the citations for publications within Journal A in a year that has been gained from the same year of publications to future years and dividing it with the number of scientific publications in a given year (Table 5.1). For example: If the year of publication is 2004, then DIFs will be computed by summing up the citations for the publications within Journal A from 2004 up to 2013 and dividing it with the number of scientific publications in 2004 (Table 5.1). Table 5.1 has classified the DIFs as the prospective citations as it deals with the citations for the current and future years and it does not deal with fixed timing.

Table 5.2 reflects the publication-citation matrix for a journal (e.g. Journal A) based on SIF. With the utilization of Table 5.2, it can be observed that the important preference was given to the total number of publications and citations within Journal A in the past time periods or lagged timing. SIFs refers to the total citations for the publications within Journal A in the past time periods that have been gained by collecting the citations in the fixed lagged time periods (Table 5.2). Based on the

structure of Table 5.2, it can be observed that the SIFs were computed by summing up the total citations for publications in the past time periods and dividing it with the total scientific publications in the past time periods. For example: if the year of publication is 2006, then the SIF will be computed by summing up the total citations in both years (2004 and 2005) and dividing it with total publications in 2004 and 2005 (Table 5.2). Table 5.2 has reflected SIFs as retrospective citations as it follows the citations and publications in the lagged periods. It neglects continuous citations over years as it has been connected to fixed lagged periods (Table 5.2).

Table 5.1: Publication-Citation matrix for Journal A
(Diachronous impact factor)

PY	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
	PUB	PUB	PUB	PUB	PUB	PUB	PUB	PUB	PUB	PUB
2004	CIT									
2005	CIT	CIT								
2006	CIT	CIT	CIT							
2007	CIT	CIT	CIT	CIT						
2008	CIT	CIT	CIT	CIT	CIT					
2009	CIT	CIT	CIT	CIT	CIT	CIT				
2010	CIT	CIT	CIT	CIT	CIT	CIT	CIT			
2011	CIT	CIT	CIT	CIT	CIT	CIT	CIT	CIT		
2012	CIT	CIT	CIT	CIT	CIT	CIT	CIT	CIT	CIT	
2013	CIT	CIT	CIT	CIT	CIT	CIT	CIT	CIT	CIT	CIT

Note: PY=publication year, PUB=Total publications, and CIT=Total citations received on   the publications
Source: Ingwersen et al. (2001)

Table 5.2: Publication-Citation matrix for Journal A
(Synchronous impact factor)

PY	2006	2007	2008	2009	2010	2011	2012
2004	CIT-PUB	CIT-PUB	CIT-PUB	CIT-PUB	CIT-PUB	CIT-PUB	CIT-PUB
2005	CIT-PUB	CIT-PUB	CIT-PUB	CIT-PUB	CIT-PUB	CIT-PUB	CIT-PUB
2006		CIT-PUB	CIT-PUB	CIT-PUB	CIT-PUB	CIT-PUB	CIT-PUB
2007			CIT-PUB	CIT-PUB	CIT-PUB	CIT-PUB	CIT-PUB
2008				CIT-PUB	CIT-PUB	CIT-PUB	CIT-PUB
2009					CIT-PUB	CIT-PUB	CIT-PUB
2010						CIT-PUB	CIT-PUB
2011							CIT-PUB
2012							

Note: PY=publication year, PUB=Total publications, and CIT=Total citations received on   the publications
Source: Ingwersen et al. (2001)

5.2.3 SOURCES OF DATA

For the testing of fifth hypothesis in this thesis, the data on journal titles, citations, and impact factors for two and five years of 302 ISI-indexed journals in the subject category of Economics were extracted from the JCR 2013, and the SSCI (WOS^TM Core Collection) databases. The period from 1980 to 2013 was selected for the purpose of computing the life expectancy of the journals and validating the First-Latecomer advantage. Cluster analysis was used to sort out the selected ISI journals into two main groups based on the birth of publications and the concepts of First-Latecomer advantages.

For the testing of sixth hypothesis in this thesis, the data on journal titles, citations, authors, institutions, citing countries, citing research publications, citing articles, citing research areas, citing sources, citing categories and impact factors for 2 and 5 years of 22 ISI-indexed journals in Sciences in the developing ASEAN member countries have been extracted from the JCR 2013, and the Science Citation Index Expanded (SCI-EXPANDED) (WOS^TM Core Collection) databases from 1980 up to June 5, 2015.

5.2.4 QUANTITATIVE TECHNIQUES

This section outlined the deductive approach to compare the SIF and DIF among ISI-indexed journals owned and utilized by ASEAN member states in the Sciences and, Economics.

(A) ASEAN's ISI-indexed journals in the Sciences

(a) SIF

$$SIF_{t,m}(Y) = \sum_{i=1}^{t} TC(Y, Y-i) / \sum_{i=1}^{t} TP(Y-i)$$

Where, *SIF* represents Synchronous impact factor, *TC(Y,Y-i)* represents total citations for publications in the year Y in the selected fixed years, *TP(Y- i)* represents total publications in the selected fixed years, *t* represents the year of publication, and *m* represents ISI-indexed journals in the selected subject categories. *SIF* refers to ISI impact factor.

(Source: Garfield, 1955)

(b) DIF based on citing organizations (DIFCO)

$$DIFCO_{t,m}(Y) = \sum_{i=p}^{p+t-1} CO(Y + i, Y)/TP(Y)$$

Where, *DIFCO* represents DIF based on citing organizations, *CO(Y+i, Y)* represents citing organizations for publications in the year Y in the same year and subsequent years, *TP(Y)* represents total publications in the year Y, *t* represents the total number of publication years, and *m* represents ISI-indexed journals in the selected subject categories.

(Source: Adapted from Ingwersen et al., 2001)

(c) DIF based on "unique" citing countries (DIFUCC)

$$DIFUCC_{t,m}(Y) = \sum_{i=p}^{p+t-1} UCC(Y + i, Y)/TP(Y)$$

Where, *DIFUCC* represents DIF based on unique citing countries, *UCC(Y+i, Y)* represents unique citing countries for publications in the year Y in the same year and subsequent years, *TP(Y)* represents total publications in the year Y, *t* represents the total number of publication years, and *m* represents ISI-indexed journals in the selected subject categories.

(Source: Adapted from Ingwersen et al., 2001)

(d) DIF based on "unique" citing sources (DIFUCS)

$$DIFUCS_{t,m}(Y) = \sum_{i=p}^{p+t-1} UCS(Y + i, Y)/TP(Y)$$

Where, *DIFUCS* represents DIF based on unique citing sources, *UCS(Y+i, Y)* represents unique citing countries for publications in the year Y in the same year and subsequent years, *TP(Y)* represents total publications in the year Y, *t* represents the total number of publication years and *m* represents ISI-indexed journals in selected subject categories.

(Source: Adapted from Ingwersen et al., 2001)

(e) DIF based on "unique" citing subject categories (DIFUCSC)

$$DIFUCRC_{t,m}(Y) = \sum_{i=p}^{p+t-1} UCRC(Y+i,Y)/TP(Y)$$

Where, *DIFUCRC* represents DIF based on unique citing subject categories, *UCRC(Y+i, Y)* represents unique citing research areas for publications in the year Y in the same year and subsequent years, *TP(Y)* represents total publications in the year Y, *t* represents total number of publication years, and *m* represents ISI-indexed journals in the selected subject categories. DIFUCSC was adapted from Ingwersen et al. (2001).

(B) ISI-indexed journals in Economics

(a) SIF - ISI impact factor is measured as below:

$$SIF_{t,m}(Y) = \sum_{i=1}^{t} TC(Y,Y-i)/\sum_{i=1}^{t} TP(Y-i)$$

Where, *SIF* represents synchronous impact factor, *TC(Y,Y-i)* represents the total citations for publications in the lagged fixed years, *TP(Y- i)* represents the total publications in the lagged fixed years, *t* represents the selected lagged years of publication, and *m* represents ISI-indexed journals in the subject category of Economics.

(Source: Garfield, 1955)

The SIFs that are used in this thesis are two-year and five-year impact factor of the targeted ISI-indexed journals. It is used as a benchmark for the purpose of comparative analysis deployed in the paper to capture the short-term impact of citations among scientific journals by considering the citation lags.

(b) DIF based on Non-Self Citations (DIFNSC) are measured as follows:

$$DIFNSC_{t,m}(Y) = \sum_{i=p}^{p+t-1} NSC(Y+i,Y)/TP(Y)$$

Where, *DIFNSC* represents DIF based on non-self citations, *NSC(Y+i, Y)* represents non-self citations for publications in the present and subsequent years, *TP(Y)* represents total publications in the year Y, *t* represents life expectancy of publications within a particular journal. and *m* represents ISI-indexed journals in the subject category of Economics. DIFNSC was adapted from Ingwersen et al. (2001).

Following Lu et al. (2014) journal concentration index, DIF based on the Citation Concentration Index (DIFCCI) is proposed to evaluate the concentration of citations from citing articles as the citing articles refer to the subset of journals:

(c) DIFCCI is measured as follows:-

$$DIFCCI_{t,m}(Y) = 1 - [\sum_{i=p}^{p+t-1} CA(Y+i,Y)/TC(Y+i,Y)]$$

Where, *DIFCCI* represents DIF based on the citation concentration index, *CA(Y+i, Y)* represents citing articles for publications in the present and subsequent years, *TC(Y+i, Y)* represents the total citations for publications in the present and subsequent years, *t* represents life expectancy of publications within a particular journal, and *m* represents ISI-indexed journals in the subject category of Economics.

Following Prathap (2011) and Glanzel's (2008) Energy Index based on the theory of performance and energy analogy (*vis viva* on the field of kinetics or dynamics (Terall,

2004)) was utilized as a baseline to develop Journal Energy Index (JEI) based on non-self citations:

(d) DIF based on Journal Energy Index (DIFJEI) is measured as follows:

$$DIFJEI_{t,m}(Y) = \sqrt{[DIFNSC_{t,m}(Y)]^2.TP(Y)}$$

Where, *DIFNSC* represents DIF based on non-self citations, *TP(Y)* represents the total publications in the year Y, *t* represents life expectancy of publications within a particular journal, and *m* represents ISI-indexed journals in the subject category of Economics.

The DIFs used to evaluate the performance of citations among scientific journals is based on the FA (present and future years). Since it focuses on continuous years, it can be classified as a dynamic version of impact factor. Non-self citations and citing articles were taken into consideration for its capability of capturing the recognition of the contents in the current journals among authors of *unique* journals. *Unique* journals refer to journals in different subject categories.

Citation Concentration Index (CCI) was taken into consideration to measure the concentration level of citations received from citing articles. If the CCI is close to zero, then, it shows that the current journals deal with zero or lower concentration of citations gained from citing articles and vice versa.

According to Terall (2004), the notion of energy is based on the interactional effects of *mass* and *velocity*. In the context of this thesis, *Mass* represents the quantity of publications whereas *velocity* refers to the quality of publications. The overall formulation of DIFJEI has the capacity to explain the metaphysical nature of performance among both first comer and latecomer journals. It shows the movements of citations among the publications over the selected period through the interaction effects

of quantity and quality. It was normalized through the squaring method due to the variations of issues and publications within ISI-indexed journals. Each of the indices was normalized to serve the variations of citing issues, number of publications and affiliated subject categories. This is necessary for the purpose of comparison based on the rankings of journals. In this thesis, micro refers to all the citations and citing agents, meso deals with ISI-indexed journals and macro refers to the scientific publications. Detailed explanations of the normality tests, parametric and non-parametric independent sample tests were stated in Chapter 3.

5.3 RESULTS AND ANALYSIS FOR ASEAN'S ISI JOURNAL

This section examines the nature and differences of SIF and DIF among the ISI-indexed journals owned by developing ASEAN member countries, namely Malaysia, the Philippines and Thailand in the Sciences.

Table 5.3: Synchronous impact factors, Diachronous impact factors and total publications of ISI-indexed journals in Malaysia

Domestic Journal Name	SIF-2	SIF-5	TC	NSC	SC	TP
Asia-Pacific Journal of Public Health	1.111	1.312	2214	1460	754	923
Asian Myrmecology	0.625	0.613	114	82	32	62
Bulletin of the Malaysian Mathematical Sciences Society	0.854	0.86	950	630	320	536
Journal of Oil Palm Research	0.177	0.399	248	223	25	262
Journal of Rubber Research	0.128	0.198	150	117	33	164
Journal of Tropical Forest Science	0.667	0.675	1387	1263	124	675
Malaysian Journal of Computer Science	0.5	0.574	131	94	37	115
Neurology Asia	0.244	0.354	317	275	42	389
Sains Malaysiana	0.48	0.427	1171	1022	149	1323
Tropical Biomedicine	0.816	1.045	1631	1482	149	582

Source: WOS database, ISI (1980-June 5, 2015)

Table 5.4: Diachronous impact factors of ISI-indexed journals in Malaysia

Domestic Journal Name	DIFUCC	DIFCO	DIFUCS	DIFUCSC
Asia-Pacific Journal of Public Health	0.12	2.45	0.76	0.16
Asian Myrmecology	0.98	5.26	0.82	0.34
Bulletin of the Malaysian Mathematical Sciences Society	0.13	1.18	0.41	0.08
Journal of Oil Palm Research	0.18	0.90	0.51	0.23
Journal of Rubber Research	0.16	0.77	0.44	0.20
Journal of Tropical Forest Science	0.15	1.95	0.66	0.15
Malaysian Journal of Computer Science	0.20	0.79	0.76	0.31
Neurology Asia	0.14	1.25	0.48	0.20
Sains Malaysiana	0.06	0.72	0.45	0.10
Tropical Biomedicine	0.20	2.94	0.89	0.20

Source: Author's computations

Table 5.5: Correlation between Synchronous and Diachronous impact factors of ISI-indexed journals in Malaysia

	DIFUCC	DIFCO	DIFUCS	DIFUCSC	SIF-2	SIF-5
DIFUCC						
DIFCO	0.37					
DIFUCS	0.61	0.71**				
DIFUCSC	0.85**	0.23	0.57			
SIF-2	-0.17	0.61	0.38	-0.39		
SIF-5	-0.07	0.64**	0.50	-0.30	0.98**	

** Significant at 0.05(5%). This refers to Spearman rank correlation.
Source: Author's computations

(a) Malaysia

Table 5.3 shows the SIFs, DIFs and total publications of domestically owned ISI-indexed Malaysian journals. Based on Table 5.3, it can be observed that the SIFs refer to 2-year impact factor and 5-year impact factor. All the DIFs were computed based on the indicators such as total citations, self-citations, and non-self citations over the periods. All the domestically owned ISI-indexed journals in the Sciences are Asia-Pacific Journal of Public Health, Asian Myrmecology, Bulletin of the Malaysian Mathematical Sciences Society, Journal of Oil Palm Research, Journal of Rubber Research, Journal of Tropical Forest Science, Malaysian Journal of Computer Science, Neurology Asia, Sains Malaysiana, and Tropical Biomedicine. With reference to Table

5.3, Asia-Pacific Journal of Public Health has recorded the highest number of SIFs and total citations (with the combinations of total non-self citations and total self-citations).

Asia-Pacific Journal of Public Health has the highest number of 2-year impact factor (1.111), 5-year impact factor (1.312) and total citations (2214). As indicated earlier, the ISI's impact factor has no capacity in determining the long-term performance of domestically owned ISI-indexed Malaysian journals based on continuous periods in terms of its scientific visibility. In this case, the most suitable indicator or proxy that can be used to detect the long-term performance of domestically owned ISI-indexed Malaysian journals were DIFNSC. It has the capability of detecting and evaluating the scientific visibility of issues within the scientific publications that are located within Malaysian journals.

Through the comparison of DIFNSC among domestically owned ISI-indexed Malaysian journal, it can be seen that Tropical Biomedicine has the highest impact factor in terms of total non-self citations (1482). This shows that Tropical Biomedicine has external visibility (local and international visibility) among external ISI-indexed journals besides Tropical Biomedicine. Table 5.4 reflects the DIFs based on unique citing countries, citing organizations, unique citing sources and unique subject categories among domestically owned ISI-indexed journals in Malaysia. Through the utilization of Table 5.4, it can be inferred that Asian Myrmecology has the highest number of DIFUCC (0.98), DIFCO (5.26), and DIFUCSC (0.34).

The non-parametric approach of correlation test (Spearman rank correlation) has been employed due to the nature of skewed counts of citations and citing agents (Table 5.3 and Table 5.4). High correlations between two and five-year impact factors were because of the similar technical definitions with 98 percent of overlapping effects (Table 5.5) In the context of Malaysian journals, DIFUCS plays a significant role in

explaining the effective changes of journal rankings compared to the five- year impact factor that can only be served as the complementary method to the two- year impact factor.

Among all, the most significant indicator that can be used to evaluate both short and long-term performance for Malaysian journals was a normalized version of DIFUCS. It has indicated the non-overlapping effects (62 percent) in revealing their "true" scientific performance and fairness based on a FA (Table 5.5). DIFUCS has the capacity to eliminate the general biases of the SIF that deals with short-term windows as it deals with only citations of full-length articles and with lagged years. The reliability of the latter can be seen by tracking the upward and downward movement of journal rankings (Garfield, 1998).

Table 5.6: Synchronous impact factors, Diachronous impact factors and total publications of ISI-indexed journals in Philippines

Domestic Journal Name	SIF-2	SIF-5	TC	NSC	SC	TP
Asia Life Sciences	0.18	0.142	112	79	33	346
Journal of Environmental Science and Management	0.103	0.11	46	37	9	114
Philippine Agricultural Scientist	0.368	0.336	737	599	138	714
Philippine Journal of Crop Science	0.039	0.163	88	55	33	215

Source: WOS database, ISI (1980-June 5, 2015)

Table 5.7: Diachronous impact factors of ISI-indexed journals in Philippines

Domestic Journal Name	DIFUCC	DIFCO	DIFUCS	DIFUCSC
Asia Life Sciences	0.12	0.49	0.18	0.12
Journal of Environmental Science and Management	0.15	0.59	0.25	0.21
Philippine Agricultural Scientist	0.09	0.95	0.46	0.11
Philippine Journal of Crop Science	0.11	0.50	0.20	0.13

Source: Author's computations

	DIFUCC	DIFCO	DIFUCS	DIFUCSC	SIF-2	SIF-5
DIFUCC						
DIFCO	-0.40					
DIFUCS	-0.40	1.00**				
DIFUCSC	0.80	-0.20	-0.20			
SIF-2	-0.40	0.40	0.40	-0.80		
SIF-5	-1.00**	0.40	0.40	-0.80	0.40	

** Significant at 0.05(5%). This refers to Spearman rank correlation.
Source: Author's computations

(b) The Philippines

Table 5.6 shows the SIFs, DIFs and total publications of domestically owned ISI-indexed journals in the Philippines. Based on Table 5.6, it can be observed that the SIFs refer to 2-year impact factor and 5-year impact factor. All the DIFs were computed based on the indicators such as total citations, self-citations, and non-self citations over the periods. All the domestically owned ISI-indexed journals in the Sciences are Asia Life Sciences, Journal of Environmental Science and Management, Philippine Agricultural Scientist and Philippine Journal of Crop Science.

With reference to Table 5.6, Philippine Agricultural Scientist has the highest number of 2-year impact factor (0.368), 5-year impact factor (0.336), total citations (combinations of self citations and non-self citations) (737) and non-self citations (599). The values of total citations and non-self citations have indicated that there is a higher level of scientific visibility of issues within scientific publications that are located within Philippine Agricultural Scientist. In this case, the most suitable indicator or proxy that can be used to detect the long-term performance of domestically owned ISI-indexed journals in the Philippines was DIFNSC. It has the capability of detecting and evaluating the scientific visibility of issues within the scientific publications that are located within journals in the Philippines.

Table 5.7 reflects the DIFs based on unique citing countries, citing organizations, unique citing sources and unique subject categories among domestically owned ISI-indexed journals in the Philippines. Through the utilization of Table 5.7, it can be inferred that Journal of Environmental Science and Management has the highest number of DIFUCC (0.15), and DIFUCSC (0.21).

The non-parametric approach of correlation test (Spearman rank correlation) was employed due to the nature of skewed counts of citations and citing agents (Table 5.6 and Table 5.7). Although the five-year impact factor shares a similar technical definition with two-year impact factor, it deals with small portions of overlapping effects with 40 percent (Table 5.8). In the context of journals in the Philippines, DIFs based on citing organization, and unique citing sources serve as the alternatives to the ISI impact factor and it plays a significant role in explaining the effective changes of journal rankings.

DIFCO and DIFUCS have the capacity to eliminate the general biases of the SIF that deals with short-term windows as it deals with only citations of full-length articles and with lagged years. The reliability of the latter can be seen by tracking the upward and downward movement of journal rankings (Garfield, 1998).

Table 5.9: Synchronous impact factors, Diachronous impact factors and total publications of ISI-indexed journals in Thailand

Domestic Journal Name	SIF-2	SIF-5	TC	NSC	SC	TP
Asian Biomedicine	0.163	0.206	713	561	152	834
Asian Pacific Journal of Allergy and Immunology	1.255	1.17	4724	4319	405	1096
Buffalo Bulletin	0.06	0.21	152	109	43	654
Chiang Mai Journal of Science	0.418	0.531	638	487	151	579
Maejo International Journal of Science and Technology	0.329	0.45	461	407	54	312
Scienceasia	0.347	0.541	771	746	25	490
Southeast Asian Journal of Tropical Medicine And Public Health	0.546	0	2042	1896	146	1057
Thai Journal of Veterinary Medicine	0.123	0.119	291	216	75	715

Source: WOS database, ISI (1980-June 5, 2015)

Table 5.10: Diachronous impact factors of ISI-indexed journals in Thailand

Domestic Journal Name	DIFUCC	DIFCO	DIFUCS	DIFUCSC
Asian Biomedicine	0.08	0.88	0.45	0.14
Asian Pacific Journal of Allergy And Immunology	0.11	3.36	1.32	0.14
Buffalo Bulletin	0.04	0.26	0.09	0.04
Chiang Mai Journal of Science	0.12	1.14	0.62	0.19
Maejo International Journal of Science and Technology	0.22	1.68	0.93	0.32
Scienceasia	0.15	1.94	1.03	0.24
Southeast Asian Journal of Tropical Medicine And Public Health	0.12	2.36	0.70	0.13
Thai Journal of Veterinary Medicine	0.08	0.52	0.20	0.10

Source: Author's computations

Table 5.11: Correlation between Diachronous and Synchronous impact factors of ISI-indexed journals in Thailand

	DIFUCC	DIFCO	DIFUCS	DIFUCSC	SIF-2	SIF-5
DIFUCC						
DIFCO	0.63					
DIFUCS	0.72**	0.93**				
DIFUCSC	0.87**	0.47	0.68			
SIF-2	0.53	0.93**	0.81**	0.40		
SIF-5	0.34	0.41	0.64	0.56	0.41	

** Significant at 0.05(5%). This refers to Spearman rank correlation.
Source: Author's computations

(c) Thailand

Table 5.9 shows the SIFs, DIFs and total publications of domestically owned ISI-indexed journals in Thailand. Based on Table 5.9, it can be observed that the SIFs refer to 2-year impact factor and 5-year impact factor. All the DIFs were computed based on the indicators such as total citations, self-citations, and non-self citations over the periods. All the domestically owned ISI-indexed journals in the Sciences are Asian Biomedicine, Asian Pacific Journal of Allergy and Immunology, Buffalo Bulletin, Chiang Mai Journal of Science, Maejo International Journal of Science and Technology, Scienceasia, Southeast Asian Journal of Tropical Medicine and Public Health, and Thai Journal of Veterinary Medicine.

Table 5.9 has indicated that Asian Pacific Journal of Allergy and Immunology has recorded the highest number of 2-year impact factor (1.255), 5-year impact factor (1.17), total citations (combinations of self citations and non-self citations) (4724), and total non-self citations (4319). The values of total citations and non-self citations have indicated that there is a higher level of scientific visibility of issues within scientific publications that are located within Asian Pacific Journal of Allergy and Immunology in the long-term. In this case, the most suitable indicator or proxy that can be used to detect the long-term performance of domestically owned ISI-indexed journals in Thailand was DIFNSC. It has the capability of detecting and evaluating the scientific visibility of issues within the scientific publications that are located within the mentioned journal in Thailand.

Table 5.10 reflects the DIFs based on unique citing countries, citing organizations, unique citing sources and unique subject categories among domestically owned ISI-indexed journals in Thailand. Through the utilization of Table 5.10, it can be asserted that the Maejo International Journal of Science and Technology has the highest number of DIFs based on unique citing countries (0.22) and unique citing subject categories (0.32). Asian Pacific Journal of Allergy and Immunology has the highest level of scientific visibility among local and international organizations and unique sources through higher value of DIFCO and DIFUCS.

The non-parametric approach of correlation test (Spearman rank correlation) was employed due to the nature of skewed citation counts (Table 5.9 and Table 5.10). Although the five- year impact factor have shared similar technical definition with the two- year impact factor, it deals with small portions of overlapping effects with 41 percent (Table 5.11). In the context of journals in Thailand, DIFUCSC serves as the alternative to the ISI impact factor. It plays a significant role in explaining the effective

changes of journal rankings compared to the role of DIFUCS as the complementary method to the classical two-year impact factor.

DIFUCSC has the capacity to eliminate the general biases of the SIF that deals with short-term windows as it deals with only citations of full-length articles and with lagged years. The reliability of the latter can be seen by tracking the upward and downward movement of journal rankings (Garfield, 1998).

5.4 RESULTS AND ANALYSIS FOR ISI JOURNALS IN ECONOMICS

This section examines the nature and differences of SIF and DIF among the ISI-journals in Economics. This section also examines the approaches of impact factors among ISI-indexed journals that was utilized by ASEAN member states such as Malaysia, Singapore, Thailand, Philippines and Indonesia. Table 5.12, Table 5.14 and Table 5.15 were included in APPENDIX E. This section looks into the applicability of diachronous impact factors in influencing the scientific visibility of ISI-indexed journals in Economics that was utilized by Malaysia, Singapore, Thailand, Philippines and Indonesia. The ISI-indexed journals in Economics were Value in Health, American Journal of Agricultural Economics, Hitotsubashi Journal of Economics, Ecological Economics, Technological and Economic Development of Economy, Journal of Finance and others. This also involves Journal of Financial Economics, Journal of Econometrics, Journal of Public Economics, Journal of Monetary Economics, Journal of Banking & Finance and others. The results for ISI-indexed journals in Economics were extracted from own publication (Krishna et al., 2015).

Table 5.13: Characteristics of first comer and latecomer ISI-indexed journals, 1980-2013

	First comer journals[a]	Latecomer journals[b]
Average Impact factor (2 year)	1.36	0.92
Total Publications	235,703	118,869
Median (total citations)	15291	794
Median (Self citations)	1202	121
Median (Non-self citations)	13998	660
Minimum (Publications)	399	39
Maximum (Publications)	11412	23735
Median (Publications)	1961	288
Median(CCI)	0.30	0.19
Maximum(CCI)	0.69	0.59
Minimum(CCI)	0.09	0.00
Median(Citing articles)	10993	624
Maximum(Citing articles)	165736	34611
Minimum(Citing articles)	336	3
Median(Non-self citing articles)	10439	480
Maximum(Non-self citing articles)	161985	32042
Minimum(Non-self citing articles)	178	1

[a] First comer journals consists of ISI-indexed journals that have life expectancy of 34years (2013-1980).
[b] Latecomer journals consists of ISI-indexed journals that have life expectancy of 24 years (2013-1990) or less than 24 years

Source: Author's computations

Table 5.12 (APPENDIX E) illustrates the list of first comer and latecomer journals in Economics. Table 5.13 summarizes the quantitative descriptions of first comer and latecomer journals in Economics. Among first comers, American Journal of Agricultural Economics has the maximum and Hitotsubashi Journal of Economics has the minimum number of publications. American Economic Review deals with the highest number of citing articles with non-self citations. Among first comer journals, Journal of Finance has the highest CCI; Australian Economic Papers has the lowest CCI. Among latecomers, Value in Health has the maximum publications and its citations exceeded the first comer journal. Hacienda Publica Espanola-Review of Public Economics has lower publications compared to Hitotsubashi Journal of Economics. Ecological Economics has the highest number of citing articles with the highest number of non-self citations. It is much lower compared to first comer journal. Technological and Economic Development of Economy leads the concentration on citing articles

whereas Revista de Historia Industrial, Korean Economic Review, Economia Mexicana-Nueva Epoca, and Custos e Agronegocio on Line have no concentration on citing articles. This shows that most latecomer journals concentrate on the citations received from few citing articles compared to first comers.

Only five out of the 20 most cited journals in Economics are sold commercially such as Journal of Financial Economics, Journal of Econometrics, Journal of Economy Theory, Journal of Public Economics, and Journal of Monetary Economics (Bergstrom, 2001). Tables 5.14 and 5.15 (APPENDIX E) indicate the list of ISI journals in Economics based on affiliated and non-affiliated subject categories. Journals with affiliated subject categories include in disciplines, such as finance, business, environmental studies, Sociology and law, whereas journals with non-affiliated subject categories focus only on Economics. Only 42 and 101 first comer and latecomer journals respectively, are linked to affiliated subject categories such as Journal of Finance, Journal of Financial Economics, Small Business Economics, and Ecological Economics whereas 52 and 107 first comer and latecomer journals respectively are related to Economics such as Journal of International Economics, Journal of Post Keynesian Economics, American Economic Review, Technological and Economic Development of Economy, Economic Systems Research, and others. Some of the stated journals were utilized by Malaysia, Singapore, Thailand, Philippines, and Indonesia.

Table 5.16: Distribution of Synchronous and Diachronous impact factors for First comer and Latecomer journals

Variable	Kolmogorov-Smirnov P-value	Shapiro-Wilk P-value
(a) First comer journals		
SIF-2	0.00**	0.00**
SIF-5	0.00**	0.00**
DIFNSC	0.00**	0.00**
DIFCCI	0.20	0.04**
DIFJEI	0.00**	0.00**
(b) Latecomer journals		
SIF-2	0.00**	0.00**
SIF-5	0.00**	0.00**
DIFNSC	0.00**	0.00**
DIFCCI	0.00**	0.00**
DIFJEI	0.00**	0.00**

** Significant at 0.05(5%)
Source: Author's computations

Table 5.17: Correlation between Synchronous and Diachronous impact factors for First comer and Latecomer journals

	SIF-2	SIF-5	DIFNSC	DIFCCI	DIFJEI
(a) First comer journals					
SIF-2					
SIF-5	0.97**				
DIFNSC	0.81**	0.86**			
DIFCCI	0.35**	0.31**	0.31**		
DIFJEI	0.78**	0.78**	0.81**	0.34**	
(b) Latecomer journals					
SIF-2					
SIF-5	0.95**				
DIFNSC	0.74**	0.81**			
DIFCCI	0.42**	0.34**	0.34**		
DIFJEI	0.60**	0.65**	0.85**	0.48**	

** Significant at 0.05(5%)
Source: Author's computations
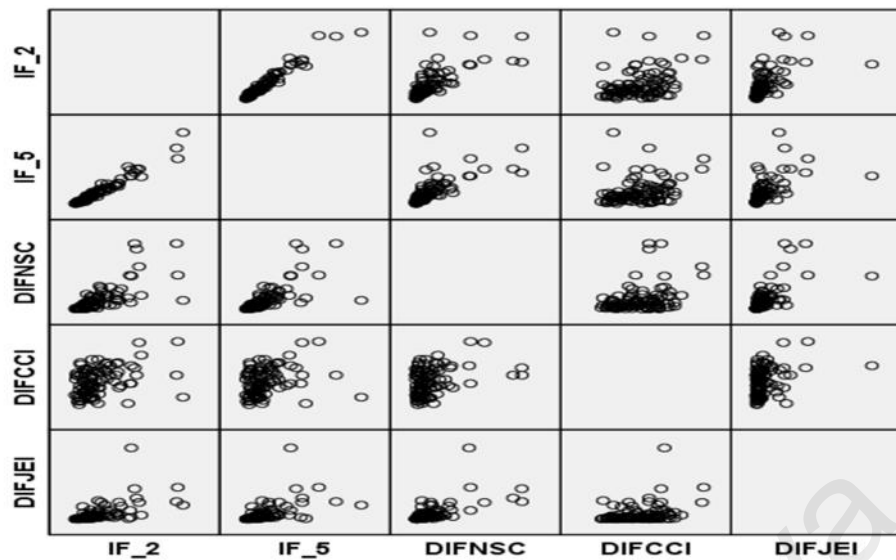
Figure. 5.2: Matrix Scatter plot of impact indices for first comer journals
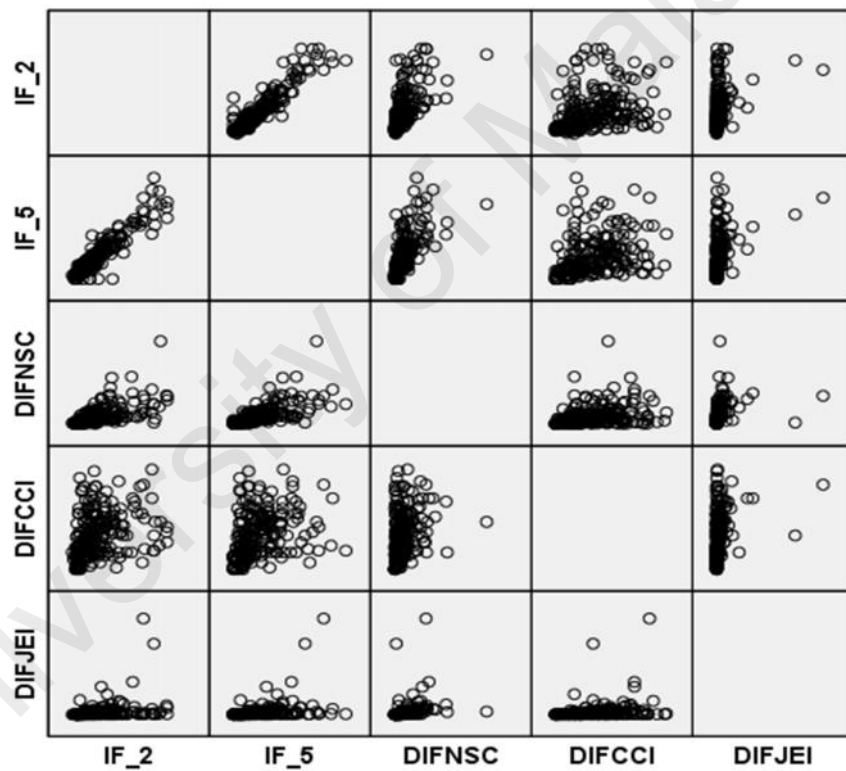
Figure 5.3: Matrix Scatter plot of impact indices for latecomer journals

The selected indices for both groups of journals are not normally distributed due to the pattern of heterogeneity among highly skewed citations (Refer to Table 5.16 and APPENDIX C). Hence, the non-parametric approach of correlation test (Spearman rank correlation) (Refer to Table 5.17, Figure 5.2 and Figure 5.3), Mann-Whitney U-

Wilcoxon W test and Friedman test were employed to test the strengths, and differences of impact indices between and within the journals.

The high correlation between two-year and five-year impact factors was observed for both first comer and latecomer journals. It is because they are consistent with their technical definitions (Table 5.17). In addition, 72 to 81 percent of the correlations were observed between the 2-year impact factor and the selected diachronous indices except for CCI for both groups, though, their technical interpretations are not the same (Table 5.17). This is because the DIFs have captured partial citations and publications over two years (2011and 2012) of the selected journals.

Table 5.18: Changes in the ranks of journals between 2-year impact factor and 5-year impact factor for First comer and Latecomer journals

Changes in rank	Number of journals
(a) First comer journals	
+1	11
-1	2
(b) Latecomer journals	
+1	22
-1	25
+2	1
-2	3
-3	2

Source: Author's computation

Table 5.19: Differences of Synchronous and Diachronous impact factors between First comer and Latecomer journals

		Mean ± SD	P-value [a]
SIF-2	FC	1.36 ± 1.28	0.00**
	LC	0.92 ± 0.77	
SIF-5	FC	1.98 ± 1.98	0.00**
	LC	1.14 ± 0.99	
DIFNSC	FC	12.54 ± 17.48	0.00**
	LC	4.02 ± 4.93	
DIFCCI	FC	0.31 ± 0.13	0.00**
	LC	0.21 ± 0.14	
DIFJEI	FC	1725751.60 ± 3166676.78	0.00**
	LC	101148.21 ± 355322.30	
SIF-2, SIF-5, DIFNSC, DIFCCI, DIFJEI	FC	-	0.00[b]**
	LC	-	0.00[b]**

[a] obtained from Mann-Whitney U-Wilcoxon-W test. [b] obtained from Friedman test
** Significant at 0.05(5%)
Source: Author's computations

Although there was a high correlation between the two- and five-year impact factors, small changes in journal rankings were still observed among 66 scientific journals in which the significant changes were identified in 53 latecomer journals (Table 5.18 and Table 5.19). Impact improvements were observed among 23 latecomers compared to 11 first comers, while impact deteriorations were observed among 30 latecomer journals and only two first comers (Table 5.18). Impact neutrality (zero change in journal ranking) was observed among the remaining 236 journals in which majority were first comer journals. Among the latecomer journals that showed significant positive and negative changes in impact were the Journal of Economic Surveys, Journal of Risk and Uncertainty, Cambridge Journal of Regions Economy and Society, Industrial and Corporate Change, Oxford Review of Economic Policy, European Journal of Health Economics and others. From here, it can be seen that a five-year impact factor is a complementary method for first comers whilst it serves as an alternative indicator for latecomer journals to measure their short-term performance. This influences the past trends of scientific visibility on ISI-indexed journals that were utilized by researchers from Philippines and Singapore.

Table 5.20: Changes in the ranks of journals between 2-year impact factor and Diachronous impact factor based on non-self citations for First comer and Latecomer journals

Changes in rank	Number of journals
(a) First comer journals	
+1	32
-1	9
+2	2
(b) Latecomer journals	
+1	40
-1	41
+2	4
-2	15

Source: Author's computations

Significant differences in the rankings were observed among 143 first comer and latecomer journals (94% of total journals) when comparing the two-year impact factor and the non-self citations (see Table 5.19 and Table 5.20), which shows correlation effects of 74 and 81 percent between the two indices for both groups. It shows that DIFNSC favors both first comer and latecomer journals, but, more priority has been given to latecomers (Table 5.20). Impact improvements were observed among 44 latecomer journals compared to 34 first comers, while impact deterioration was observed among 56 late and nine first comer journals (Table 5.20). Among the latecomer journals that experienced significant changes in the rankings were Journal of Risk and Uncertainty, Mathematical Finance, Industrial and Corporate Change and Journal of Economic Surveys. This has the capacity of influencing the current and future trends of scientific visibility on ISI-indexed journals that were utilized by researchers from Philippines and Singapore.

Table 5.21: Changes in the ranks of journals between 2-year impact factor and Diachronous impact factor based on the journal energy index for First comer and Latecomer journals

Changes in rank	Number of journals
(a) First comer journals	
+1	87
-1	51
+2	17
- 2	30
+3	1
- 3	5
(b) Latecomer journals	
+1	32
- 1	46
+ 2	1
- 2	30
+ 3	1
- 3	5

Source: Author's computations

For DIFJEI, the generation of positive energy in terms of impact improvement was observed among 34 latecomers compared to 105 first comers whereas negative energy through impact deterioration was seen among 81 latecomers compared to 86 first comers (Table 5.19 and Table 5.21). The changes of rankings through DIFJEI are almost consistent with the remaining indices except DIFCCI due to the high correlations between them. It favors first comers rather than latecomers as the former has the capacity to show the dual momentum of positive and negative energies of performance among the significant first comers are Economics Letters, American Journal of Agricultural Economics, Journal of Economic Theory, European Economic Review, Journal of Banking & Finance, and Applied Economics. This influences the current and future trends of scientific visibility on ISI-indexed journals that were utilized by researchers from Malaysia, Thailand, Indonesia, Singapore and Philippines.

Table 5.22: Changes in the ranks of journals between 2-year impact factor and Diachronous impact factor based on the citation concentration index for First comer and Latecomer journals

Changes in rank	Number of journals
(a) First comer journals	
+1	22
-1	14
+2	7
-2	4
3	6
-3	1
(b) Latecomer journals	
+1	33
-1	41
+2	16
-2	19
3	5
-3	10

Source: Author's computations

Table 5.23: Differences of 2-year impact factor and Diachronous impact factor based on the total citations between First comer and Latecomer journals based on subject categories

	First comer journals			Latecomer journals			P-value[1]	P-value[2]
	SIF-2	DIFTC	N	SIF-2	DIFTC	N		
Subject Affiliated	1.33	30167	52	1.00	3986.7	107	0.00**	0.12
Non-Subject Affiliated	1.38	36600	DIF-IF-42	0.84	2049.8	(DIF-101) (IF-100)	0.00**	0.02**

[1] obtained from Mann-Whitney test based on the values of DIFTC. [2] obtained from Mann-Whitney U-test based on the values of SIF-2.DIFTC is DIF that refers to the total citations in all the years of publications within selected journals.
** Significant at 0.05(5%)
Source: Author's computations

Almost all the diachronous indices highlight the significant biases among the latecomer journals compared to first comers. Among all, the most significant indicator that can be used to evaluate both short and long-term performance for both journals is DIFCCI (Table 5.19 and Table 5.22). It has supported 60 and 57 percent of late and first comer journals in revealing their "true" scientific performance and fairness based on an FA. Through the evaluation of the performance of journals using the index, it can be seen that both older and latecomer journals perform better in expanding citations. While the older gains the higher degree of popularity and recognition, they also provide space

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for newer or later comer journals to build up their reputation by using the former as a benchmark. In other words, the First-Latecomer approach offers a win-win situation for both older and newer journals. Table 5.23 indicates some biases that can be seen between first comer and latecomer journals in the context of subject categories. The SIF only favors the first comer journals with affiliated and non-affiliated subject categories such as Journal of Finance and Journal of Financial Economics due to the advantage of early scientific recognition. The clear biases between the first comer and latecomer journals can be evaluated through the significant differences of DIFs and highest momentum of reflection goes to first comers rather than latecomers such as Value in Health, and Technological and Economic Development of Economy. DIFCCI was considered as an effective proxy to measure the short-term and long-term scientific visibility of Value in Health, Technological and Economic Development of Economy, and others. DICCI has the capacity of monitoring the scientific visibility of ISI-indexed journals that were utilized by the researchers from Malaysia, Singapore, Thailand, Indonesia and Philippines.

DIFCCI has the capacity to eliminate the general biases of the SIF that deals with short-term windows as it deals with only citations of full-length articles and with lagged years. The reliability of the latter can be seen by tracking the upward and downward movement of journal rankings using Garfield (1998). As it can be seen the existing impact factor distorts the scientific fairness (Ingwersen et al. 2001) among the older and newer journals. Older journals may have accumulated higher citations on their scientific contents because of the higher degree of recognition based on concepts or issues. Newer journals may not have gained enough citations due to the lack of recognition. Under this proposed framework, they would have more time to catch up with older journals by building their own scientific citation base and international recognition. The latter

strategy can be done by considering the life expectancy of publications that are based on diachronous or continuous timing of citations.

In addition, the bias introduced by the ISI impact factor can be seen in the concentration of the scientific documents. The current impact factor only takes up citations from full-length articles, while ignoring other scientific documents, such as, conference proceedings, article reviews, book reviews and others. DIFCCI has taken up citations of all the stated scientific documents for evaluating the scientific concentration among the first comer and latecomers. DIFCCI is normalized by adjusting for the variations of issues, number of indexed publications and affiliated subject categories within the selected ISI journals in Economics. The existing impact factor does not have serious concerns on the affiliated and non-affiliated subject categories.

This thesis is different from Lu, et al. (2014) and Ajiferuke and Wolfram (2010) in terms of the sampling period of investigation, citation-citer analysis, life expectancy, concentration of subject category, and the concepts of First-Latecomer advantages. The contribution of this paper is from the perspective that it has analyzed the real short-term and long-term performance of ISI-indexed journals in Economics by taking care of the life expectancy of publications, a concept of First-Latecomer advantages and development of DIFCCI and DIFJEI.

Overall, this exercise shows that the assessment of performance among scientific journals should not be based on just one dimension. It should be based on multi-dimensions (Vanclay 2009). It can then be validated through evaluations using the journal diffusion factors (Frandsen 2004; Rowlands 2002), Citer analysis (Ajiferuke and Wolfram 2010; Lu et al. 2014), and other related indices. The main limitations of this exercise are stated as follows: firstly, it deals with only citations through comparisons

using the SIF and the DIF; second, it focuses on the evaluation of the characteristics among ISI-indexed journals in a single subject category.

5.5 SUMMARY

This analytical chapter seeks to provide answers to the following thesis question:-

(a)   Can the Diachronous impact factor be a "complementary" or substitute" to the Synchronous impact factor among domestically owned ISI-indexed journals and ISI-indexed journals in Economics in the case of selected ASEAN member states?

The thesis question in this analytical chapter has formulated the following thesis hypotheses:

H_5:   The diachronous impact factor serves as a "substitute" to the Synchronous impact factor among ISI journals in Economics.

H_6:   The diachronous impact factor serves as a "substitute" to the synchronous impact factor among domestically owned ISI-indexed journals in developing ASEAN member states.

Although ISI's JIF is widely used in evaluating the performance of scientific journals, it has come under heavy criticisms in terms of its technical and practical aspects of evaluations. These drawbacks of the traditional impact factors have resulted in proposals for new indicators as a replacement for the old indicator. In general, the DIF offers a good alternative evaluation method for journals as it promotes the scientific fairness among scientific journals in which it maintains the effective facilitation of resources for research funding. The Synchronous approach offers a complementary instrument for evaluating short-term performance and permanent impact of publications among first comers. The evidence shows that these approaches can provide an

opportunity for latecomers to improve their short and long-term scientific performances as the FA ignores citation lags.

The overall investigations are limited in terms of discussions on the different segments of citations, the issues of co-citations, lack of content appreciations through intellectual dishonesty and different structures of research visibility.

Table 5.24: Features of Synchronous and Diachronous approaches of impact factors

	Synchronous Approach	Diachronous Approach
Years of investigation	Fixed years	Flexible years
Performance Evaluation	Short-term performance	Short and Long-term performance
Scientific document	Only full-length articles	All the scientific documents, including conference proceedings and reviews
Lagged structure of years	Yes	No
Usefulness	Only favors first comer journals.	Priority will be given to latecomer journals but first comer journals will also be considered for impact evaluation.
Advantages	(a) It can be used mostly by first comer journals to evaluate the past performance of their publications. (b) It can capture the permanent impact of journals. (c) It can evaluate the short-term performance from present to past via backward approach	(a) It can be used by first comer and latecomer journals to evaluate the past, current and future performance of their publications. (b) It can capture the actual impact of journals. (c) It can evaluate the short and long-term performance from present to present and future via FA.
Disadvantages	(a) No continuous changes of citations as the focus is mainly on BA (b) Focus is only on full-length articles (c) The basic technical aspects neglect issues or titles and keywords.	(a) The basic technical aspects have not explored the usage of issues, titles and keywords within the computations although there is a way to deal with it.

Source: Author

Table 5.24 illustrates the features of Synchronous and diachronous approaches of impact factors via various aspects of evaluations such as years of investigations, performance evaluation, scientific documents, and lagged structure of years, usefulness, advantages and disadvantages. The Synchronous approach is more applicable to the scientific investigations on the short-term performance of citations or citing agents that are tied to fixed timing; it favors most of the first comer journals that have created their

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citation system from the early stage. It is often called the classical approach as it evaluates the citations from present to past via backward dimension. The diachronous approach is more suitable and applicable to the scientific investigations on short-term and long-term performance or citing agents that are consistent with continuous timing, and it favors both first comers and latecomers, but more priorities are given to latecomers who have just started to create their citation system.

In general, this analytical chapter has confirmed the validity of the stated hypotheses, and the DIFs have served as a substitute to the classical impact factors among ISI-indexed journals in developing ASEAN member states and ISI-indexed journals in Economics. This has also indicated that DIFs will be able to detect the scientific visibility of contents within publications in ISI-indexed journals owned by developing ASEAN member states in the Sciences, namely, Malaysia, Thailand and Philippines. This will also influence the visibility of ISI-indexed journals utilized by ASEAN member states: Malaysia, Singapore, Thailand, Indonesia and Philippines.

Future research should examine the segregated effects of the unique heterogeneous agents (authors, institutions, funding agencies, research areas, subject categories, and research grants) on changes in journal rankings among ISI-indexed journals in the different subject categories. In this way, the interactional effects between diachronous impact factors, and theories of micro-meso-macro and meso trajectory phases of Innovation could be further explored.

CHAPTER 6: CONCLUSION

6.1 INTRODUCTION

The thesis frames the important scientific contents: scientific collaborations, SNSs and JIFs based on the need to maintain the effectiveness of resource allocations that can maximize the critical direction of research assessment. The thesis aims to investigate the significance of local and international collaboration between authors and institutions in Malaysia and the other ASEAN member states to highlight the flow of Absolute and comparative advantages. Besides that, the thesis also looks into the need for using the social network for enhancing research exposure through research visibility, dissemination of research issues and scientific publications instead of just using it for social connections. The issue of the contradiction that results from current citations is also explored. The three analytical chapters show the data as well as the possible solutions to areas of study undertaken. The following thesis questions are explored in this thesis:

(a) What are the characteristics of local and international scientific collaborations among most productive authors and institutions in Malaysia and the other ASEAN member states?

    (i) What are the behaviors of rates and strengths of scientific collaborations among most productive authors and institutions in Malaysia?

    (ii) Are there significant differences in rates and strengths of scientific collaborations between most productive authors in Malaysia?

    (iii) Are there significant differences in rates and strengths of scientific collaborations between most productive institutions in Malaysia?

    (iv) What are the behaviors of rates and strengths of scientific collaborations between Malaysia and the other ASEAN member states?

(b)   Can the SNSs influence research exposure among ASEAN research participants?

(c)   Can the diachronous impact factor be a "complementary" or "substitute" for the synchronous impact factor among ISI-indexed journals owned and utilized by ASEAN member states?

   (i)   Can the Diachronous impact factor be a "complementary" or "substitute" for the Synchronous impact factor among ISI-indexed journals owned by developing ASEAN member states in the Sciences?

   (ii)   Can the Diachronous impact factor be a "complementary" or "substitute" for the Synchronous impact factor among ISI-indexed journals utilized by selected ASEAN member states in Economics?

These thesis questions led to a set of hypotheses that were tested by statistical and bibliometrics techniques. The hypotheses tested were:

H_1:   There are significant differences in rates and strength of scientific collaborations between most productive authors in Malaysia.

H_2:   There are significant differences in rates and strength of scientific collaborations between most productive institutions in Malaysia.

H_3:   There is limited scope for local scientific collaborations between Malaysia and the other ASEAN member states.

H_4:   The utilization of SNSs enhances research exposure among ASEAN research participants.

H_5:   The diachronous impact factor serves as a "substitute" for the synchronous impact factor among ISI journals in Economics.

H$_6$: The diachronous impact factor serves as a "substitute" for the synchronous impact factor among domestically owned ISI-indexed journals in developing ASEAN member states.

Significant differences in both rates and strengths of scientific collaborations were observed among most productive authors in Malaysia except for most productive institutions in Malaysia. The implicit meaning of the scientific collaboration is that most of the Malaysian researchers prefer to get in touch with researchers who have the highest number of scientific publications. The scientific CR among the local and international institutions are still low due to poor networking capacity among local researchers. The patterns of scientific collaborations between Malaysia and the other ASEAN member states are low because of limited talent' identifications in joint papers. These results satisfy the first two of the three hypotheses on scientific collaborations.

It is observed that there are avenues or positive trends via SNSs such as Facebook and LinkedIn for expanding the space for most of ASEAN research participants to enhance their research exposure through various intellectual engagements on research activities with international researchers from Pakistan, the US, Australia, and the UK. The contradictory thoughts on the single function of SNSs by scholars are refuted by the arguments on multidimensional levels of research functions among the SNSs through Socimetrics (measurement of SNSs). It has been shown that Malaysia is the best participating ASEAN country that has promoted the positive effects between research groups, research elements, research visibility and scientific publications, although the effects are not so strong. These results support the fourth hypothesis on the research influence of SNSs.

It has been shown that DIFs based on unique citing sources, citing organizations, and unique citing subject categories can be used to explain the fairer assessment of short

and long-term scientific performance of ISI among domestically owned ISI-indexed journals in Malaysia, the Philippines, and Thailand. The DIFCCI can be utilized to provide equal scientific treatment of performance between first comer and latecomer journals in Economics. DIFs have the full capacity to overcome all the drawbacks of the classical ISI impact factor. The results support the fifth and sixth hypotheses of this thesis.

This thesis produced contributions in different aspects-

(a)   Utilization of qualitative and quantitative techniques to evaluate the research discussions within the social networking sites

(b)   Qualitative baseline for the development of the virtual collaboration system via webinar and Skype

(c)   Baseline for the implementation of the research monitoring system within SNSs

(d)   Development and proposals of impact indicators based on the original version of the diachronous model. The proposals for diachronous impact factors involve the interaction between micro, meso and macro.

The results have revisited and challenged some of the existing works on related research issues. This is discussed in the following three sections. The next sections are organized as follows: theoretical implications, policy implications, recommendations for future research.

6.2 THEORETICAL IMPLICATIONS

Although the issues of local and international collaborations, impact factors of ISI-indexed journals, and research influence of social media have been analyzed thoroughly in the literature, most of these discussions are only limited to the classical

interpretations of aggregated scientific collaborations, JIFs, and social media. The existing research elements offer limited knowledge that can narrow the policy directions and reduce the maintenance of scientific fairness within resource allocation.

The multidimensional perspective of scientific collaborations, JIFs, and research influence of SNSs has offered systematic and robust results. Most of the existing discussions have so far explored various patterns of co-authorship and multi-authorship in terms of local and international collaborations between authors, institutions and countries only in specific fields of research without the investigation on most productive scientific researchers and collaborators. The overall discussions on the behavior of scientific co-operations between most productive authors, institutions, and their scientific collaborators add values to the theory of collaboration through the additional thoughts on the strategies for the selection of collaborators, and scientific behavior of top performing agents (authors and institutions). The results in the first analytical chapter. It is reflected in the variations in the mean values of CR and relative collaborations. Most productive authors maximize their scientific utilities in terms of research reputation of publications by choosing top collaborators as the most influential group for their scientific collaborations. This is followed by their action of penalizing and avoiding new comers from being the significant collaborators. This is consistent with the Revealed Preference Theory (Samuelson, 1938), the theory of Pareto efficiency (developed by Vilfredo Pareto in 1906) and Matthew Effect (Merton, 1988). The flow of knowledge diffusion through scientific collaborations and SNSs depends heavily on the structure of human capital, and comparative and Absolute advantages.

The most important insight of the second analytical chapter on the reliability and validity of SNSs as the research mediators confirm the idea of Altmetrics (Martin & Irvine, 1983). It refutes the classical theory on the single social function of SNSs. The utilization of SNSs has enhanced different types of research exposures in terms of

research visibility, discussion of research issues and virtual collaborative system significantly among Malaysian research participants. This has extended the current version of Altmetrics.

The results of the third analytical chapter show that the DIF serves as an effective indicator to monitor the short and long-term scientific performance of ISI-indexed ASEAN journals, and ISI-indexed journals in Economics It is noted that DIFs based on the multidimensional concepts can provide a fair assessment of the influence on the citations and citers between the first comer and latecomer journals. This refutes the classical theory of citation by Garfield (1955) that is based on single measurement of citations.

It is expected that the overall results of this thesis will open up clearer focus on the virtual scientific communications through SNSs, scientific collaboration, and alternative impact factors based on the multidimensional concept. ASEAN scholars can utilize all the three stated research elements to enhance research exposure and maintain effective facilitation of resource allocations using multidimensional ways. In general, the issues that have been highlighted earlier have dealt with the mono dimension of Sciences and there has been no attempt to look deeply into the connections between Economics theories and different aspects of the Sciences.

This increases the possibility of employing the nature of scientific collaborations and SNSs into the modified structure of knowledge diffusion, the theory of resource allocation and utility preference theory. The weaknesses and strengths of JIFs can be converted into costs and benefits through the theory of costs-benefits analysis. The costs of dealing with SIFs are higher than its benefits because it only favors highly influential journals without really caring much about the quality of contents within the journals.

6.3 POLICY IMPLICATIONS

The results of this thesis offer useful insights in terms of policy implications for scientific policy makers and others. The current scientific policies only prioritize the number of citations and publications as a proxy for research quality, which is classical and biased to the nature of the scientific system. This thesis has several policy implications.

Firstly, this thesis adds values to the effective maintenance of current scientific policies through the incorporation of discussions on the scientific behavior between most productive researchers and scientific collaborators at different levels. This will allow the scientific policy makers to decide on the extent of biases and fairness within scientific system based on First-Latecomer advantages and Matthew effect. Modified Salton measure with time factor evaluates the strength of scientific collaborations between individuals at different levels. The STI policy can incorporate the strategies taken by the most productive authors and institutions to monitor the progress of knowledge diffusion locally and internationally. Besides that, the current STI policy can evaluate the different trends of absolute and comparative advantages gained by most productive authors and institutions over the time. STI policy will be able to monitor most productive research areas and evaluate the subject biasness as the higher level of scientific collaborations were focused only on certain research areas in the Sciences.

Secondly, this thesis includes the discussions on the multidimensional functions of SNSs in enhancing research exposure among ASEAN research participants. This additional inclusion offers opportunities to the scientific policymakers to investigate the trend of growing Altmetrics, as it will be able to serve as an avenue to reflect the virtual scientific visibility within the SNSs. The current STI policy can include the measurement of social networking sites (Socimetrics) to monitor the progress of

intellectual conversation between researchers in Malaysia and international countries through likes, comments and views within research conversations. This will be able to measure the flow of knowledge diffusion on various issues within and external boundaries of research groups on Facebook and LinkedIn. STI policy can consider the citations that have been generated through social networking sites for detecting the scientific visibility of contents and researchers.

Thirdly, it has been discussed that a number of citations is not a proxy for research quality, as it does not differentiate the citations based on the issues and techniques discussed in the research publications. The discussions on the multidimensional JIFs will be useful for the scientific policy makers to monitor the effectiveness of resource allocation, scientific fairness, and interactions between the costs and benefits analysis. STI policy can consider the diachronous approaches to evaluate the short-term and long-term visibility of research issues and researchers over the time. Diachronous approaches will be the benchmark for STI policy to look into the fair research assessment of researchers, scientific publications and institutions.

Various dimensions of scientific collaborations, research influence of social networking sites and different measurements of diachronous impact factors have maintained the effectiveness of Science, Technology and Innovation (STI) policy through knowledge diffusion, efficiency of resource allocations, and theory of social welfare. This will build up effective knowledge based economy. All the measurements have been evaluated on the basis of subjective judgement and it will useful to monitor the progress of sustainability within STI policy through knowledge based economy.

6.4 RECOMMENDATIONS FOR FUTURE RESEARCH

This thesis has focused more on the scientific investigations in ASEAN member countries. Whether the examinations are valid for the rest of the world has to be further

investigated. It is quite clear that this thesis has taken the lead to focus only on Facebook and LinkedIn in detecting the influence of the active usage of SNSs on the enhancement of research exposure among ASEAN participants. The generalizations of results for scientific decisions are questionable because of the limited research sample and coverage of discussions. The discussions on the individual effects of scientific collaborations are just limited to authors, institutions, and ASEAN member states, and it should be extended to broad investigations on different types of collaborations based on the concept of Triple Helix within, and between ISI journals owned by ASEAN member states.

The focus of local and international scientific collaborations was limited to Malaysia, and it should be expanded to different developing and developed countries. The discussions of research virtual system through research groups should be expanded to the remaining SNSs such as Twitter, Skype, and others. Although this thesis has illustrated the modified versions of impact factors based on the diachronous approach, there is still a need to advance the thoughts on the complex connectivity between micro, meso, and macro.

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