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INTERNATIONAL JOURNAL

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The Greater Mekong Subregion Academic and Research Network (GMSARN) was founded followed an agreement among the founding GMS country institutions signed on 26 January 2001, based on resolutions reached at the Greater Mekong Subregional Development Workshop held in Bangkok, Thailand, on 10 - 11 November 1999. GMSARN is composed of eleven of the region's top-ranking academic and research institutions. GMSARN carries out activities in the following areas: human resources development, joint research, and dissemination of information and intellectual assets generated in the GMS. GMSARN seeks to ensure that the holistic intellectual knowledge and assets generated, developed and maintained are shared by organizations within the region. Primary emphasis is placed on complementary linkages between technological and socio-economic development issues. Currently, GMSARN is sponsored by Royal Thai Government.

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Barriers to Border Trade along the East-West Economic Corridor: The Case of Thailand-the Lao PDR Trade on the Border of Mukdahan Province

Pensri Jaroenwanit and Saran Ratanasithi

Abstract— *The objective of this research is to study the barriers impeding trade along the East-West Economic Corridor. The border trade activities between Thailand and the Lao PDR occurring on the border of Mukdahan Province was chosen for this study since this area has been widely accepted as a major entrance not only to Lao PDR but Vietnam basically owing to its geographically advantages. This research employs both qualitative and quantitative research techniques to collect and analyze its data so that the research questions can be answered. It started with compiling qualitative data from various sources and activities prior to operationalizing them via questionnaire survey. Findings show that barriers affecting trade between Thai and Lao PDR can be categorized into three main groups based on sources of these impediments, i.e. barriers induced by overseas economic and political conditions, those derived from factors related to Thai government, and barriers influenced by factors internal to the trading firm. It can be concluded that major sources of border trading barriers are failure of both Thai and Lao public administration to facilitate trade flows between the two countries. Suggestions are thus proposed to Thai central and local governmental authorities to adjust and improve their roles and responsibilities so that we are able to improve border trading performance between the two countries and can expect favorable and sustained consequences of EWEC development project.*

Keywords— **Barriers, Border Trade, East-West Economic Corridor (EWEC), Mukdahan Province.**

1. INTRODUCTION

The end of the Cold War has facilitated the expansion of the Association of Southeast Asian Nations (ASEAN). Within this expanded framework, sub-regions have been formed, among them the Greater Mekong Sub-region (GMS), followed by an Ayerawadi-Chao Praya-Mekong Economic Cooperation Strategy (ACMECS). Though literature provides substantial contribution to our understanding of border trading impediments, review results show that literature has consistently ignored investigating border trading activities in South East Asian, specifically Greater Mekong Sub-region, a region where border trade has flourished and continued at least for a few centuries based on written record. We can hardly afford this ignorance any longer given the fact that this subcontinent is under a strong development plan called East-West Economic Corridor (EWEC) as sponsored by Asian Development Bank (ADB).

The East-West Economic Corridor is both a transport system and a framework for cooperation which connects four out of the six countries in the GMS, namely Union of Myanmar, Thailand, the Lao PDR, and the Socialist

Republic of Vietnam. The main objectives of the EWEC are: to further strengthen economic cooperation between and among the four countries; to reduce transport costs in the corridor and make the movement of goods and people more efficient; and to reduce poverty in the corridor by supporting the development of the rural border areas, increasing earnings of low-income groups, providing employment opportunities, and promoting tourism [1].

The EWEC is the first transportation corridor running the entire width of mainland Southeast Asian, a distance of 1,450 kilometers. Major components of the East-West Economic Corridor completed by 2007 included the second Thai-Laos Friendship Bridge at Mukdahan border checkpoint. Mukdahan Province is located on the bank of the Mekong River and is a crucial part of the East-West Economic Corridor. The Second Thai-Lao Friendship Bridge was opened to traffic in January 2007. It links Mukdahan Province with Savannakhet Province in Lao PDR and serves as part of the road network linking four countries in accordance with the EWEC development initiative. It will also foster economic development, trade, and investment in the region [2]. In 2007, following the opening of the Second Friendship Bridge to traffic, cross border trade between Mukdahan and Savannakhet rose by 100 percent than the previous year, and in August 2008 trade amounted to 2.26 billion baht, an increase of 19 percent than the same period in 2007. Out of this volume, 860 million baht was Thai exports to Laos, while 1,400 million baht involved Thai imports from Laos. The growth rate of trade is likely to continue to increase with more influx of foreign investment; however, some imminent barriers were expected to be found because of an inconsistency of governmental policy of both Thai and Laos. Moreover

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the fact that there are many types of border trading in this sub-region, which are formal trade, informal trade, transit trade and barter trade, [3] even complicates the trading relationship. This research was conducted under the attempts to find out what barriers affect Thai-Laos border trade along the East-West Economic Corridor. It focused on the impediments pertaining to the border trading activities of Thai trading firms. The findings were presented and discussed in the context of the international marketing literature. The implications were then drawn for public and private authorities to improve border trading system and procedures.

2. LITERATURE REVIEW

Attempting to answer the general research question of what barriers affect Thai-Laos border trading by utilizing extant body of knowledge, this section scrutinizes and discusses relevant literature. This knowledge collectively reflect importance of the topic of study and elaborate conceptualization, taxonomy, and relationship of each relevant concept and construct. It includes discussion of 3 basic groups of literature, i.e. border trade, Thai-Laos border trade relationship, and barriers to export. Details of all knowledge are presented as follows.

2.1 Border Trade

To be able to have vivid understanding of obstacles to border trade, it is imperative that we first have a clear illustration of border trading activities in term of its conceptualization, taxonomy, and related issues.

Definition

Office of Commercial Affairs of Chantaburi Province officially defines border trading as various forms of trading among people residing in or business concern incorporated in the borderland area, i.e. village, sub-district, district, or province on the national frontier adjacent to the nation's neighbouring countries [4]. Border trade volume and value are usually small; while its trading process is simple and convenient. Most of goods traded are fundamental products necessary for day to day life, e.g. consumer products, agricultural products, and natural produces collecting from the borderland natural surroundings. Border trading comprises of both legal and illegal trading activities and the legal trading is conducted both through custom process and without passing the custom.

Apart from above definition, border trade is usually characterized by the following aspects. It is a form of international trading which conducting across national border among communities residing along the borders. Border trading is traditional and simple form of international trade exchanging goods that are important in our day to day life basically consumer products [5]. It is traditional in the sense that it has long existed as a part of a walk of life of people living in the borderland; therefore its major objective is not for economic growth but subsistence and relationship of the trading communities. Border trading is simple in the sense that it is basically done via simplest mode of exchange no matter whether negotiation, transportation, or payment. It

is different from the other two forms of international trade, regular and transitional trade, which is conducted principally for economic growth via various and complicated mode of exchange from negotiation, transportation to payment settlement. The regular international trading activities are basically conducted by business entities through massive transportation mode by sea or by air; while in transitional trade, there is a third party nation whose area permitted for transition of traded commodities between two trading nations.

Taxonomy of Border Trade:

Based on whether a specific trading transaction is recorded by custom officer, border trading is classified into two broad groups of recorded or official and unrecorded or unofficial trades.

1. Official recorded trading transaction is a transaction which goes through custom processes and procedures at custom office or border check point; thus is recorded by custom officer. This type of border trade is usually conducted by licensed traders who are registered and officially allowed to perform specified trading transaction.

2. Unofficial unrecorded trading transaction is a transaction which does not go through custom processes and procedures and hence is not recorded in custom database. It is usually a negligible trading amount of consumer goods conducted by individual trading counterparts.

No matter whether it is done officially or unofficially, border trading usually takes place via one of the following four kinds of border passing point [4].

1. Permanent border crossing point is an official border pass which has to be approved by both countries. In the case of Thailand it has to be approved by the cabinet and then Minister of Interior will be authorized to announce and manage the point. At each permanent passing point, every necessary custom procedures and processes for border trading is performed as well as official procedures and processes of individual migration through the crossing point. The purposes of launching any particular permanent points might be due to trading, or general national relationship.

2. Temporary border crossing point is an official border pass which is usually initiated by the Thai side to facilitate the flow of traded goods across the border; therefore, the launching process of the point is shortened. It is under the authority of the ministry of interior to announce any appropriate pass points temporary crossing points. However, this decision has to be approved by the National Security Council. In launching any particular point, there must be a definite time frame of point validity and there must be no negative consequences on national security.

3. Flexible border check point is also an official border pass point but is usually initiated, launched, and operated by provincial authority under agreement and supervision of the Ministry of Interior. The major purpose of permitting flexible pass through the border is

local in nature. It is launched for maintaining and nurturing the trade and traditional relationship between the local communities situated on the borderland for the sake of humanity.

4. Unofficial geographically possible border crossing point is an unofficial pass point where there is no or minimal natural hindrances impeding border crossing. It is regularly a favourite port of all illegal trading.

Issues related to Border Trading

Border trading has conferred many economic benefits to Thailand. It helps improve competitiveness of Thai products in the neighbouring markets in term of advantage transportation costs. Border trading also takes part in spurring economic activities both in Thailand and its neighbouring countries [5]. This consequently improves income and standard of living of the regions with minimum intrusion into traditional walk of life of the trading communities as well as minimal destruction of natural resources.

Moreover, border trading amid Greater Mekong Sub-region has a considerable growth potential at least for two important reasons. Firstly, it accounts for only around 30% of total border trading activities of Thailand [6]. This fact is particularly true for Thai-Laos border trading when border trading between Thailand and the other two neighbours, i.e. Myanmar and Cambodia, is relatively problematic in term of international politics and relationship. Specifically substantial amount of trade along Thai-Myanmar border is illegal drug trafficking directly or indirectly conducted by various armed forces of independent minority groups ruling the borderland, e.g. Mon and Karen. While imminent national conflict between Thailand and Cambodia stemmed from Preah Vihear issue and unsolved border line configuration, occasionally threatens smooth trading relationship between the two countries.

Secondly, EWEC project, initiated and sponsored by Asian Development Bank, is an important economic development project that will help stimulate and facilitate economic corporation among neighbouring countries in the region. EWEC aims to create and improve connectivity and competitiveness of the GMS member nations while maintaining and nurturing regional community. Thailand in particular actively participates in EWEC by aligning its national development strategy to those of EWEC [6]. Reference [7] found that every stakeholder on EWEC development pathway including three Northeastern provinces of Thailand, i.e. Khon Kaen, Kalasin, and Mukdahan, has a positive expectation toward EWEC contribution to regional growth and development. These stakeholders include public and private enterprises, and individual worker in both manufacturing and agricultural sectors. The public offices expected to be affected the most are those related to education, health, social working, transportation, and communication; while those private concerns are various service industries, e.g. wholesale, retail, logistics, and agricultural industries.

2.2 Thai-Lao Border Trade Relationship

This section discusses the following topics, i.e. Lao International Trade and Investment Policy, Lao Trade Policy toward Thailand, and issues of trade and barriers to trade in the Northeastern part of Thailand.

Lao International Trade and Investment Policy

Though Lao economy has not yet fully open to international community, it pursues the following international trade and investment policy [8].

1. Lao government requires that foreign investors open bank account in Laos to be qualified for applying for investing in Laos. This account has to be open by individual person acting on behalf of any applying business concerns and once the permission is offered, the account can be converted to business account. Prospective foreign investors have to also pledge an amount of fund as an investment guarantee so that Lao government is confident in those particular overseas investors.

2. Employment recruitment is required that priority of employment offered to Laotian unless there is no Laotian expert and if employed, those foreign personnel are required to transfer their knowledge and skill to Lao employee.

3. Incentives for foreign investors.

a. Government provides satisfactorily protection for foreign investors and their assets including permission to rent a piece of land and transfer this rent.

b. There will be no confiscation or forced reallocation of assets of foreign investors.

c. Foreign investors will be able to transfer back to their home countries or any specified destination any incomes or benefits generated in Laos.

d. There will be no government intervention on market economy and there will be active government support on free market competition.

e. There will be no discrimination on racial or nationality of foreign investors.

f. It is allowed that foreign investors bring in foreign experts to work in their investment projects.

g. There will be fully support and facilitation on arrival and departure of foreign investors.

h. Laos is granted generalized system of preference privileges from EU on textile and garment which will benefit foreign investors investing in these industries.

i. Laos is an ASEAN member who is obliged under AFTA to reduce and finally eliminate its tariff and non tariff barriers to trade among the member countries.

4. Tax privileges for foreign investors.

a. 2-4 years business income tax exemption depending on types of project.

b. Import tariff reduction to 1% on import capital goods and their components and parts together with raw materials.

c. Preferable business income tax rate of 20% for investment project located in urban areas, 15% for the project located in rural areas, and 10% for the project located in remote areas.

d. Tax exemption on export or re-export products.

e. Tax exemption on raw material imported for export production.

f. Possible tax exemption for mega investment projects.

g. Avoidance of double taxation between Thailand and Laos enable Thai investors to reduce tax burden in case their incomes have been already taxed in Laos.

Lao Trade Policy toward Thailand:

Thai-Laos agreements on trade and investment promotions are as follow.

1. The two countries will cooperate in promoting investment in various sectors, e.g. contract farming projects, construction of agricultural produces processing plants, development of investment estate in Savan-Seno special economic zone, development of Udomchai city to be commodity distribution center, on-route breaking points of land fleet transportation, and modern shopping center. For tourist sector, Thai and Laos will jointly encourage joint venturing between business entities of the two nations to develop trade and investment infrastructures especially en-route number 9 which starting at the second Thai-Laos friendship bridge in Mukdahan Province of Thailand and destine to Savannakhet Province of Laos.

2. There are also transportation and custom cooperation. Thai and Laos will work together to solve border crossing problems and eliminate border trade obstacles. There will be an exchange of custom procedures and processes between the two countries to facilitate flow of goods through the border pass points. Moreover, Thailand will help improving Lao labour productivity based on request of Lao organization. Other assistances are for instance providing academic support for feasibility study of launching a central product market and training Lao officers to support launching of custom single stop inspection at any crowded border crossing points.

3. Thailand will help develop Lao local products and facilitate Lao local entrepreneur participation in international trade show in Thailand.

4. There is also private to private cooperation between Thai and Lao businesses by establishing Thai-Laos Chamber of Commerce. This will lead to business matching and capital joint venturing between business counterparts of the two countries. Moreover, memorandum of understanding was signed for academic cooperation in various disciplines, e.g. agriculture, processed agriculture, cultivation of energy substitution plant, mining, and environment.

Issues and barriers to trade in the Northeastern part of Thailand

There are two most important issues concerned by several seminal works related to trade investment and development in the Northeastern part of Thailand done within the last 5 years. These topics are consequences of EWEC development project and factors related to success of regional economic development. The former basically relates to economic effects of EWEC on regional communities and industries in term of development status or prospect and strategy of provinces, especially Mukdahan, or groups of provinces and industries along EWEC developmental path [7], [20]-[25]. The latter deals with factors related to success of regional economic development led by industrial activities and border trading [23], [26], [27].

For the first issue, overall results indicate that Northeastern provinces along EWEC path, especially Mukdahan, Kalasin, and Khon Kaen, will be centers of most economic activities; therefore will benefit from economic growth and development led by increasing level of trade and investment in the region. Khon Kaen will become a hub of human resources development and a logistics center of export agricultural products especially tapioca and sugar related industries, while Kalasin will be a logistics center of rice export processing [20], [21]. Reference [21] indicates that agricultural, industrial, and trading activities conducted along EWEC path way will all benefit provided that provincial authorities adapt their strategic development plan in such a way that they are aligned with EWEC strategic thrust. She suggests that provincial officers actively initiate friendly cooperation plan with Laos in agriculture, trade, tourism, and investment. Reference [21] points out that jasmine rice, and organic agriculture, has a bright opportunity and should be actively promoted; while sunrise industries are processed agriculture, traditional textile, automobile, mining, electronics, tourism, and logistics. She also encourages improvement of trade and investment infrastructures, labor skill, and custom procedures and processes to improve quality and competitiveness of Thai products and to boost every economic activity and promote sustainable development.

However, there is a glaring worry of imbalance effect of economic growth and opportunity derived from EWEC. Reference [22] pointed out that growth is unequally distributed between urban and rural areas of Mukdahan Province. They explained that majority of people in Mukdahan who is farmers living in remote areas gets less benefits from EWEC than big trading and industrial businesses. They questioned whether the former provincial development plan has captured and integrated opinion and need of majority agricultural communities. Reference [22] believed that there is no linkage between traditional economic activities and development direction under EWEC.

Regarding the factors related to success of border trading, there are both stimulating and impeding components. Reference [27] found that SMEs in the Northeastern area have moderate difficulty in entering into export business; yet they require government assistance in export business education and training in various functional areas, e.g. marketing, finance,

accounting, production, and logistics. They also need support in their human resources development scheme. Reference [23] found that there is still the lack of cooperation among various government offices responsible for facilitating border trading, the event that deteriorates enhancing trading opportunity provided by construction of the second Thai-Lao friendship bridge in Mukdahan. These unorchestrations happen in every combination of cooperation level from central agency, regional, to local offices. Moreover, there is also a lack of cooperation between Thai and Lao public concerns.

There are also various trade impediments stemmed from the Lao sides. There are insufficient and inappropriate trade infrastructures in Laos. There is still the lack of trust on Thai sincerity in trading with Laos; therefore Lao authority still imposes trade barriers on Thai products, e.g. import tariff, and import quota on such products as cement, vegetable oil, steel rod. Lao's custom procedures and processes in each border crossing point are not standardized; the situation that leads to corruption of Lao officials. Volatility of Kip (Laotian currency) increases risk of payment settlement and thus discourages trade. Unofficial and illegal trading still prevails along Thai-Lao border [5].

2.3 Barriers to Export:

Export barriers have been interested and investigated by export marketing scholars since 1960's [9], [10]. This is due to the fact that export is essential to economic growth and development especially for emerging economies whose domestic market potential is constrained and that globalization sentiment grows ever faster and deeper [11], [12]. Moreover, there is a tenet that identification and elimination of export impediments will not only encourage business to start exporting but also to enable active exporters to improve their performance [13].

There are continuing academic endeavor on the topic of export barriers ever since early 1960s [9]. Early works basically focused on identifying and taxonomizing the construct; however, interests in later works were slightly shifted to attempting to explain and understand export behavior and performance of firms [10], [14]. Probably clear interest in export barriers started again in 1985 when a study attempted to identify underlying factors of export barriers facing U.S. paper industry [17]. During 1990s interest in export barriers was at its peak when there were several studies released covering various geographical contexts [18]. However, currently it seems that there is declining interest in the field of export barriers when scholar working in the field may get stuck amid inconclusive results generated so far [11]. Thorough review of studies related to exporting activities in the last 4 decades can be seen in extant literature [13], [15], [16].

Definition

Reference [18] proposed that barriers to exporting are all those attitudinal, structural, operational and other constraints that hinder the firm's ability to initiate, develop, or sustain international operations. This proposed definition is utilized in this research study.

Taxonomy

The probably most exhaustive taxonomy of export barriers configures four types of export barriers [18]. These are internal-domestic, internal-overseas, external-domestic, and external-overseas export barriers. This typology is derived from the notion that export barriers can be generated within and outside of the firm; while they are able to happen domestically or abroad. It is very likely that typology of export barriers more applicable to SMEs exporters should be simpler; therefore the four dimensions taxonomy might have to be collapsed to two dimensions of domestic and overseas export barriers [12]. Reference [19] argued that the possibly most suitable taxonomy of export barriers for exporter from developing economies is the two dimensions of domestic and internal-firm export barriers. His robust theoretical rationale behind this typology derived from trade and development economics literature which posit that national governments are genuine sources of any export barriers external to the firm no matter they occur domestically or overseas; while internal-overseas component seems to be irrelevant considering very limited overseas operation of firms from less developed countries.

Issues related to Export Barriers

Studies of export barriers are basically engaged in identifying possible export barriers, taxonomizing these emerging obstacles, and investigating their relationship with relevant factors as firm characteristics and strategy, firm export experience, and time horizon of export operation. Moreover currently the focuses are on SMEs exporter and emerging economies context [11], [12]. Reference [12] found that there are some underlying factors that are not subject to idiosyncratic characteristics of SMEs exporting firms but are stable and always exercise their effect on firm export operation. These barriers are information inefficiencies, price competitiveness, foreign customer habit, and overseas political and economic issues. Reference [11] found that latent dimension of export barriers as perceived by Brazilian firms are stable across extended period of time. These components are low product and price competitiveness, lack of knowledge and resources, and institutional barriers. However, exporter perceived increasing barriers as they gain more experiences. They are surprised of this results which are contrary to mainstream belief and witnesses. Reference [11] justify this contradiction by hinge on current malign economic situation which very likely lead to firm's pessimistic sentiment toward barriers confronting them.

3. METHODOLOGY

The research methods comprised of both qualitative and quantitative techniques. It was started with compiling qualitative data from various sources and activities prior to operationalizing the qualitative findings. Its qualitative endeavours included archival data investigation, in-depth interview and focus group discussion. In-depth interview was done with 20

informants comprising of scholar who are academic border trade researchers and experts of the field who are experienced or successful border traders and government officers in charge of border trading activities. Focus group was conducted with 11 active border traders from various trading sectors.

Then quantitative field survey research method was conducted by using questionnaire as a data collection tool. The sampling frame for this study consists of representatives from Thai firms. These target respondents are in managerial position either owners or decision-makers who directly involve in their company's Thai-Laos border trading at Mukdahan check point. The sampling frame is based on the border traders' database provided by Mukdahan custom office. There were 105 border trading firms in this database. Based on this number, purposive sampling method was used by specifically focusing on only regular trading firms. Owing to the relatively small size of the sampling frame, data were collected by personal interviews in an attempt to enhance the rate of respondent participation. Sixty firms within the sampling frame were approached and attempts were made to solicit responses from each of them. A total of 37 firms consented to supply the necessary information. Descriptive statistical analysis method was employed for analyzing the surveyed data to validate and confirm qualitative results of this research.

4. RESULTS

This paper finds that there are 3 broad groups of export barriers hindering border trading between Thai-Laos Border of Mukdahan Province. These barriers are barriers related to overseas political and economic conditions, barriers related to Thai Government roles and its policy and regulation, and barriers related to internal-firm factors which are discussed as follows.

1. Barriers related to overseas political and economic conditions. This is the most serious group of barriers consisting of 6 particular obstacles (See Table 1) which are as follows.

a. Lao international trading system that is not facilitating border trading. These impediments range from undeveloped Lao international trading system, awkward procedures and complicated processes of export and import activities, and unstable of these systems with unexpected or unannounced changes.

b. Lao international trade policy that implicitly favoring trading with China and Vietnam. This preference can be inferred from at least a few observed trading behaviors with or rules and regulations toward Thai counterpart. There is a reduction and restriction of number of import agency importing from Thailand. Moreover transportation from Thailand is still subjected to border crossing fee which should be at least reduced or eliminated as soon as possible.

c. Poor and obsolete international trading infrastructures of Laos especially road system linking Thai and Vietnam. The inappropriate states of road, for instance narrow width, non smooth surface, which lead to either direct or indirect deterrence to trading both in

term of delayed transportation and risk of damages to transported products. Moreover, there is a lack of supporting logistics no matter whether they are warehousing, or loading and unloading facilities.

d. Low purchasing power of Lao people owing to their low per capita income; thus their inclination to price sensitivity buying behavior. This barrier puts Thai products in a disadvantage position relative to both Chinese and Vietnamese products which are by far relatively price competitive.

e. Misbehavior and unethical practices of Lao businessmen especially in keeping promise of payment settlement. This barrier leads to restriction of trade when Thai traders have to minimize their credit risk by reducing open account trading volume. At the same time they have more burdens struggling to increase their working capital to finance these overdue trade account receivable.

f. Competition from lower quality but considerably cheaper counterfeiting products from China and Vietnam.

Table1: Barriers Related to Overseas Political and Economic Conditions

Barriers	Mean	SD.	Level of Importance
Competition from lower quality but considerably cheaper counterfeiting products from China and Vietnam.	4.84	1.21	Very important
Lao international trading system that is not facilitating border trading.	4.78	1.44	Very important
Poor and obsolete international trading infrastructures of Laos especially road system linking Thai and Vietnam.	4.35	1.60	Very important
Misbehavior and unethical practices of Lao businessmen especially in keeping promise of payment settlement.	4.16	1.69	Very important
Lao international trade policy that implicitly favoring trading with China and Vietnam.	3.97	1.61	Quite important
Low purchasing power of Lao people owing to their low per capita income; thus their inclination to price sensitivity buying behavior.	3.92	1.69	Quite important

Remarks	Scale	Importance
1.00 – 1.83	is	not important
1.84 – 2.67	is	less important
2.68 – 3.50	is	not quite important
3.51 – 4.33	is	quite important
4.34 – 5.17	is	very important
5.18 – 6.00	is	most important

2. Barriers related to Thai Government roles and its policy and regulation. This group of barriers consists of 6 particular obstacles as follows (See Table 2).

a. Lack of efficiency of government agencies relevant to border trading. It is alleged that Mukdahan governor does not have constructive vision toward border trading activities. Moreover it appears that Mukdahan administration has not had explicit strategic plan that specifies direction, action, and time frame of its promotion and assistance to trade and investment yet. It has been accused that some government agencies possess abundant trade and investment information but are not capable of disseminate this information to relevant business communities.

b. There is a lack of cooperation between government agencies, between government agencies and private agencies, and between Thai and Lao agencies.

c. There is no particular government agency responsible for monitoring and researching Lao Market. This leads to the lack of Lao market information no matter whether consumer behavior, market structure and

competition, distribution channel, and updated trade and investment rules and regulations.

d. Obsolete law, together with complicated, and inflexible rules and regulations related to border trading. These unfavorable legislative and regulative environments collectively deteriorate border traders' intention and ability to trade.

e. Consistent and substantial unofficial trading along Thai-Lao border discourages border traders who conduct trading activities correctly since it turns out that those traders following official trading tracks ending up with cost disadvantage and losing market to those unofficial traders. Moreover grey marketing activities generated by this unofficial trading flows inhibiting Lao businessmen from being appointed authorized dealers of Thai business organization.

f. Poor productivity owing to rising costs of inputs as aggravating by poor input productivity especially labor productivity deteriorates the existing inferior of cost disadvantages position of Thai products. Oil price surges sharply owing to uncontrollable international economic and political conditions as aggravated by poor and insincere national energy plan. This leads to cost increases in various activities relating to border trading activity especially transportation cost. Thai labor productivity have been consistently poor owing to poor curricular and extracurricular self support education which their essences are distorted to degree-driven inspiration instead of developing necessary productive skill as governed by moral sentiment and public minded.

exploit their counterpart from delivering low quality products, providing no or poor after-sale services, to charging unfair prices.

Table3: Barriers Related to Internal-Firm Factors

Barriers	Mean	SD.	Level of Importance
Misbehavior in conducting business such as competing basically on price protocol, minimizing cost by using every possible means no matter whether they are legitimate or not.	4.43	1.66	Very important
Practicing unethical trading by taking every possible opportunity to exploit their counterpart.	4.05	1.72	Quite important
Most Thai border traders seem to be lack of vision and proactive marketing strategy in doing trading.	4.00	1.60	Quite important
Conducting business with traditional manner leads to risky operations such as giving trade credit to customers without legal documents.	3.59	1.61	Quite important

Remarks	1.00 – 1.83 is	not important
	1.84 – 2.67 is	less important
	2.68 – 3.50 is	not quite important
	3.51 – 4.33 is	quite important
	4.34 – 5.17 is	very important
	5.18 – 6.00 is	most important

5. DISCUSSION AND RECOMMENDATION

This paper discussion consists of two basic parts which are firstly making sense of our border trading typology of 3 groups of barriers as comparing to existing knowledge reviewed, and secondly elaborating on detailed impediments vis a vis extant empirical works available. Then this section puts forward some recommendation to every level of government agency related to Thai-Lao border trading activities. It ends with proposing a few relevant future research opportunities.

Finding that there are three groups of export barriers, firstly those related to overseas economic and political conditions, secondly those related to domestic governmental services, and thirdly those related to firm's internal factors, our paper provides another piece of evidence supporting the extant literature that export barriers literature is still characterized by inconclusive results [11], [12]. Moreover, contextual factor, specifically border trading activities between two developing economies, play important role in determining typology of trading barriers.

The resulting three groups of border trading barriers are not consistent with any existing typologies, which is probably attributable to border trading contextual specific. The typology resemblances the extant literature in the sense that trade impediments can be divided into domestic and overseas factors [12]; however, in border trading context, those barriers related to firm's internal factors are so outstanding and idiosyncratic relative to those occurring in the extant literature that they cannot be sub-divided into either domestic or overseas groups rather they should be united as a single group of barrier. This is due to the fact that border trading has its very idiosyncrasy in the sense that the activities taking place on the borderland. This special territory has its very unique characteristics since although legitimately divided by the two nations' sovereignty, behaviorally is united in term of people's walk of life and business patterns. This research typology of export barriers thus is not the same as those proposed by the past research [18].

This research typology is also similar to the past research in that there are external and internal firm barriers; however, the external factors are so imminent that they cannot be included in the group of domestic barriers and deserve being set apart as another group of

Table2: Barriers Related to Thai Government Roles and Its Policy and Regulation

Barriers	Mean	SD.	Level of Importance
Rising costs of inputs as aggravating by poor input productivity especially labor productivity deteriorates the existing inferior of cost disadvantages position of Thai products.	4.76	1.67	Very important
Lack of efficiency of government agencies relevant to border trading.	4.38	1.36	Very important
There is no particular government agency responsible for monitoring and researching Lao market.	4.35	1.27	Very important
Traders who conduct trading activities correctly and follow official trading tracks ending up with cost disadvantage and losing market to those unofficial traders.	4.11	1.37	Quite important
Lack of cooperation between government agencies, between government agencies and private agencies, and between Thai and Lao agencies.	3.81	1.66	Quite important
Obsolete law, complicated, inflexible rules, and regulations related to border trading.	3.59	1.55	Quite important

Remarks	1.00 – 1.83 is	not important
	1.84 – 2.67 is	less important
	2.68 – 3.50 is	not quite important
	3.51 – 4.33 is	quite important
	4.34 – 5.17 is	very important
	5.18 – 6.00 is	most important

3. Barriers related to internal-firm factors. There are 2 barriers in this group as follows (See Table 3).

a. Most Thai border traders seem to be lack of vision in doing trading. They are short-term oriented preoccupied with and place much more importance on year to year profit outlay than long-term overall performance of the trading activities.

b. The aforementioned mal-attitude in conducting business leads to risky and misbehavior business operations such as competing basically on price protocol, minimizing cost by using every possible means no matter whether they are legitimate or not, and practicing unethical trading by taking every possible opportunity to

overseas economic and political conditions [19]. This further division is basically due to the fact that some economic and political conditions of Laos, i.e. trade and investment policies, trade infrastructure, and Laotian purchasing power, are matters of Lao internal affairs that are beyond direct intervention of Thai government. These impediments internal to Laos are not or hardly related to Thai government involvement; hence, should not be considered domestic government related barriers.

This research's finding of governmental related trading impediments is very interesting in the sense that it reminds of urgent adjustment needed if both Thai and Laos would like to collect as much benefits as possible from mega development project like EWEC. These results imply that both Thai and Laos are not going to gain much from EWEC as long as their state services and cooperation are still weak. Therefore, strategic adjustment of local administration together with international cooperation are needed, especially in potential economic activities as agriculture, trading, and tourism, if Thai and Laos were to benefit from EWEC [21]. Improvement of cooperation between Thai and Lao public and private organizations are also recommended as echoed in the extant research [23].

Moreover the findings showing poor trading practices are consistent with results found in past research [27]. This suggests that it might be appropriate to establish a government agency responsible for monitoring and researching Lao market and cooperate with Lao government. The task of this special organization will cover knowledge creation, and dissemination, and training and development of border trading concerns. Upgrading or improving functions or services of regional overseas trade office of the Department of Export Promotion should be considered. In addition, poor productivity and trade infrastructures should be improved as well as integration of processed agriculture, and traditional textile industries into the trading stream if we would like to see local communities participating in EWEC.

If sustainability of development and fair income distribution are truly important, local community participation in the local strategic development plan is actively encouraged. This provides strong support for the extant research calling for reviewing local development plan to incorporate local people's walk of life and traditional economic activities so that everyone affected by EWEC fairly gain from this mega development scheme [22].

Furthermore, proposition specific to every level of government agencies related to Thai-Lao border trading activities are also provided.

Central governmental administration might consider announcing border trading a national agenda so that persisted governmental support can be secured. Government initiative and active role in pushing the reviewing of law and regulations applicable to border trading is also suggested. Early setting up new agency or improvement of existing agency that is responsible for looking after Lao market is also imperative. This particular organization will be responsible for conveying collected information and generated knowledge to border

traders so that their competitiveness and productivity can be improved. It should also act as a coordinating agency that links every related public and private agency together and orchestrates everyone's direction and strategy.

Ministry of foreign affair has a major role in this promising economic activity. It might have to consider work actively in adjusting Lao national administration's negative attitude toward Thai government trade and investment policies related to Laos. Every level of Thai diplomats might also have to consider adjusting their role to actively participate in improving trading opportunity and relationship with Laos. These adjustment will in turn help convince Lao authority to adjust their policy in a more favorably fashion toward Thai trade counterpart.

Custom office is also a very critical part of trading jigsaw. Its facilitating and transparent procedures and processes will be considerably appreciated. Custom's one stop services initiation is very fascinating but implementing this scheme has to be active, cooperative, and consistent. Custom officers' role in inhibiting or even eliminating unofficial trade will also very helpful to encourage traders who adhere to official moral practices.

Provincial administration's role in incorporating local community into developing local and national development plan is vital since they are supposed to know the best of every relevant traditional requirement. Moreover, it should work closely with custom officers in inhibiting or eliminating unofficial and illegal trades along the border.

Finally, future research opportunities are projected so that further academic endeavor in the field of border trading can be initiated. Extending from this qualitative enquiry by conducting main quantitative empirical study to clarify confirm and generalize the findings of this study is strongly encouraged. Conceptualization and taxonomy of export barriers need further quantitative exploration. Dependent relationship between export barriers and their strategic and performance consequences are also very interested research topics. Intervening role of such interesting macro variable factors as local cultures, political stability and regional relationship and security or micro firm level factors as size, experiences, and export development stages are also needed research intention.

6. CONCLUSION

Considering barriers collectively, some interesting issues are emerged. It might be able to say that Thai and Lao government are not absolutely successful in performing their role of promoting border trading between the two nations since they have lack of efficiency in supporting trade, they do not cooperate well, and they do not reshuffle related law and regulations in time. The Lao side might be of a little disadvantage because of their poor trade infrastructures and weak purchasing power of their people. Business sectors of the two trading countries are not quite good in term of their way of running border trading activities. Active national and local administration improvement of their roles and responsibilities are of extreme priority if Thai-Lao border

trading is going to prosper sustainably as a part of EWEC mega development project.

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Unlocking the Greater Mekong Subregion - Striving Towards a Seamless Community -

Gianluca Bonanno

Abstract— *The last decade has seen the Greater Mekong Subregion (GMS) develop at an unprecedented pace. Gross domestic product levels have substantially increased, as have most social indicators. What is more remarkable, foreign direct investment numbers have more than quadrupled in a matter of years. So much effort put into the development of the sub-region has already started to bear fruit. The movement of people and goods has risen to the extent that brand new regulations have been laid down and adopted. This paper looks at recent changes along the economic routes crisscrossing the GMS, and at the reaction of its peoples to some new procedures that have started to be applied at specific cross-border points. In particular, it argues that the application of a new type of law, called raw law, is one of the key elements in order to foster the development of border areas into special economic zones, with a consequent multiplier effect for all of the GMS member economies. Finally, it briefly touches upon some of the constraints that hinder a thorough exploitation of the sub-region's potentialities.*

Keywords— **Greater Mekong subregion cooperation program, cross-border transport agreement, check-points, raw law.**

1. INTRODUCTION

The Greater Mekong Subregion (GMS), the most glittering development opportunity in the whole of Asia, is gradually but steadily attracting the eyes of the international audience. After a period of mistrust and instability, the sub-region has been a stage for successful development stories, as well as a few failures. Nevertheless, after peace prevailed over the conflicts that were smiting its peoples, an unprecedented wave of regionalising efforts has pervaded the entire area, enticing many a foreign institution into investing and actively participating in the development of the GMS. The first external player to take up the challenge of lifting the GMS out of poverty was the Asian Development Bank (ADB), with its Greater Mekong Subregion Cooperation Program started in 1992. Albeit a shy inception, the programme rapidly grew of importance, and so did the first and possibly most important regional partner of the ADB, the Mekong River Commission (MRC). Since those early years, things have changed at an unpredictable pace. Increased interconnectivity of goods, peoples and labour markets made for the rise of expectations in a fully-fledged, inter-linked society and development efforts gained steam as a favoured development option for augmenting overall economic growth in the sub-region. In less than two decades the GMS has become one of the most crowded developing corners of the world. An increased range of international actors have been attracted by the potentialities of the sub-region, and currently a wide selection of international organisations and agencies, foreign governments' departments, representatives of the

private sector as well as the civil society is striving along with local governments and players in order to achieve the ultimate goal of sustainable development and, eventually, eradicate poverty from the sub-region. Given the peculiar situation that presented itself at that time, the first priority among the development community was that of upgrading the existing infrastructure and building brand new links that could connect major centres within the GMS and beyond. In other words, the abatement of physical barriers was given priority. That meant the construction of highways, railway systems, and airports throughout the sub-region. The projects were so ambitious and magnificent that by no means the GMS countries could have ever managed to come on top of it by themselves. Nevertheless, even at those early times, the opinion of dealing with the GMS as a single entity made its way through a whole jungle of involved actors, and even though we can still observe a substantial lack of coherence and the overlapping of many development projects, the GMS is nowadays fairly interlinked and in continuous implementation.

The greatest challenges that the sub-region is facing in this second phase of the regionalising process are the maintenance of current infrastructure built during the first phase, and, most important, the abatement of the so-called non-physical barriers that are severely hindering a more thorough and unbiased development. Non-physical barriers are already a major obstacle when they are still confined within national boundaries, but they become a serious threat to the stability of the whole region when they come to influence the bilateral behaviour of neighbouring countries. Given the increased mobility following the gradual completion of infrastructure works, non-physical barriers become even more crucial in the hard task of tracking down intra-regional flows of any kind.

As it is with every developing area in the world, the abatement of physical barriers tends to get a higher priority in governments' agendas, particularly because it

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helps numbers to increase rapidly, thus making investors feel satisfied with their deal. Policy makers agree on this point, too. Nonetheless, the real deal is not just the construction and improvement of infrastructure, but a feasible prospect to maintain it in good conditions, and, most important, the effort put in the training of officials on the adoption of new procedures. This paper firstly looks at the current state of things with regard to existing linkages within the GMS, the rationale behind them, their advancement, and their constraints within the framework of the ADB's Cross-Border Transport Agreement (CBTA). With this background picture, it investigates deeper into the reaction that such linkages have ignited among locals as well as the expectations they have or have not met with their developers. Witnessing to the people is the overarching goal of this study. Peoples are directly touched by changes and their reaction is the very first and most inspiring step towards adjustment, because it will eventually reach the top of a country's hierarchy and will make history.

2. METHODOLOGY

Risks

Whenever dealing with sensitive issues, it is always an undertaking that implies certain risks. A part from obvious difficulties deriving from unstable conditions in the places where research is being conducted, there is a much heavier responsibility in delivering results as unbiased as it is possible. This issue is of particular relevance in the Greater Mekong Subregion, where changes are occurring quickly and have implications that go well beyond national boundaries. We cannot even be sure of the accuracy of official statistics, and contradicting data are all but uncommon. The key to success in this kind of study is that of carrying out extensive research on site, visiting the places concerned more than just once and at different times of the year and, most important, getting there every time through different sponsors so as to become aware of the undeniable multiplicity of situations and points of view of possibly all of the parties involved. The importance of raw data is fundamental, as challenging is its collection, particularly for observers from outside. Moreover, based on the results of a well-proven method used during the years, the amount of raw data should be at least equivalent to three times that of official statistics. In order to achieve this goal and maintain high standards of feasibility, a meticulous planning phase is indispensable.

Planning

As stated towards the end of the introduction here above, the aim of this paper is that of witnessing to the current condition of border areas within the GMS. That implies an analysis of exchanges occurring across the frontiers as well as movements and changes in local livelihood systems of the zones adjacent to the check-points. Considering factors such as the extension of the area and the unequal distribution of the population, the need to narrow down the scope of the study can be easily understood. What gives width to this effort is the

criterion used in deciding what to take and what to leave aside. To such regard, there are several issues that have been considered during this planning phase. The most decisive one was the importance shown by the adoption of the Cross-Border Transport Agreement (CBTA) in 2003. Propounded and largely founded by the ADB, this agreement aimed at easing flows transiting across the GMS borders, and through the years, it has been signed by all of the GMS members. Within the framework set by the CBTA, a transition between mere transport corridors into economic corridors has taken place, fostering an all-field development along some of the major arteries that crisscross the sub-region. The border check-points along such corridors and their adjacent areas are the places where the scope of this study has been narrowed down to. [Fig.1] The reason for this decision is simple. Cross-border activities around such areas have been increasing at an unprecedented pace. Moreover, new procedures are being experimented there under the implementation phase of the CBTA. In other words, such places are forerunner points where future cross-border regulations will be modelled upon, thus it is of fundamental importance to analyse the impact that new behaviours and trends have on economic outcomes as well as on social, institutional, and generational processes.

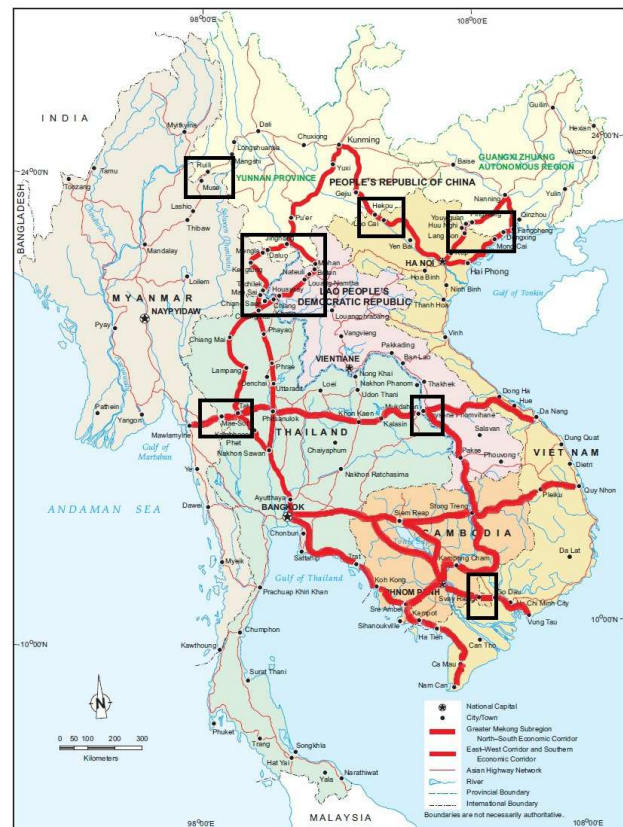


Fig.1 Main economic corridors and considered check-points

Data Processing and Analysis

Most of the data collected during fieldwork activities are raw data. It should be mentioned at this point that this

study is only part of a much bigger project, which also covers official statistics and findings of the last five years. However, this paper concentrates mostly on trends and impressions based on raw data collected during a time span of three years (2008-2010), because its aim is not that of supporting statistical numbers or policy issues, but that of providing some evidence for new behaviours of people crossing the GMS internal borders. A close and continuous connection with local people has been maintained and in many cases a direct collaboration provided for a huge amount of invaluable information, particularly about the way ordinary people manage to cross the borders without entering the sphere of illegality.

Considering the different levels of development, the conformation of the land, varying concentrations of cross-border flows, alongside unifying regionalising efforts, the GMS internal borders present close similarities as well as abyssal differences. In the wake of the creation of a seamless community, where laws and procedures are eventually meant to be uniformly applied, the analysis of the findings gathered within this study tries to shed some light on how people react to the new procedures that are being adopted. The results of this analysis will show how surprisingly similar behaviours are predominant, even when observed in places distant hundreds of miles from one another.

3. RESULTS AND DISCUSSION

The results of the project to which this study belongs are diversified in nature. They span from custom procedures to intra-regional migration and cross-border trade, although they focus on the reaction of local people to the creation and implementation of intra-regional routes, the so-called economic corridors. As far as this paper is concerned, the results that will be discussed hereafter are limited to four, and have been selected in order to provide the reader with an overall picture of the direction which the sub-region is moving towards. In particular, the intention is to show that, whereas rarely the expectations of the governments reflect those of the people, the latter's ability to adapt usually minimise the counter effects of top-down enforced policies.

In particular, the process that has been examined here was set in motion by the commitment of the GMS members, largely supported by the international community, to implement the second phase of the regionalising effort by starting to abate the so-called non-physical barriers, i.e. procedural and institutional flaws that hinder smooth exchanges among neighbouring countries.

The Raw Law

Movements along the borders between two or more sovereign countries have been historically regulated by the customary law. This kind of law is at the top of the formal scale of the laws promulgated by a state, after statutes and regulations. As such, in order to become operational it has to go through a strict process that even in the most developed countries may take quite a long time. In the past, changes were somewhat lazier than

they are in our times, so legislators had more time in their hands to handle them. With the coming of globalisation and the liberalisation of markets (including labour markets), countries had to care not only of changes occurring within their boundaries, but more and more of things happening around them. Hence the birth is the so-called raw law. Raw law is a quite new term and indicates a group of regulations that can be categorised neither as customary law nor as consuetudinary law. It is not customary because it is not directly formulated by the central government of a country, and it is not consuetudinary because it is not only oral, but written, and can be implemented and treated as the official law. In fact, raw law stands for those regulations and procedures that are thought of by the local governments and handed over to the central governments, in order to quickly respond to new occurrences and necessities that cannot wait for the entire legislative process needed in the case of the customary law, not to mention statutes and regulations. The adoption of the raw law is then limited to those particular areas, although it can be referred to by other local governments that are in the same situation. The raw law has become increasingly common particularly along the economic corridors. Therefore, north-south, east-west as well as movements in the Mekong Delta region are all subject to a gradual adoption of this new system, under the guidelines of ADB's CBTA. Nonetheless, the raw law is not yet everywhere officially recognised nor applied, because if it might turn out to be very useful, officials are not yet used to it, nor are they getting precise and standardised guidelines as for how to enforce it. This is easily explained by the fact that the raw law is applied, as stated above, to rapidly changing locations, i.e. border areas, thus cross-border movements of both people and goods are directly affected by its implementation. No authoritative institution can currently impose to the GMS sovereign states the adoption of the raw law, hence the only way to persuade them of its real benefits is by maximising the results at specific fore-runner locations. The following sections give practical examples of how the raw law is being applied with regard to cross-border movements along some major check-points and their adjacent areas as indicated in Figure 1.

Crossing the borders

The raw law is specifically meant to ease the otherwise time-consuming process of crossing a frontier. When talking about the Greater Mekong Subregion we shall keep in mind that, although past historical events have created frictions among neighbours that have exacerbated some tensions along their boundaries, the peoples dwelling those very territories have found themselves split between two or more countries, whilst often belonging to the same village or ethnic group. Spontaneous exchanges are nothing new in the sub-region. People have always moved for trade, labour, religion, and personal reasons for many centuries. From an anthropological point of view, there is an interesting theory that may be well applied here. It is about the contraposition of the concepts licit/illicit and legal/illegal. It is every government's duty to establish

what is legal and what is illegal within the boundaries of its state. And this is concretely empowered by the promulgation and application of the law. The same might not be said for the concept of licit/illicit. Peoples around the world have very different ideas of what is licit and what is illicit, this being based on historical, cultural, religious, and habitual grounds.

That said, this in no way means that people around the world have the right to do as they wish as long as they consider it licit. What is being said here is that throughout the years, governments have kept adjusting their regulations to the characteristics of their peoples. By doing so, countries may have become closer at times, distant at others. The GMS members have experienced a turbulent past. What the international community is trying to do with its co-operation programmes is to bring the countries and its peoples close again, by smoothening institutional differences and levelling up development gaps. One of the best ways to start doing this is to look at the frontiers and how things are dealt with there. Till not many years ago, in 2005, when this project was initiated, spending up to several hours to clear a busy check-point was the rule. That happened because custom controls were lazy, lacked efficiency and carried out fractionally and at different places. After 2005 and the initial implementation phase of the CBTA, things started to slowly but steadily change. In particular, new procedures to regulate temporary flows of people and goods across the borders started to be implemented.

One of such procedures is the adoption of temporary border passes granted to individuals crossing the frontier for a limited period of time and with the limitation of movement only within a pre-determined area around the check-point. Although there are other restrictions in the use of such permits, the innovative aspect is that they are directly issued by local custom authorities and they do not need heavy documentation upon their application. They are extremely useful for people who cross the borders daily and this new system dramatically boosts local business and the development of border areas. Temporary border passes are already in use at many busy check-points and they are becoming quickly popular (particularly after tourists were allowed to request them, too).

Another procedure that has been implemented concerns the movement of goods. It has as its ultimate goal the establishment of single-stop custom inspections, meaning that custom officials from both sides carry out their duties simultaneously and at nearby stations, thus dramatically quickening the transit through the gates.

In this scenario, gates for people and gates for goods are nearby, but not in the same place, in order not to create delays and for practical managerial reasons. The adoption of temporary border passes for people and improved custom inspections for goods has caused exchanges to increase rapidly. That has spurred the development of adjacent areas, now bustling with a myriad of newly established small businesses, there to satisfy a greater demand of services for people who cross the borders. In this regard, the adoption of the raw law has proved to be rather successful.

Tracking down intra-regional flows

Improved overall conditions and the adoption of the raw law as explained above have dramatically caused movements across borders to boom.

In the case of goods, statistics show that import-export figures for the considered check-points have more than quadrupled in the last ten years [1]-[6]. This is partly due to quite a large number of infrastructure works that have been built during the past decades and that coincide with the transport corridors mentioned earlier in the paper. Particularly along the borders between China and the rest of the GMS countries, the prevalence of mountains and weather-sensitive roads have meant days spent on poor but heavily trafficked routes. Many small and medium enterprises could not afford the costs to endeavour in such trips, thus resorted to other market solutions. All-weather roads and renewed routes have made it affordable to almost everybody. So recent years have seen an increased participation of businesses not headquartered in border areas, followed by a significant expansion of the market sector. Hence, there became apparent the need to extend custom controls further inland, in order to avoid overloading the still inadequate gates. At the moment of writing, most of the GMS countries have control gates spread over their territory. Also called in-land check-points and belonging to the raw law framework, they are a useful tool to keep track of moving goods. This dramatically speeds up controls at the frontier and is a more efficient measure to track down illegal movements and irregularities as well.

As far as the movement of people is concerned, it becomes a little more troublesome. People are less traceable than goods, partly because they move more quickly, and partly because they might not move grouped. Migrants have always preferred unofficial, less beaten tracks. This study has found how this trend has recently shown minor yet significant changes.

Increased interconnectivity and improved infrastructure have stimulated the growth of the service sector, in particular way that related to intra-regional activities. Travel agencies, transport companies, places providing accommodation and board, hospitals as well as offices providing assistance for cross-border procedures have made their appearance and have soon proved successful. In sharp contrast with past trends, this study has found out that migrants increasingly resort to middlemen when planning their journeys. [Fig 2]

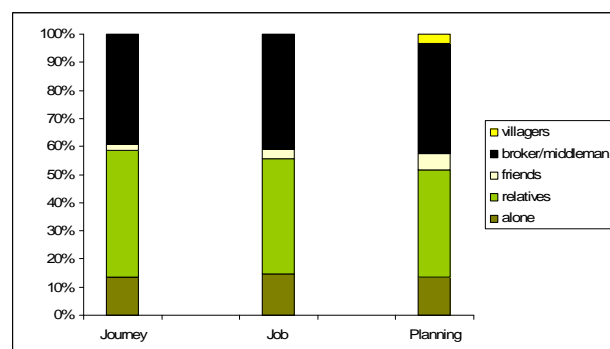


Fig.2 The role of social networks in migration.

Although this new figure is undoubtedly useful, brokers do not always share their clients' interests, and inexperienced people often end up being trafficked and eventually exploited, with none of the guarantees they had paid for. Moreover, the raw law, which, as explained earlier in the paper, eases the way people cross borders, is applied almost at the same check-points, further inviting migrants to choose those routes.

After such considerations, it might well be said that the appearance of the raw law and its application have caused a chain-reaction that not only has boosted the development of border areas, but has improved the efficiency of intra-regional flows, too, and although we are at the very early stages of the process, good deeds can already be seen. At the same time, an approximate application of such new procedures and loose controls can equally spur the proliferation of negative trends and consequences. This last issue might well be said to be the greatest challenge that the GMS countries are currently called to address, and from their response depends the future of sub-regional integration in mainland Southeast Asia.

Constraints and Challenges

Every law has a loophole. It could not be more appropriate for the GMS, indeed. In the case of the sub-region, many an external actor has and is participating in the development process. Many projects are funded and oftentimes directed by external agencies, and most of the training activities are delivered by foreign institutions. All of this inevitably leads to a substantial lack of uniformity among recipients. Although there are a great number of constraints currently afflicting the sub-region, this paper looks at those most related to the findings herewith introduced.

A trend that is becoming noteworthy regards the movement of goods and the reaction that import-export companies have shown towards the adoption of the raw law. In the very proximity of cross-border check-points where the new procedures are being applied, a number of illegal crossings have made their appearance. The load of these gates is such that is rather impossible for them to remain unnoticed. Nevertheless, local authorities do not seem to be much worried about them. So why does it happen? Well, when economists talk about relaxed trade tariffs and free trade agreements, it is usually something politicians have agreed upon on mutual grounds. In the case of the GMS, the six member economies do by no means share the same level of economic development, thus whilst there actually is a will to foster growth through preferential agreements, these do not always reflect the real needs of the economy. Hence, quotas established by the governments do not always represent the real demand/offer numbers set by a still volatile market. What is happening in the GMS is clear. Export licences of a country do not match with import licences of the partner country. The gap is so wide and the need to export and/or import is so strong that a whole parallel market has taken shape in recent years. This problem is widespread and will not be considered for analysis here. What interests this study is the fact that this surplus is being channelled through those informal gates that have

been mushrooming near the official gates. Moreover, both parties understand that the products been exchanged are necessary for their local economies (mostly construction materials, appliances, non-processed produce, and gasoline) and just let it be.

Another noteworthy trend that could be observed regards the crossings of people, particularly migrants. Again, migration in the GMS is a topic of huge importance and vastness to be sufficiently covered here. This study has shown how the adoption of the raw law has somehow influenced the way migrants move. In particular, it could be noticed that some people have started using the temporary border permits as a *lasseiz-passer*, an easier way to skip lengthy formalities and find one's way once on the other side. There are innumerable tricks to find a good reason for not being able to go back once passed the frontier, and here, again, the role of the broker becomes the key to success. The governments of some of the GMS countries have already become aware of this new kind of migration flows, and have thus established repatriation programmes aimed at literally deporting people back to their country of origin [7]. The issue is that this mechanism works if migrants are caught within a relatively short period of time. If not, they are likely to settle in, find a job, apply for a working permit and earn the right to stay. This is reflected by the fact that many migrants settle in areas relatively close to the frontier (which does not require long journeys) and work in agriculture (which does not require complex applications or specific qualifications) [8]. A way that has proven to be useful in tracking this kind of migrants is to keep record of their remittances, i.e. a percentage of the money they earn with their jobs that they almost regularly send back home [9]-[10]. Moreover, by cross-checking remittances, border passes and services delivered by the brokers we can obtain, within a little margin of error, the number of people that have crossed the frontier taking advantage of this new situation.

4. CONCLUSION

The aim of this study was that of showing how things have rapidly changed in the sub-region and how its peoples have equally adapted to the new situation. Moreover, a new trend could be observed. Whereas in the past people usually adapted to new circumstances in order to survive and/or defend their own cultural identities, the GMS of nowadays is being heavily influenced by globalising trends, and its peoples are easily attracted by profits. In the cases considered in this paper, the appearance of the raw law and of special economic zones along the borders and the eagerness of foreign investors to make their own profits risk to spoil local business towards inappropriate behaviours. Local awareness is still low, and however everybody talks about fostering the participatory process to include the local communities, times may not be that ripe in some cases. Awareness-raising activities are still insufficient and carried out not uniformly. In still too many cases, alas, sovereignty issues are still uppermost and governments are not willing to share too much. On the other side of the same coin, some local communities

have shown different levels of mistrust and fear of getting too much involved; because they are often aware that the guarantees they are being given might not be honoured [11].

The good news is that gradually, but steadily, the efforts of the international community are reaching out to more and more people every day, and the effects of a rapid globalisation cannot but help. Keeping intact and operational what has been built is understandably important, although the real challenge of our times is to instruct locals in an as unbiased as harmonised way as possible. To strive for a sincere co-operation is each and every government's responsibility; to strive for the improvement of peoples around the world is everybody's responsibility.

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Thai Traders' Competitive Competency and Strategies along the East-West Economic Corridor: The Case of Thai-Lao PDR

Pensri Jaroenwanit

Abstract— The objective of this research was to study the competitive competency and strategies of Thai border trade businesses along the East-West Economic Corridor, the border trade between Thailand and Lao PDR on the border of Mukdahan Province. The research methods comprised of both qualitative and quantitative research. It was started with compiling qualitative data from various sources and activities prior to operationalizing the qualitative findings. Its qualitative endeavours included archival data investigation, in-depth interview with practically experts of the field, successful border traders, and government officers in charge of border trading activities, and focus group discussion with active border traders from various trading sectors. Then, quantitative research, the field survey method, was conducted by using questionnaire as a tool for collecting data from 37 Thai border traders. Descriptive statistical analysis method was employed for analyzing the surveyed data to validate and confirm its qualitative results. It was found that Thai border trade businesses have developed competitive competencies which then turned into competitive advantages, comprised of five major advantages which are local advantage, marketing management advantage, financial management advantage, strategic management advantage, and personnel management advantage. It can be concluded that there are five important strategies which are product strategy, customer relationship management strategy, service & product quality differentiation, pricing strategy, and cost leadership strategy. Suggestions are thus proposed to improve border trading strategies of Thai border trade businesses.

Keywords— Border trade, East-West economic corridor (EWEC), competitive competency, strategies.

1. INTRODUCTION

As a result of the increasing tendency towards a global economy and the severity of many countries' trade deficit pressures, by many countries specifically developing countries, exporting has received considerable attention over the past decades. Exporting is extremely attractive in the point of view of most national governments, because it allows the accumulation of foreign exchange reserves, enhances societal prosperity, and helps national industries develop and improve productivity [1]. Border trading is one of an exporting form, it is buying and selling that happens across international borders. Though literature provides substantial contribution to our understanding of exporting and border trading impediments, review results show that literature has consistently ignored investigating border trading activities in South East Asian economies, specifically Greater Mekong Sub-region (GMS), a region where border trade has flourished and continued at least for a few centuries based on written record. This paper aims to explore the competitive competency and strategies of Thai traders, the border trade between Thailand and Lao PDR on the border of Mukdahan Province, and the recommendation for traders and authorities to improve Thai trading

system and operations in the future. **East-West Economic** is an economic development program initiated in 1998 by the Ministerial Conference of Greater Mekong Sub-region organized in Manila, the Philippines in order to promote development and integration of four countries, namely: Laos, Burma, Thailand and Vietnam. This corridor became operational in December 12, 2006. The economic corridor is created based on a road of 1,450 kilometres with the west end at port city of Mawlamyine (Myanmar), crossing Kayin Division, Thai provinces of Tak, Sukhothai, Phitsanulok, Phetchabun, Khon Kaen, Kalasin and Mukdahan and Laotian provinces of Savannakhet, Vietnamese provinces of Quang Tri, Thua Thien-Hue Province and Da Nang city as the east end [2].

The East-West Economic Corridor is both a transport system and a framework for cooperation which connects four countries in the GMS. The main objectives of the EWEC are: to further strengthen economic cooperation between and among the four countries; reduce transport costs in the corridor and make the movement of goods and people more efficient; and reduce poverty in the corridor by supporting the development of rural and border areas, increasing earnings of low-income groups, providing employment opportunities, and promoting tourism [3].

The EWEC is the first transportation corridor running the entire width of mainland Southeast Asian. Major components of the East-West Economic Corridor have been completed by 2007 including the second Thai-Lao Friendship Bridge at Mukdahan border checkpoint. Mukdahan is located on the bank of the Mekong River and is a crucial part of the East-West Economic Corridor. The Second Thai-Lao Friendship Bridge was opened to

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traffic in January 2007. It links Mukdahan with Savannakhet province in Laos and serves as part of the road network linking four countries in accordance with the EWEC development initiative. It will also foster economic development, trade, and investment in the region [4]. In 2007, following the opening of the Second Friendship Bridge to traffic, cross border trade between Mukdahan and Savannakhet rose by 100 percent over that of the previous year, and in August 2008 trade amounted rose to 2.26 billion baht, an increase of 19 percent over that of the same period in 2007. Out of this amount, 860 million baht involved Thai exports to Laos, while 1.4 billion baht involved imports from Laos.

The growth rate is likely to continue to increase with more foreign investment, some possible barriers were expected to be found because of an inconsistency of governmental policy of both countries and there are many types of border trading in this subregion, i.e., formal trade, informal trade, transit trade and barter trade [5]. Thus, border traders have had to seek for appropriate strategies as well as competitive competencies themselves to overcome those barriers.

This research has been conducted under the attempts to find out competitive advantages or competencies and strategies of Thai-Laos border traders. It is focused on the impediments pertaining to the border trade activities of trading firms. The findings are presented and discuss in the context of the international marketing literature. The implications are drawn for government, authorities to improve border trading system and procedures and also for traders to improve their trading strategy.

2. LITERATURE REVIEW

International trading competency and strategy has been of considerable interest for the past decade. The strategy literature provides a theoretical foundation for including strategy as a determinant of firms' trading performance.

2.1 The Concept of Strategy

Strategy refers to a plan of action designed to achieve a particular goal. The strategy should reflect the firm's environment and the resource allocation should reflect the strategy [6]. Strategy at a corporate level represents the cumulative direction of the organization given the nature of the industry, the competitive environment and internal factors related to production, finance, marketing and personnel [7]. The determinants of firms' trading performance can be classified into two main groups, internal and external determinants, and strategy is one of the internal determinants. It is comprised of general strategy, product quality, product line, product adaptation, price adaptation, dealer support and promotion adaptation [8].

The researcher who proposed the first model of export marketing was Cateora, who developed a model of international marketing and proposed that an uncontrollable international market environment influenced firms' controllable international marketing strategies [9]. Cateora's (1983) model postulated that international marketing involved creating a marketing mix, which was optimal to the business environment of

each country to which a firm's product was sold. Bilkey (1987) identified the determinants of a successful export marketing mix strategy and found that firms that exercised the best marketing practices experienced roughly 20 percent higher profit than firms that did not [10]. Bilkey (1987) developed his theoretical model by modifying Cateora's (1983) to include organizational short-run uncontrollable factors and controllable export marketing mix strategy and came up with the export marketing mix strategy model.

Bilkey (1987) indicated that a successful export marketing mix was contingent upon contextual factors in such a way that, in order to be successful in exporting, firms had to adjust their export marketing mix to fit their environmental and organizational factors, and that there were not any export marketing strategies that were successful in every context. The legitimacy of the theoretical paradigm underpinning Bilkey's (1987) model is provided by Cavusgil and Zou (1994). They argued that exporting can be conceptualized as a management strategic response to the interplay of internal and external forces [11].

2.2 Components of Export Strategy

Export strategy is comprised market selection, product and product line, pricing, distribution, and promotion [12]. Zou and Stan (1998) revealed that export marketing strategy involves strategic factors such as: 1) general export strategy 2) marketing research utilization, 3) export planning, 4) export organization, 5) product adaptation, 6) product strengths, 7) price adaptation, 8) price competencies, 9) price determination, 10) promotion adaptation, 11) promotion intensity, 12) channel adaptation, 13) channel relationships, and 14) channel types [13]. All variables of border trading strategy of this research were developed by combining grounded knowledge of export strategy and all information from the results emerged from conducting the qualitative research.

2.3 The Concept of Competitive Competency

Competency is a condition of being sufficiently qualified to perform a particular action. To achieve this condition, one must possess the proper knowledge, skills, training, and professionalism. Competencies are those capabilities that are critical to a business achieving competitive advantage. The starting point for analysing competencies is recognising that competition between businesses is as much a race for competence mastery as it is for market position and market power. Management cannot focus on all activities of a business and the competencies required to undertake them. So the goal is for management to focus attention on competencies that really affect competitive advantage [14].

Core competencies are the most significant value creating skills within corporation and key areas of expertise which are distinctive to firm and critical to the firm's long term growth.

A competence which is central to business's operations but which is not exceptional in some way should not be considered as a core competence, as it will not generate a differentiated advantage over rival businesses. It follows

from the concept of core competencies that resources that are standardized or easily available will not enable a business to achieve a competitive advantage over rivals.

2.4 How to Created Competitive Advantages

When a firm sustains profits that exceed the average for its industry, the firm is said to possess a competitive advantage or competitive competency over its rivals. The goal of much of business strategy is to achieve a sustainable competitive advantage. Michael E. Porter identified two basic types of competitive advantage; cost and differentiation advantage [15]. The details of those competitive advantage are as follows:

- Cost advantage
- Differentiation advantage

A competitive advantage exists when the firm is able to deliver the same benefits as competitors but at a lower cost (cost advantage), or deliver benefits that exceed those of competing products (differentiation advantage). Thus, a competitive advantage enables the firm to create superior value for its customers and superior profits for itself.

Cost and differentiation advantages are known as *positional advantages* since they describe the firm's position in the industry as a leader in either cost or differentiation.

2.5 The component of competitive advantage

The component of competitive advantage comprises resources and capabilities, cost and differentiation advantage, and value creation [16]. Details of all components are as follows:

1) Resources and Capabilities

A resource-based view emphasizes that a firm utilizes its resources and capabilities to create a competitive advantage that ultimately results in superior value creation. According to the resource-based view, in order to develop a competitive advantage the firm must have resources and capabilities that are superior to those of its competitors. Without this superiority, the competitors simply could replicate what the firm was doing and any advantage quickly would disappear [17].

Resources are the firm-specific assets useful for creating a cost or differentiation advantage and that few competitors can acquire easily. The following are some examples of such resources:

- Patents and trademarks
- Proprietary know-how
- Installed customer base
- Reputation of the firm
- Brand equity

Capabilities refer to the firm's ability to utilize its resources effectively. An example of a capability is the ability to bring a product to market faster than competitors. Such capabilities are embedded in the routines of the organization and are not easily

documented as procedures and thus are difficult for competitors to replicate.

The firm's resources and capabilities together form its distinctive competencies. These competencies enable innovation, efficiency, quality, and customer responsiveness, all of which can be leveraged to create a cost advantage or a differentiation advantage.

2) Cost Advantage and Differentiation Advantage

Competitive advantage is created by using resources and capabilities to achieve either a lower cost structure or a differentiated product. A firm positions itself in its industry through its choice of low cost or differentiation. This decision is a central component of the firm's competitive strategy [17].

Another important decision is how broad or narrow a market segment to target. Porter formed a matrix using cost advantage, differentiation advantage, and a broad or narrow focus to identify a set of generic strategies that the firm can pursue to create and sustain a competitive advantage.

3) Value Creation

The firm creates value by performing a series of activities that Porter identified as the value chain. In addition to the firm's own value-creating activities, the firm operates in a *value system* of vertical activities including those of upstream suppliers and downstream channel members.

To achieve a competitive advantage, the firm must perform one or more value creating activities in a way that creates more overall value than do competitors. Superior value is created through lower costs or superior benefits to the consumer (differentiation).

3. METHODOLOGY

The research methods comprised of both qualitative and quantitative research. It was started with compiling qualitative data from various sources and activities prior to operationalizing the qualitative findings. Its qualitative endeavours included archival data investigation, in-depth interview with 20 scholarly and practically experts of the field, i.e. academics researching border trade, experienced or successful border traders, and government officers in charge of border trading activities, and focus group discussion with 11 active border traders from various trading sectors.

Then, quantitative research, the field survey method, was conducted by using questionnaire as a data collection tool. The sampling frame for this study consists of representatives from Thai firms who are owner or decision-makers in managerial position and directly involved in their company's Thai-Laos border trading at Mukdahan check point. The sampling frame is based on the traders' database provided by Mukdahan custom office. There were 105 border trading firms in this database. Based on this number, purposive sampling method was used by specifically focusing on only regular trading firms. Owing to the relatively small size of the sampling frame, data were collected by personal interviews in an attempt to enhance the rate of

respondent participation. Sixty firms within the sampling frame were approached and attempts made to solicit responses from each of them. A total of 37 firms consented to supply the necessary information. Descriptive statistical analysis method was employed for analyzing the surveyed data to validate and confirm its qualitative results.

Factor analysis was used to identify the minimal number of dimensions that underlie the observed variables. Results of factor analysis can be presented including factor loadings of items or correlations with the original variables and percentages of variance accounted for by individual factors. In this study, Principal Component Analysis method was used with eigenvalues set to unity. Interpretation is facilitated by rotation in which original factors are redefined using different rotation techniques. Varimax rotation technique was used in this study. The goal is to simplify factors by maximizing the variance of loadings within factors, across variables [18].

The criterion for acceptance is based on eigenvalues greater than 1. Based on factor analysis results, the reliability of each factors was assessed using Cronbach's coefficient alpha. Coefficient alpha was required a minimum of 0.70 [19].

In regard to validity, convergent validity is indicated by high correlations with other items measuring the same construct. Discriminant validity is indicated by lower correlations with items measuring other constructs. For this study, loadings of 0.40 or greater were desired for the primary factor to which an item belongs.

4. RESULTS

The key research results are as follows:

4.1 *Competitive Competency of Thai Border Trade Businesses*

The research result shows that on a four-year average, Thailand's export products to Laos were in the top five most important export categories including consumer goods, fuel, electrical appliances and equipments, walking tractors and equipments, and iron and steel pipes. These products accounted for 60% of average total annual exports. Another potential export product was tonic beverages and monosodium glutamate. However, the competition has become intense with increasing number of competitors, resulting in a decline in profit. The major trade competitors are China, Vietnam, Singapore, Japan, Germany, France, etc.

The competitive competencies of Thai border trade businesses have developed and implemented, which then turned into their competitive advantages, comprised of 19 general aspects and by using factor analysis, they could be grouped into 5 major advantages; local advantage, marketing advantage, financial management advantage, strategic management advantage and human resources management advantage (See Table 1). From table 1, most factor loadings show an acceptable value of more than 0.40. Most items loaded on one factor alone, thus providing evidence of convergent and discriminant validity. Internal consistency was established by

calculating Cronbach's alpha for each factor. Results show that Cronbach's alpha meets the requirement of higher than 0.7. The details of each advantage are shown as follows:

1) *Local Advantage*

The competitive competency of being local comprises the ability to understand Laos trading practices and long experience in border trade business. Additionally, most of traders live in Mukdahan area, being accustomed to the border trade for many years and understanding trade practices and behavior of Laos traders. Such advantage generates business stability while fluent communication in Laos and Chinese facilitates successful negotiation, and assists in market and clients' credit history research and follow-up process. The individual data from the Thai-Laos border trade reveals that 83% of traders were able to speak and understand Laos language, resulting in the understanding of Laos culture, and good rapport with Laos, Vietnam and Thai authorities which are the key competitive advantages of the border trade.

2) *Marketing Management Advantage*

The research indicates that Thai-Laos border trade businesses were competent in being a middleman and implementing marketing strategy as they searched for market data of trading counterparts and implemented systematic marketing plans.

3) *Financial Management Advantage*

Financial management and accounting has become a strong advantage. The internal audit process is effective while source of fund is sufficient resulting in readiness in trade receivable management.

4) *Strategic Management Advantage*

The strategic management competency involves defining clear border trade policy, defining responsible party with well quality control system and sufficient resources i.e. human resources, equipment and research & development resources.

5) *Human Resources Advantage*

The border traders are well-equipped with qualified manpower who are able to manage small number of purchasing orders with effectiveness and timeliness.

Table 1 : Extracted Factors and Factor Loadings Related to Competitive Advantages

Factor and Items Loaded on Each Factor	Mean	S.D.	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Factor 1 : Local Advantage							
1. Experiences in the border trade business (no. of years in the business)	4.95	1.10	0.795				
2. Understands culture of a neighboring country	4.92	0.95	0.755				
3. Is able to speak and understand the language of a neighboring country	5.03	1.21	0.743				
4. Understand trading practices in a neighboring country	4.86	1.03	0.731				
5. Has good rapport with Thai authorities	4.57	1.34	0.639	0.600			
6. Has good rapport with Laotian & Vietnamese authorities	4.51	1.41	0.627	0.429			
Factor 2 : Marketing Management Advantage							
7. Has clear product position in a neighboring country	4.49	1.12		0.865			
8. Searches for knowledge or marketing information of a neighboring country	4.73	1.07		0.720			
9. Systematically plans for the border trade business	4.49	1.22		0.710			
10. Communicates with clients and has effective export network	4.76	1.19	0.360	0.575			
11. Is a monopolist seller to Laos	4.03	1.40	0.343	0.556			
Factor 3 : Financial Management Advantage							
12. Has sufficient cash flow for credit trading	4.76	1.12				0.803	
13. Has well checking and internal controlling system	4.59	1.19			0.458	0.656	
Factor 4 : Strategic Management Advantage							
14. Has good quality control	4.59	1.17			0.854		
15. Has clear policy of the trade border business	4.65	1.11	0.302	0.736			
16. Has sufficient resources i.e. equipment, R&D	4.35	1.30		0.725			
17. Has strong responsible units	4.30	1.31		0.566			
Factor 5 : Human Resource Management							
18. Is able to manage small number of purchasing orders with effectiveness and timeliness	4.68	1.23					0.931
19. Has qualified human resources	4.51	1.17	8.73	2.08	1.73	1.24	0.878
Eigenvalue							1.08
Percentage of variance			45.98	10.96	9.12	6.50	5.60
Cumulative variance explained			45.98	56.94	66.06	72.56	78.16
Cronbach's Alpha			0.818	0.811	0.844	0.776	0.855
Remarks: Interpretation of Mean							
	1.00-1.83 is		3.51-4.33 is		rather a strength		
	1.84-2.67 is		4.34-5.17 is		a strength		
	2.68-3.50 is		5.18-6.00 is		highly a strength		

4.2 Thai Border Trade Business's Strategies

The important strategies which traders have adopted and implemented for the border trading include 13 general strategies. By using factor analysis, all 13 strategies could be grouped into 5 business strategies (See Table 2). From table 2, most factor loadings show an acceptable value of more than 0.40. Most items loaded on one factor alone, thus providing evidence of convergent and discriminant validity. Internal consistency was established by calculating Cronbach's alpha for each factor. Results show that Cronbach's alpha meets the requirement of higher than 0.7. The details of each strategy are shown as follows:

- 1) Product Strategy** is to consistently retain brand image of the product and service and to focus on product quality instead of cutting prices.
- 2) Relationship Management Strategy**, with Laos traders, is to continuously maintain close relationship with partners and provide services based on trust and loyalty, as payment is occasionally made in cash.
- 3) Service Quality & Product Differentiation Strategy** is to respond to customers' needs in every aspect.
- 4) Pricing Strategy** is to allow credit trading with trusted partners and the adjustment of price to reflect the current competition condition.
- 5) Cost competitiveness strategy** becomes practical as most consumers have low income. A number of competitors are from China and Vietnam who compete with cost advantage by offering lower price with fine quality. Besides, the shipping service is used as distribution channel to save time and cost while inventory management is based on just in time basis to control cost effectively.

All five-group strategies resulted in successful border trade business which is well-equipped with ability to create satisfaction to clients or trading partners, ability to build relationship and develop trading network in Laos

and Vietnam and ability to build loyalty in customers or trading partners.

Table 2 : Extracted Factors and Factor Loadings Related to Business Strategies

Factor and Items Loaded on Each Factor	Mean	S.D.	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Factor 1 : Product Strategy							
1. Frequently retains product image and service	5.27	1.04	0.767				
2. Focuses on product quality rather than price cutting	5.05	1.08	0.469	0.401			
Factor 2 : Relationship Management Strategy							
3. Frequently builds good relationship with trading partners	5.53	0.91		0.905			
4. Frequently retains client base in the border region	5.45	0.95		0.903			
5. Has honesty with trading partners	5.30	0.94		0.857	0.350		
6. Frequently retains trust with trading partners	5.27	0.93		0.806	0.363		
7. Responds to clients needs in every aspect	5.24	1.04		0.758	0.383		
Factor 3 : Service Quality & Product Differentiation Strategy							
8. Focuses on service quality with trading partners	5.24	1.06	0.379				0.746
9. Focuses on differentiation of product and services	5.00	1.03					0.703
Factor 4 : Pricing Strategy							
10. Frequently adjusts price to reflect current economic condition	4.35	1.49					0.908
11. Provides credit terms to trusted trading partners only	5.05	1.00					0.808
12. Allows early payment in cash for new trading partners	4.84	1.21					0.661
Factor 5 : Cost competitiveness strategy and efficiency							
13. Use shipping service due to convenience	4.84	1.14					0.856
Percentage of variance			47.06	12.80	8.08	6.40	5.42
Cumulative variance explained			47.06	59.86	67.94	74.34	79.76
Cronbach's Alpha			0.846	0.817	0.866	0.796	0.843
Remarks: Interpretation of Mean							
	1.00-1.83 is		3.51-4.33 is		rather important		
	1.84-2.67 is		4.34-5.17 is		very important		
	2.68-3.50 is		5.18-6.00 is		most important		

5. DISCUSSION AND RECOMMENDATIONS

The research finding of competitive competency is very interesting in the sense that it shows of current operations of Thai border trade businesses can benefit as possible from mega development project like EWEC.

Thai border trade businesses have strong competitiveness with efficient business functional advantages especially in marketing and finance as well as personnel activities together with local advantage. Regarding to local advantage, the finding shows a key strength in business practice is reliance on personal and business relationships and networks which it is consistent with the results found in the past research [20]. Thai border trade businesses are also competent in not only negotiating and dealing with neighboring customers, but also in managing and understanding neighboring authorities. Thai border trade businesses have learned to maintain a very high level of product quality. This competency is clearly a criteria one in developing successful marketing advantage that can be differentiated from other foreign competitors.

However, there are some aspects of competitive competency have to be improved: be monopolist seller in Laos; has strong units to responsible for all business function; and sufficient resources i.e. equipment, R&D. These results imply that Thai border trade businesses are going to gain much more from EWEC if they can strengthen themselves in all aspects.

With regard to strategies, the findings show that there are many strategies involving this border trade market. The marketing strategy is very important and received much attention from Thai trade businesses to employ for successful competition in this border market. A successful marketing mix is a way that firms adjust their marketing mix to fit changing environmental and organizational factors [21]. It also integrates marketing activities by identifying clear customers, marketing research utilization, marketing planning, marketing organization, product, price, promotion, and distribution which are consistent with the results found in the past research [22].

Moreover the findings show that maintaining good relationship, honesty and trust with trading partners are the most important strategies for business implementation which are consistent with the results

found in the past research [23]. Thus, it can suggest that establishing a strategic business unit to responsible for monitoring and managing relationship with trading partners might appropriate for business sustainability. This special's strategic business unit's task will cover knowledge creation, and dissemination, and development of border trading relationship marketing concerns. Responds to clients need in every aspect is also the most important strategies of Thai border trade businesses which is the key attribute called adaptiveness of particular importance global strategy [24]. However, all usable strategies are needed to improve and appropriated trading activities should be provided for business sustainability. Furthermore, for firm wishing to directly compete for market share in border trade market along EWEC, the development of respectable integrated strategy is potentially the most critical challenge, the heterogeneous of market demands leading to the conclusion that Thai-Laos border trade cannot be cultivated with a single strategy.

The border trade strategy leading to sustainable development of trade and investment cooperation between countries in the Mekong Sub Region should be under the philosophy of free trade and fair trade framework. The lack of one will cease a success in trade, since free trade is the condition of the removal of trade obstacles, resulting in sustainable trade (Necessary but insufficient condition for trade). In addition, the condition of fair trade, which is a condition of the allocation of commercial benefits that are mutually beneficial for partners, has originated to prevent exploitation of benefit for one's own interest. This can be enhanced through the adjustment in attitudes of those involved with trade and seeking for factors or the cause of inequity in the trade among partners. There should be studies to determine the types of products in order to increase imports to reduce the trading gap. Therefore, strategic adjustment of local administration together with international cooperation are needed, especially in potential economic activities as agriculture, trading, and tourism, if Thai and Laos were to benefit from EWEC [25].

In order to eliminate obstacles and develop the border trade system, government, customs, Ministry of Foreign Affairs and the Provincial Government should be highly involved in maintaining the continuity of the policy to support the border trade which should become a national agenda. Moreover, the structural problems among different sectors such as a development of labor and business productivity should be solved. Additionally, Ministry of Foreign Affairs plays an important role not only in maintaining good relations between countries, but also in border commercial. Meanwhile, customs and Provincial agency should support necessary trade infrastructure, and trade regulations.

6. CONCLUSION

This paper finds that there are 5 groups of competitive competency of Thai border trade businesses trade at Border of Mukdahan province: 1) Local advantage is the strongest competitive competency since they could

understand Lao PDR traditional trade system as well as Lao traders' behavior very well. Moreover ability in communication by using Lao language and Chinese in business negotiation and seeking market information; 2) Marketing management advantage, found that Thai border trade businesses on Thai-Lao PDR border of Mukdahan Province have capability in finding marketing information from neighbor countries as well as systematic planning on trading; 3) Financial management advantage, found that Thai border trade businesses have a good monitoring and internal control system as well as sufficient financial sources of credit management; 4) Strategic management advantage, consist of clear specifying business policy, having strategic business units which cover all trading functions, and excellent quality control system; and 5) Personnel management advantage, found that Thai border trade businesses have a good quality of human resources.

Regarding to the business strategies of Thai traders, the results show that there are five important strategies: 1) Product strategy, by continuously keeping good image and quality of products and services; 2) Customer relationship management strategy, by creating close relationship with Laotian entrepreneurs and doing business with sincere and trust; 3) Focusing on service & product quality differentiation by attempting to satisfy customers' needs in all areas; 4) Pricing strategy, by giving credits to reliable trading partners, and price adjustment to competitive situation; and 5) Cost leadership strategy, to gain a competitive advantage from China and Vietnam for consumer products which offer to low income and brand disloyalty segment, by offering low price with good quality.

Considering border trading competitive competencies and strategies collectively, some interesting issues are emerged. It might be able to say that Thai border trade businesses are not absolutely successful in performing their operations since they are lack of efficient strategies in supporting their trade, they do not operate well, and they do not reshuffle all business relates in time. Business sectors of the two trading countries are not quite good in term of their way of running border trading activities. Active national and local administration improvement of their roles and professional manners of Thai border traders are going to prosper sustainably as a part of trading along EWEC.

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The Successive Implement of ISO 9001, ISO 14001 & OHSAS 18001 for Large Enterprises in Thailand

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Pornrapeepat Bhasaputra and Woraratana Pattaraprakorn

Abstract— The purpose of this paper is to present the successive implementation of ISO 9001 Quality Management System, ISO 14001 Environmental Management System and OHSAS 18001 Occupational Health and Safety Assessment Systems for large enterprise in Thailand. In addition, this paper studies the key success factor to drive the implementation of ISO standards system in the designated factories which defined by The Energy Conservation and Promotion ACT (No.2) 2550. The factors of global economy are driven the business partners to communicate with international standard, which the different Thai Standard Industrial Classification (TSIC) many have the different factors for driving implementation. The beginning state of introduction ISO 9000 aim to improve quality system and the efficiency of communication between buyer and supplier until the recent revised of ISO 9001:2008 had emphasis management responsibility and customer satisfaction. Furthermore, ISO 14001 and OHSAS 18001 are introduced to emphasis organization to control the environmental management system and follow the occupational health and safety laws. The ISO are still an interested from many enterprises to certify the implementation and the opportunity of growth of ISO standard in Thailand industrials. Finally, the fabricated metal, parts, equipment and electronic component or TSIC 38 is the night rank of certified ISO for designated factories in Thailand.

Keywords— The International Organization for Standardization (ISO), The Occupational Health & Safety Management System (OHSMS), The Integrated Management System (IMS), The Occupational Health and Safety Assessment Series (OHSAS), Thai Standard Industrial Classification (TSIC).

1. INTRODUCTION

During the past two decades, the global economic significantly grows in the western countries and flow to the Asia countries. The globe economic and the demand of the good quality products at the affordable cost are leading the large enterprises from the western countries in Europe and North America, are looking for the new manufacturing base in the developing countries. One of the most barriers at the begging of the transferring or relocation manufacturing base from the western countries to the new location with the lower manufacturing cost at the acceptable quality products is the communication in the common understanding. The beginning of the 20th century, business of components, parts, service and suppliers are the most demand for western countries. The interaction has been between purchaser from western countries and supplier in the developing countries on the local tariffs, regulations, standard and technical specifications exchanges would be a critical barriers and exceeding difficult. The consequence of the international trading activities required a common understanding of products requirement, technical specification, regulations and

repeatability quality. The international standard had developed and aimed to define the generic standardization requirement and repetitive applications in the industry, engineering, science, technology and economy. At the starting of standardization arose to limit the anti-economic diversity to their interchangeability, facilitating activities at manufacturing and the repair and maintenance of products and services [1].

The International Organization of Standardization (ISO) founded on 23th February 1947 at Geneva, Switzerland. The ISO was first create after the World War II, known as BS5750, to solve the problems in the British high-tech Industries. However, BS5750 is known as a management standard because there is no specified on what it is manufactured, but how does the manufacturing process manage. In 1987, The British Government adopted BS5750 as international standard called ISO 9000, a generic quality management system standard [2, 3]. ISO is a network of the national standards institutes of 162 countries, on the basis of one member per country, with a Central Secretariat in Geneva, Switzerland, that coordinates the system. ISO standards contribute to making the development, manufacturing and supply of products and services more efficient, repeatability quality, product compliance to the specification, safer and cleaner. They make trade between countries easier and fairer. ISO standards are technical agreements which provide the framework for compatible technology worldwide.

Since ISO 9000 was introduction in 1987, it has been revised in 1994, 2000 and become ISO 9001:2008 or version 2008. However, the ISO 9001 was diversified in many fields of management systems in term of very different functions and operating activities, such as

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environmental management was ISO 14001 and occupational hazard prevention was OHSAS 18001 for occupational health and safety management. The ISO 14001 standard, environmental management system, was published in September 1996 and revised in November 2004. The ISO 14001 was developed by the enforcement of market mechanism, sustainable development, pollution prevention and compliance assurance [4]. The standard is a part of an organization's management system that used to develop and implement the environmental policy and manage the environmental aspects. ISO 18000 in the namely of OHSAS 18001 standard, was an international occupational health and safety management system published in 1999. According to the higher specification of OHSAS 18001, ISO had dropped the developed process to set up ISO 18000. OHSAS 18001 was developed to be compatible with ISO 9000:1994 and ISO 14001:1996 in order to facilitate the integration of quality environment as well as occupational health and safety management systems. Thailand had launched the TIS 18001 standard similar to OHSAS 18001 standard.

2. DEVELOPMENT OF INTERNATIONAL STANDARDS

In the early of 20th century, the rapid growth of the western economies and the successive of dissemination of management standard in globalization enhance the growth of business infrastructure in Asia countries. It made the outsource business expansion from the multinational companies. The key success factors of those companies are the international standard system, policy and procedure from the corporate enterprises. The ISO standards are the most contribution to the success of technology transfer from the western to Asia countries. A development journey of ISO has developed the first ISO 9001 system in 1987. It was a Quality management tool designed to help an organization achieves its Total Quality Management (TQM) goals. ISO 9001:2008, the more recent version of ISO 9000 family, consists of a series of quality management standards aimed to standardize working processes and encouraged quality production throughout a variety of industries. ISO 9001:2008 regularly analyzes conformance to customer requirements, characteristics of planning, construction implementation processes, and supplier performance data. ISO 9001:2008 is the set of organized tools and methods that may work in conjunction with a TQM approach to achieve quality milestones.

An environmental management system (EMS) is the system by which a company controls the activities, products and processes that cause or could cause environmental impacts and in doing so minimizes the environmental impacts of its operations. This approach is based on the management of "cause and effect", where company's activities, products and processes are the causes or "aspects" and their resulting effects, or potential effects, on the environment are "impacts". Aspects would be things within company's control that directly or indirectly cause those impacts. Environmental systems such as an internal waste reduction program can

be perform or can be formal and standardized, such as ISO 14001. ISO 14000 is a series of international standards for environmental management. It is the first series of standards that allow organizations from around the world to pursue environmental efforts and measure performance according to internationally accepted criteria. ISO 14001 applies to any organization that wishes to improve and demonstrate its environmental performance to others through the presence of a certified EMS [5].

An Occupational Health and Safety Management System (OHSMS) provides a framework for managing Occupational Health and Safety (OH&S) activities, procedures and processes so they become more efficient and a more integrated part of the overall business operations. An OH&S management system also provides a formal structure for identifying and managing significant OH&S hazards and risks. OH&S Management System is based on standards which specify a process for achieving improved OH&S performance and comply with the local regulations. Similar to the quality management process, there are safety standards available to assist in the construction safety management process. The Occupational Health and Safety Assessment Series (OHSAS) 18001, is an international specification standard created to address a variety of job-site health and safety issues commonly encountered in the construction and manufacturing sectors. The OSHAS 18001 is a documentation intensive system that can be altered and customized to cater organizations particular needs. The primary rationale behind OSHAS 18001 is to continuously minimize occupational hazard risk in the workplace, which in turn improves company profitability [6]. Quality, the environment, health and safety are all unified by the concept of risk. Using three separate management systems within one organization is clearly time-consuming expensive and inefficient. According to the integrated management systems, the organization can minimize duplication documents and work load, align objectives and reduce costs.

An integrated management system (IMS) describes several previously separate management systems grouped together to form a single system. For example, it could combine ISO 9001:2000 (quality) certification with ISO 14001 (environment) certification. A management system is integrated when at least two out of three possible systems (quality, environment and health and safety) are integrated as shown in Fig.1. The different possibilities are:

- Quality + Environment,
- Quality + Health & Safety,
- Environment + Health & Safety,
- Quality + Environment + Health & Safety.

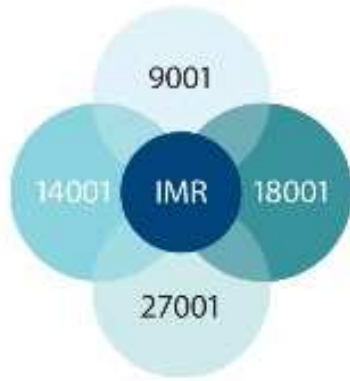


Fig.1 Integrated management system concept.

The aim of IMS is to streamline processes even further and avoid duplication procedures and working process. However, just because a system is integrated does not mean less attention is paid to auditing individual systems. The system must conform to the requirements of the individual standards, in order to maintain a high level of credibility and effectiveness [7, 8] A comparison of the specific requirements of ISO 9001, ISO 14001 and OHSAS 18001 is shown in Figure 2 and 3 [9].

3. ISO DEVELOPING IN THAILAND

In 1968, Ministry of Industry promulgated the Thai Industrial Standard Act to establish the Thai Industrial Standards Institute as national standards body responsible for standardization activities in Thailand. In 1981, ISO 9000 was introduced to Thailand. In 1991, the

institute announced an adoption of TIS/ISO9000 series as National Standard for Quality Systems. In every aspect, it is similar to the ISO 9000 series established by the International Organization for Standardization and to the European Standards EN 29000. Thai industry can be more competitive in the international market through this international standardization. In 1985, ISO14000 was promulgated to standardize environmental protection issues. Then other standards were launched mainly in the industries such as OHSAS18001.

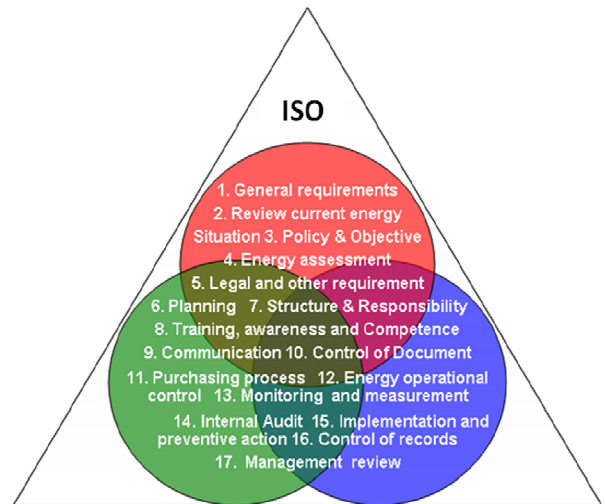


Fig. 3. The integration standard procedure of ISO 9001, ISO 14001 and OHSAS 18001.

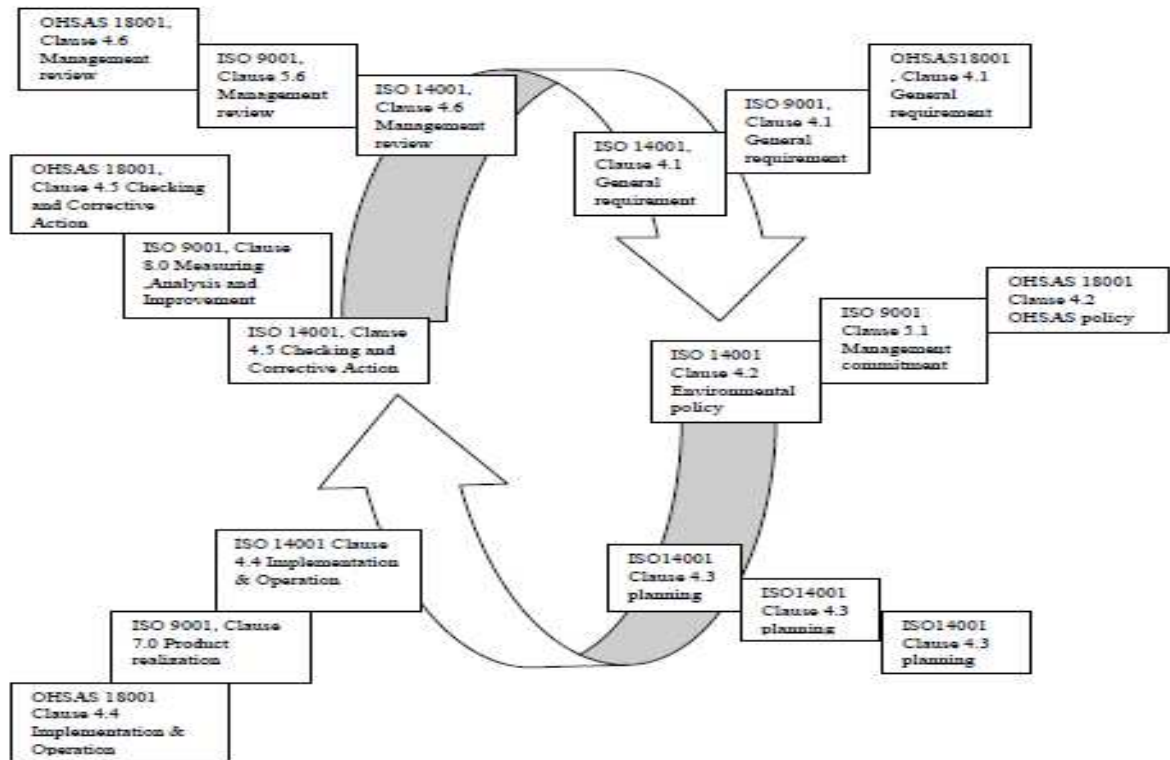


Fig.2 Integrated Implementation cycle for ISO 9001, ISO 14001 and OHSAS 18001.

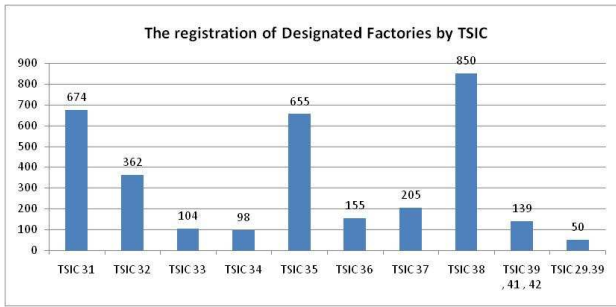


Fig. 4. The details of designated factories by TSIC.

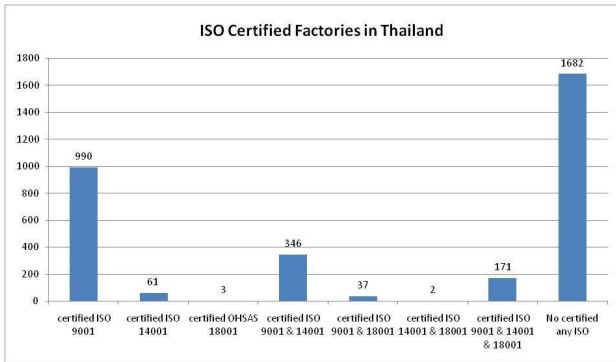


Fig.5. The certified ISO of designated factories in Thailand.

Thai Standard Industrial Classification (TSIC) had classified designated factories in 9 categories and 3,292 factories had registration as the designated factories in Thailand. The classification of designated factories is shown in Figure 4. In this paper, the classification of TSIC is used to study the ISO certified factories in Thailand.

The classified type of designated factories in Thailand is as follow:

TSIC	Description of factories
TSIC 31xxx	Food, beverage & tobacco
TSIC 32xxx	Textiles & leather products

TSIC 33xxx	Wood and wood products
TSIC 34xxx	Paper and paper products
TSIC 35xxx	Chemical and rubber
TSIC 36xxx	Non metallic mineral
TSIC 37xxx	Basic material
TSIC 38xxx	Fabricated metals
TSIC 39xxx	Other manufacturing

Figure 5 shows the details of certified ISO standard for designated factories in Thailand and Figure 6 is presented a distribution of certified ISO 19001, ISO 14001 and OHSAS 18001 by TSIC, which three highest rank of certified ISO standard in figure 6 are TSIC 38, TSIC 35 and TSIC 31 respectively.

According to above data, the TSIC 38 is the fabricated metals, parts, equipment and electronic components category. This TSIC has 850 designated factories and most of the factory had business with multinational company. The ISO is able to support this group to eliminate barriers of communication, technical specification and requirements. In fact, it make this TSIC 38 had highest certified ISO in Thailand. The second rank is TSIC 35, petrochemical, chemical and rubber products. The companies in this TSIC are most of the large enterprises and management with multinational employees and culture. The international standard is very important to standardization of clear vision, policy, working procedure, environmental at work place, safety in work place and society network. Most of large enterprises in this TSIC are certified to ISO 9001, ISO 14001 and OHSAS 18001 and compliance to local regulation. The third rank is TSIC 31 food, beverage and tobacco. This TSIC is the important for Thai people, because of the Thai culture in agriculture society with the support of government to driving Thailand to be a food products manufacturer for the world market. The communication to international world trading markets, the international standard and requirement are very important for TSIC 31.

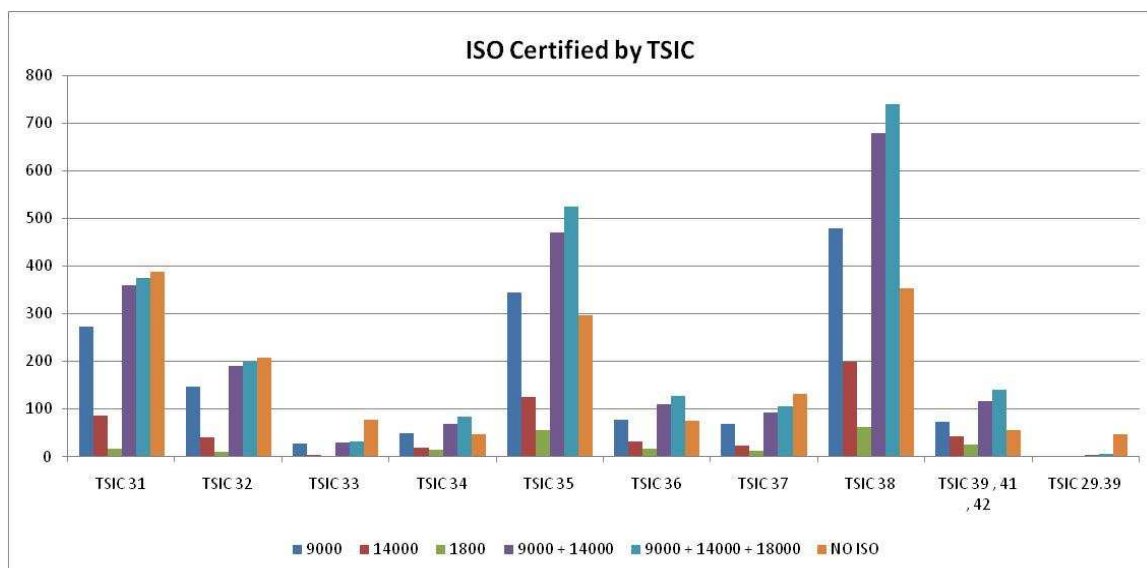


Fig.6. The result of survey in 2009, the number of designated factories with certified ISO by TSIC.

The most driving factors for designated factories in Thailand to certified ISO are global economy from the multinational companies. While the government officers and government policy, are encourage all designated factories in Thailand to be certified the international standard at least the ISO 9001. The other benefits of implement international standard at work place are the management integrity, national standard and standard working procedure. The company is improved working condition, review business risk, preventive actions, improve products quality and service mind to achieved customer satisfaction goals, improve the working environment, energy conservative, safety and social awareness.

4. CASE STUDY OF ISO

In larger enterprises, the enterprises are still focused on developing their management and manufacturing practices. At present, all companies are surveying and refurbishing several of their factories in anticipation of undertaking the ISO 14001 and OHSAS 18001 certifications. The companies plan to accredit all of their factories with ISO 9001, ISO 14001 and OHSAS18001 in the near future.

PTT is determined to be a good Thai business entity with a vision of being a Thai Premier Multinational Energy Company, using local strength for competing in the international arena. The company is committed to a mission that stresses responsibility to all stakeholders.

The ISO 9001, ISO 14001 and OHSAS18001 support its business of PTT to reach the goals as stipulated by the policy. These standards are shown in table 3 [10].

From the survey results of TSIC 35 petrochemical, chemical and rubber. All the large enterprises namely PTT PLC, Esso (Thailand) PCL, Star Petroleum Refining company limited and The Shell company of Thailand LTD are certified for both ISO 9001 and ISO 14001 and plan to compliance to OHSAS 18001 in near future. Only Thai Petrochemical Industrial PLC are certified all three ISO 9001, ISO 14001 and OHSAS 18001.

The other interested information from TSIC 38 fabrication metal parts, equipment and electronic components category. This sector most of the company is the multinational company and most of the company had head quarter outside Thailand. This section had highest ISO certification sections, because of the demand from the business model require all companies to certified ISO standard. In the study found most of companies had certified ISO 9001, ISO 14001 and OHSAS 18001, and other standard as per business partner requirement, the ISO 13485 for medial components, ISO/TS 16949 for automotive business and component parts to supplied both domestic and oversea markets. These groups of components business enterprises are driving and encourage the local partnership companies, small and medium enterprises (SMEs) to compliance with at least ISO 9001. TSIC 31 is also driving companies to certified ISO standard more over than ISO 9001, ISO 14001 and OHSAS 18001. TSIC 31 needs certified GMP (Good Manufacturing Practice) and compliance to HACCP (Hazards Analysis and Critical Control Points) under the regulation of Thai FDA (Food and Drug Administration Thailand).

Table 3. Application of the ISO 9001, ISO 14001 and OHSAS18001 of PTT.

Standard	Description	Application in The Organization																																																				
ISO 9001 Quality Management System	As one of the international standards adopted by business entities worldwide, ISO 9001 stresses quality excellence and organization efficiency.	<p>PTT has adopted international standards for quality, safety, occupational health, and environmental management, applying them as tools for the improvement of the company's management and operations. In 2008, all target sites were certified with ISO/TIS 9001, ISO/TIS 14001, and TIS 18001/OHSAS 18001, as Table 2 below.</p> <table border="1"> <caption>Percentage of ISO/TIS 9001, ISO/TIS 14001 and TIS 18001/OHSAS 18001 certified sites</caption> <thead> <tr> <th>Year</th> <th>ISO/TIS 9001 (39 target sites)</th> <th>ISO/TIS 14001 (30 target sites)</th> <th>TIS 18001/OHSAS 18001 (26 target sites)</th> </tr> </thead> <tbody> <tr><td>1997</td><td>5</td><td>0</td><td>0</td></tr> <tr><td>1998</td><td>15</td><td>0</td><td>0</td></tr> <tr><td>1999</td><td>40</td><td>20</td><td>0</td></tr> <tr><td>2000</td><td>85</td><td>50</td><td>10</td></tr> <tr><td>2001</td><td>85</td><td>65</td><td>20</td></tr> <tr><td>2002</td><td>85</td><td>75</td><td>25</td></tr> <tr><td>2003</td><td>95</td><td>85</td><td>60</td></tr> <tr><td>2004</td><td>95</td><td>95</td><td>80</td></tr> <tr><td>2005</td><td>95</td><td>95</td><td>90</td></tr> <tr><td>2006</td><td>95</td><td>95</td><td>95</td></tr> <tr><td>2007</td><td>95</td><td>95</td><td>95</td></tr> <tr><td>2008</td><td>100</td><td>100</td><td>100</td></tr> </tbody> </table>	Year	ISO/TIS 9001 (39 target sites)	ISO/TIS 14001 (30 target sites)	TIS 18001/OHSAS 18001 (26 target sites)	1997	5	0	0	1998	15	0	0	1999	40	20	0	2000	85	50	10	2001	85	65	20	2002	85	75	25	2003	95	85	60	2004	95	95	80	2005	95	95	90	2006	95	95	95	2007	95	95	95	2008	100	100	100
Year	ISO/TIS 9001 (39 target sites)		ISO/TIS 14001 (30 target sites)	TIS 18001/OHSAS 18001 (26 target sites)																																																		
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ISO 14001 Environmental Management System	ISO 14001 is a globally accepted Environmental management system, which requires a defining of organizational structure and responsibilities in order to accomplish the set environmental goals and targets																																																					
TIS 18001/OHSAS 18001 Occupational Health and Safety Management System	TIS 18001/OHSAS 18001 is a set of standards for the management of occupational health and safety, accepted in Thailand and internationally. TIS 18001/OHSAS 18001 focuses on the reduction of risks from injury, illness, and loss of properties. The standards correspond with ISO 9001 and ISO 14001.																																																					

5. CONCLUSION

All standards are really advocating the management of risk, whether the risk is delivering poor quality, causing environmental damage or injuring people, each standard is aimed at driving companies to put in place the processes and procedures, they need to control that risk and enhanced their owns business and revenue. So many companies have generated a Quality Manual and the consequence supporting procedures to meet ISO 9001 requirement, then a little while later, had to do the same thing for ISO 14001 and the environment, and so on.

So perhaps, if the company is approaching the issue of certification for the first time, developing a risk assessment process first, then systems to address the significant areas of risk may be a cost effective alternative to the traditional systems, and could still lead to an ISO certificate. Taking this approach would be fixing a problem that needs fixing, and must be easier to sell to a senior management team. A risk based approach leads to viewing the problems of Quality, Environment and Information Security etc. in a similar manner, with similar importance. All of the ISO standards have been developed around a standard template intended to fit together, and share a significant proportion of requirements. For instance, a Document and Data Control procedure which meets the requirements of ISO 9001 will also meet the requirements of ISO 14001 and OHSAS 18001 and the other standards.

The successive implement ISO 9001, ISO 14001 and OHSAS 18001 for large enterprises in Thailand was driving by TSIC 38, TSI 35 and TSIC 31 respectively. Of cause the driving successive of implement ISO standard in Thailand become three majorities factors. The first factor is globe economic transfer from western countries or multinational companies had encourage companies in TSIC 38 and TSIC 31 to certified and fully implement ISO standard and organization to support from customers driving. More over than the ISO 9001, ISO 14001 and OHSAS 18001 in both TSIC are aggressive drive to implement other ISO standards as per business category. And the implementation of ISO is not stop at their facilities, but driving the ISO standard requirement scheme to other domestic suppliers. The second factor driving companies in TSIC 35 to certified ISO standard and implementation are working environment and multinational companies. This TSIC 35 will implement just a necessary system requirement for integrity management, organization and environmental conservative. The third factor is the government policy to encourage all designated factories to certified ISO standard and implementation to their organization, products and servicing. The benefits of implementation ISO standard for large enterprises include SMEs are the efficiency or quality management policy, flexibility to support customers requirement under the repeatable products specification and proactive of servicing mind set to achieve customer satisfaction goals, environment, safety and health of all employees. The increasing of opportunity to implementation ISO standards for designated factories in Thailand is a great opportunity

and the successive implementation of ISO 9001, ISO 14001 and OHSAS 18001 of the large enterprises are driving the whole supply chain of business partners to certify and implementation of ISO standards in the next decades.

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Efficient Regional Transport to Reduce Rural-Urban Migration in Multan Region, Pakistan

Muhammad Haroon Siddique

Abstract— Situation of traffic in one of the largest cities of Pakistan is discussed regarding transport - Hukou system of China is also reviewed. Factors contributing the changes affecting relationship between rural and urban areas are analyzed. Implications regarding GIS and CCB are viewed before conclusion.

Keywords— Multan Region, Regional Transport, Rural-Urban Migration.

1. INTRODUCTION

The specific theme is the study of rural-urban migration in the Multan region in Pakistan with a view to reduce the same through an efficient regional transportation network. The topic has been chosen with a relevance to situation in Pakistan. An effort is made to explain the changing relationship between rural and urban areas over the past several decades and the factors contributing the changes are analyzed. The impacts in the context of bringing balanced development between rural and urban areas of the Multan region are studied. Sher Shah road and Bosan road experience the evidences of over-speeding more than rest of the city roads. New traffic authorities promise to make arrangements for the traffic awareness for the citizens in near future. Principal of Government College Multan also promised the students to make arrangements for training regarding traffic regulations in collaboration with the traffic police authorities. Traffic awareness and training should be made part of the syllabi at middle and secondary levels of school education [1].

Rural-urban migration is taking up the shape of another big problem for the developing nations; the following paragraph about China is quite useful to ponder:

Temporary migration due to lack of social security for migrants, rural land tenure insecurity due to frequent land reallocation and abusive land requisition due to lack of functioning and land markets are all major policy challenges that China is facing in its yet-to-be finished economic transition. Although there have been intensive studies and various policy recommendations on these issues, most discussions have so far neglected the close interrelationship between these issues and have failed to analyze them in an integrated framework [2].

Major findings of the research conducted in China regarding migration, from which the above paragraph is cited, were as follows:

- Up to now there has been very little literature that examines the policy process that would have to be put into place to ensure that China's urbanization proceeds in a healthy way.
- Rural migrant workers cannot have direct access to the same level of social security benefits, as people who are officially classified by the Hukou system as 'urban residents'.
- Though the urban Hukou-linked benefits have been declining as China's economic reforms have progressed, the Hukou system still limits these services to urban residents with Hukou, which constrains rural-urban permanent migration.
- China has reached a stage where the experimental approach of 'crossing the river by groping for stones' will not be sufficient although that is still useful.
- Further reforms need to be carried out in a holistic rather than a piecemeal manner in order to realize a full transition to market economy.

Hukou system is discussed here, that is similar to an internal passport system. Here a person's local 'citizenship' and residence is initially defined for a child as a birth right, traditionally by the mother's place of legal residence. Also useful to know that the legal residence in a city entitles one to local access to permanent jobs, regular housing, public schooling and public health care in that city. So, one needs to change this local 'citizenship' in order to permanently migrate and to be eligible for local benefits. This experience of China has great implications for rural-urban relations in developing countries as almost all the developing countries are confronting with the issues of intra-national and inter-regional migrations in different capacities, many of those are unjustified; those become a big challenge for the controlling and managing authorities to cope with.

Being China amongst the fast developing countries, their experiences benefit us to find out ways as to how other developing countries may make up their strategy for development keeping in view the rural-urban relations where reducing the rural-urban migration is an inevitable venture.

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2. AN OVERVIEW OF THE ISSUE IN OTHER CITIES OF PAKISTAN

In order to get a more accurate picture of the issue, let us study the transportation scenario in some other big cities of the country before Multan.

Karachi's transportation is entirely in the private sector and consists of about 18,000 buses. Lyari Express Way project has its main beneficiaries the contractors, builders and developers and large scale investors. Proposals for a light railway mass transit system for Karachi have already been in the offing since 1977. The 1977 plan consisted of revitalizing the Karachi Circular Railway (KCR) - built in 1962, and branching it out into the suburbs. The KCR circle was to be linked together by a part elevated, part underground transportation spine. This bi-secting link was to pass through the centre of Karachi joining Saddar and the surrounding residential and commercial areas to each other. The execution proposal would have solved all the present day issues like; inner city congestion caused by thousands of racing mini-buses causing pollution and accidents, the conflict of local and through traffic, long commuting distances and the time fuel spent commuting from the North to the South of the city. It provided a cheap pollution-free (noise and air) quick means of public transportation. However, this scheme was never implemented. Karachi Circular Railway is constantly in the print media. Announcements for its revival and execution are made regularly. However, work has not commenced on detailing the designs, preparing tendering drawings and related procedures. One of the major causes of delay is the bus operators' lobby which feels threatened by another means of public transport. They pressurize and bribe the government officials to keep delaying the works [3].

Anjum and Hameed [4] rightly consider use of different transportation modes a driving force to influence the city form, emphasizing further that the motorized transportation plays a rather crucial role in encouraging the tendency for dispersed and often low-density horizontal expansion in the industrialization era of today. Furthermore, they suggest high occupancy transportation systems such as bus and rail for a sustainable development in contrast to privately owned cars. They conclude that public transportation can play the role of a catalyst in generating house building activity in fringe areas of Lahore where previously even provision of infrastructure services could not speed up the process of housing and development with the pre-condition that certain measures be taken to the needs of the people belonging to stratified income brackets and for rights-of-way for both the bus- and rail-based options; these measures may include development of hierarchy of road network, integration of road linkages as well as provision of decent, comfortable and environment-friendly transportation. Qadeer [5] has given a detailed picture of the trends of population in Lahore. The residents of Lahore, as elsewhere in Pakistan, present a very awkward picture in different walks of life, excluding not the traffic and transportation [6].

3. REGIONAL TRANSPORT FOR REDUCING RURAL-URBAN MIGRATION IN MULTAN REGION

If the issue of rural-urban migration is not taken up seriously in case of Multan region, the problems may become many-fold. In order to address the issue, let us now study the scenario of Multan region in detail.

Back-flash

Multan is said to be called after an ancient tribe 'Mul'. Heat and dust of Multan are proverbial [7]. On one hand the city of Multan holds quite significant role in the broader perspective of the region due to certain reasons [8] and on the other hand the Multan region as a whole has got certain distinct preferences to the other regions of the country. Multan is the 5th largest city of Pakistan and considering it collectively with the rural hinterland around it the Multan region is especially important due to certain reasons, including the following:

- Agriculturally rich profile.
- Culturally millenniums-long fascinating history.
- Multi-cultural agglomeration.
- Present-day fast growth of the region as well as the regional center.

The Multanites have got wonderful potential for regional development as they have already made efforts those show what they possess. According to [8]:

- People made use of more than one method of financing as:
 - Only 33% of their respondents arranged finance at their own; of this the further sub-division was in the following forms:
 - 60% through rotary credit system
 - 26% through personal past savings
 - 14% through inheritance
 - The remaining over two-thirds went for loans; of which further sub-division was:
 - 50% borrowed from friends and relatives
 - 33% borrowed from House Building Finance Corporation
 - 10% borrowed from banks
 - 7% borrowed from their employers
- Formal sector was not welcomed by their respondents in most cases to seek loan from; 59% of the respondents not even applying for a loan from the formal sector is evidence. Inconvenient rates of interest and cumbersome procedure are the top-ranked factors among the reasons mentioned by their respondents in not applying to formal sector.
- Repayment of loans was done through the following modes:
 - Reduction in monthly expenditure
 - Working extra hours

- Selling assets
- Others (undisclosed by their respondents)
- 58.60% of respondent families had one earning member, 14.65% had 2 whereas the remaining 26.75% had more than 2 earning members.
- Slightly over one-third of their respondents had some of their family members overseas:
 - 22.93% had only 1 of their family members overseas
 - 6.37% had 2 family members working overseas, and
 - 6.37% had more than 2 members working overseas

The Multanites have shown up their potential in different walks of life. The need is now to channelizing their efforts to secure regional development reducing rural-urban migration.

Rural-urban migration is quite evident in the Multan region with population of over ten million by 1996 that was estimated by the United Nations to increase rapidly for the years to come [8]; population growth rate was recorded to be 3.4% per year [7]. A glimpse of rural-urban migration being the following:

There was housing stock of 238,000 housing units in the city of Multan yet the estimated demand was of over 305,000 by the year 2000. So the available housing was increasing at the rate of 3.11% annually to address the situation [9].

The rural-urban migration has seriously adverse effects on the society in many aspects ranging from individual and community life to the overall impression of the country and nation in the international scenario. Of all the residential areas in Dhaka, 64% are slums [9]; Bangkok has got 40% of its residents living in slums (Routray: 2008). 30-35% of the city population was living in 28 slums and katchi abadis of Multan [10].

4. WAY FORWARD

Non-tendency of vast public transportation use is on one hand multiplying the overall traffic problems in Multan city specifically and Multan region generally whereas on the other hand it hinders the way towards reducing rural-urban migration in Multan region – the region that has quite substantial potential otherwise as stated before. There used to be a time when Multan city was not as large as it is today and it is going to further enlarge in the future years. Those days people would commute on foot; or even a bicycle or a tonga (a local horse-driven cart) met the needs of the Multanites. But today people need a well-organized transportation system to commute their work places as well as to get their social activities done appropriately. Keeping in view the economic conditions of the people of Multan a public transportation system vast enough to meet the afore-mentioned needs of the target group seems to be need of the hour. As non-tendency of vast public transportation use is multiplying the overall traffic problems in Multan – making way for rural-urban migration to meet the needs of urbanizing

new society. Here comes the implementation issue for which the Geographical Information Systems (GIS) has got no match as it caters for the monitoring needs most appropriately at large and small scales both; enabling the decision-makers to get to the most appropriate alternatives. The Citizens' Community Boards (CCBs) seem also to be a very good tool to meet our goal as these are widely in use in many parts of the country and Multan especially. So we assume that the presence of a practicable mechanism of vast public transportation and efficient working of the same will result in achieving the desired degree of development in Multan region through reducing the rural-urban migration. This can be better achieved with Geographical Information System and Citizen's Community Boards.

5. IMPLICATIONS OF GEOGRAPHIC INFORMATION SYSTEMS ON TRANSPORT

Since the transportation aspects are very much geographic in nature, so some knowledge of geographic information seems to be quite useful to mention here. Geographical data can be considered as a form of spatial data [11] and Malczewski [12] believes that in a possibility of association to a place or location, a datum is regarded as geographical. Out of the data that is incorporated by the managers or decision makers almost 80% relates geographically. According to [12] *geographical or spatial decision problems* are such decision problems that involve geographical data. He further suggests that *geographical or georeferenced data* are the spatial data that are referred to a location on the Earth's surface. *Spatial data* and *geographical data* are the terms those are in use interchangeably [12]. Berry [13] and Wilson [14] clarify that *spatial structure data matrix* and *spatial interaction data matrix* are the two distinctive tabular forms the geographical data can be arranged in. *Geographical data matrix* and *spatial behavior data matrix* respectively are another form of the two afore-mentioned terms [12].

Knowing the importance of geographic information for the field of transportation, experts have come up with a specialty named Geographic Information Systems for Transportation (GIS-T). Fletcher (2000) defines GIS-T as follows:

Geographic Information Systems for Transportation (GIS-T) are interconnected hardware, software, data, people, organizations, and institutional arrangements for collecting, storing, analyzing, and communicating particular types of information about the Earth.

Since applications of GIS-T cover much of the broad scope of transportation, transportation analysts as well as decision-makers make use of GIS tools in infrastructure planning, design and management, public transit planning and operations, traffic analysis and control, transportation safety analysis, environmental impact assessment, hazards mitigation, configuring and managing complex logistics systems and so on [15].

According [16], data collection is the fore-most step as computers and GIS cannot directly be applied to the real world. Real world phenomena of interest need to be represented in symbolic form as the computers make use

of internally held numbers and characters as binary digits. Here come the 'symbolic models' that is actually an abstraction process of representing the geology, structure, geophysical or another property of Earth's surface in a computer-accessible form.

Yet another aspect of development now-a-days is the participation; GIS trend-setters have devised the fascinating concept and tool-box of Participatory Geographic Information Systems (PGIS). Jankowski and Nyerges [17] define the interesting Participatory Geographic Information Systems saying that Participatory Geographic Information Systems is the Geographic Information Systems designed and used by groups with multiple stakeholder perspectives. With additional capabilities for group decision support, PGIS is equipped with all the capabilities of GIS. Contributing to the understanding of PGIS use in society is the participatory geographic information science that is actually a sub-field of geographical information systems.

6. IMPLICATIONS OF CITIZENS' COMMUNITY BOARDS ON TRANSPORT

In Pakistan, like other countries community participation is an emerging concept in development sector. In this context, Devolution Plan 2001 of Pakistan provided a number of institutionalized opportunities for citizens to participate in council affairs. Citizen Community Board (CCB) is one of the special purpose institutions. The CCBs have been configured as community based project implementation and management bodies. They are responsible to enable the proactive element of the society to participate in the public work and development related activities of the local governments. In addition, it has been made mandatory that all kinds of small-scale development is to be carried out through CCBs. These bodies must have to generate 20% of the total costs of project whereas the rest 80% is to be contributed by the local government. For this purpose 25% of local annual development funds must be allocated to projects identified by CCBs and these may not be re-allocated to any other head of expenditures.

7. CONCLUSION

Concluding, the regional development of Multan region can get a drastic boost with effectively reducing rural-urban migration if an efficient regional transportation system is added to the region. According to Laws and Marcus [18], the problem of developing countries is two-fold as they are stuck up on one hand in being unable to find out proper reasons of their problems and on the other hand in finding the solutions. Here we have been successful on one hand in identifying the proper reasons of regional development problem in Multan region and on the other hand in finding the regional transportation as the real solution. As stated in the preceding part of this paper, there is lot of potential in the Multan region as well as the Multanites in terms of different resources and it has been exhibited also in the past. Tao and Xu [2] propose a policy package on China's migration and rural land policies to address the challenges in a holistic

manner by taking into account the impacts of China's characteristics that is a large developing country in transition according to them; we should also make use of their view. We may rightly expect a substantial regional development in Multan region now with an efficient regional transportation endeavor that will truly work as a catalytic agent in channelizing the efforts to make up best use of the potential reducing the rural-urban migration.

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Environment Planning of Watershed Area by Using a Hybrid MCDM Model

Yen Lee, Ho-Shong Hou, Yi-Chen Chen, and Gwo-Hsiung Tseng

Abstract— In the real world, environment-watershed Area sustainable development is an important issue for human life comfortable. Its sustainable development is affected by natural disasters such as earthquake, typhoon, torrential rain, etc. The decision making process are uncertain in a number of ways, such as subjective perception, natural language, etc. Most dimensions/factors have interdependent and interactive features, so they cannot be evaluated by conventional measures method. Multiple Criteria Decision Making (MCDM) model is used for addressing dependent relationships among the criteria. MCDM model is applied to measure and evaluate watershed environmental problems successfully in this paper.

Keywords— Watershed, Wetland, Multiple Criteria Decision Making, MCDM.

1. INTRODUCTION

Research Background and Purpose

The birthplace of the upstream terrain steep is uninhabitable. However, the watershed area from the beginning of the middle reaches till the lower reaches of the river to the Coastal of wetland are more gentle, which is a more complete regional environment for inhabitation. It is very important to manage the regional environment since it affects human life, and natural, ecological, and environmental sustainable development. In the recent years, the overall environmental impact of natural disasters (such as earthquakes, typhoons, and rainstorms) as well as a large number of man-made disasters for economic gains, and the rapid development of land under the living areas have caused serious environmental impact and damage, and have created an imbalance of regional space in the natural ecosystem.

The main objective of regional environmental planning for sustainable development is to improve the gaps of criteria for achieving the aspired levels of human welfare, while taking into account the factors of comfort and safety. There are some critical components in the environmental project that need to be considered for evaluating the strategy with the decision making process. In general, these critical components are numerous in number and are known to affect each other, and therefore, the analysis is complex.

A sustainable environment is a function of two major components, ecology and humans, that is, sustainable decision-making should have two simultaneous goals: (1) Achievement of human development to secure high standards of living; (2) Protection and improvement of the environment now and for the future generations.

Research Issues and Objectives

The entire process of planning depends upon how the planners or policymakers understand and interpret the concept of environmental sustainable development and regional environment planning on the nature of the planning mechanism prevalent in a country. Hence, the present study aims at developing a hybrid novel model for strategy evaluation, alternative selection, and the regional environmental project optimization. Finally, an empirical regional environment problem is investigated in order to demonstrate a novel hybrid MCDM (Multiple Criteria Decision Making) model proposed for future applications. The results indicate that the proposed method is suitable for the real world.

Framework Research Methods

In the first stage for the evaluation of environmental watershed region issues using multiple criteria decision making methods, the best project selection for the regional environment planning of evaluated criteria, the aspects under consideration, and the feasible alternatives are defined through brainstorming, scenario writing, and discussion with experts.

In the second stage, statistical factor analysis is employed in order to extract some common factors for identifying the relationship among these evaluated criteria. The other approaches available for identifying the relationship among criteria include DEMATEL (Decision-making trial and evaluation laboratory), and ANP based on the DEMATEL technique to build the network relationship map (NRM) for constructing Super matrix.

In the third stage, the weights of evaluated criteria are assessed based on the fuzzy hierarchical analytic process by utilizing geometric means to integrate the group judgment. In the fourth stage, the performance score of feasible alternatives corresponding to criteria is calculated, and fuzzy AHP (Analytic hierarchical process) is employed to derive the synthetic values within each common factor.

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Finally, the preferred order is determined for all alternatives according to the final synthetic value. Furthermore, an introduction to De Novo Programming is presented for solving the optimized distribution network design in the environment of watershed region.

2. CONCEPT OF REGIONAL ENVIRONMENT PLAN MEASUREMENTS

Environment-Watershed Plan Measurements

Environment watershed plan measurements involve a number of complex factors, however, including management engineering, ecological restoration, environmental construction, and environmental conservation issues.

Many factors/criteria; the environmental watershed plan index are considered to focus on catastrophe, human safety, comfort, interest, the ecological system, and environmental sustainability. Many studies have provided useful methodology and models based on problem-solving procedures that have mainly been applied to the field of environment watershed plan management in Taiwan. Watershed planning, restoration, and management have specific hydrologic functions and ecological impacts. The inventory, evaluation, and planning for watershed restoration were based on geomorphic, hydrologic, and ecological principles.

The criteria mainly include three conflicting types of interest: economy, ecology, and sociology. Apart from calamity, which still accounts for environment watershed planning in natural catastrophes, engineering design error and incident data, maintenance, and operational deficiencies are typically cited as causes of failed planning. This study aims to discuss the effects and produce a NRM for each factor/criterion. Influence factors/criteria and the relational structure of environment watershed planning have been studied.

This paper uses two methods to establish the evaluation model based on a new hybrid MCDM model to address dependent relationships among criteria, using a DEMATEL technique to build a NRM, then an ANP technique is used to obtain the relative importance/weighting preferences for each criterion.

The environment-watershed problems have been statistically described from natural disasters and the artificial merging of two levels. Firstly, typhoons, torrential rains, and earthquakes cause the rivers to overflow, cause the violent landslides, and result in potential debris flow. In addition, environmental demand for space and water has increased artificial disturbances changes of land pattern utilization and terrain features carry out the transition of development.

How to solve the environmental watershed problems? Firstly, from the watershed environment survey data, some characteristic values that improve and stabilize the river canal shape, increase the activities of the biological community are found. There are four influence aspects are: (1) watershed management and erosion control; (2) ecological restoration; (3) environmental construction; and (4) environmental conservation. The fifteen factors/criteria are: (1) violent landslide perturbations; (2) potential debris flow torrents; (3) rivers of erosion

and deposition; (4) soil and water conservation of roads; (5) activities of biological communities; (6) habitat molds and regeneration; (7) integrity of ecological corridors; (8) ecological monitoring and management; (9) ecological potentiality and restriction; (10) peripheral landscapes and natural features; (11) tour facilities; (12) resources of humane industries; (13) potentiality of land development; (14) artificial disturbance minimization; and (15) prevention of development. These are given in Table 1.

Table 1. The Influence Dimensions and Criteria for Comprehensive Conservation in Watershed Environment

Dimensions	Influence Criteria	Statements of Influence Criteria
Watershed Management and Erosion Control (D ₁)	1. Violent landslide perturbations (C ₁)	In order to reach the purpose of stabilizing landslide, use various kinds of projects and non-projects to increase soil body resistance.
	2. Potential debris flow torrents (C ₂)	Renovate the potential debris flow torrent and set up the mechanism of safe protection to reach the effectiveness of disaster prevention and mitigation.
	3. Rivers of erosion and deposition (C ₃)	Treat channel silt situations, the coherent abilities of every bottleneck section, and the sources of soil and sand, and then put forward the solution.
	4. Soil and water conservation of roads (C ₄)	Improve on the issues of the slope stability destroyed by road development and the conservation of water source to reduce the impact produced by roads toward environment.
Ecological Restoration (D ₂)	5. Activities of biological communities (C ₅)	Investigate biological species and habitat environment of watershed to understand the combination of regional ecology.
	6. Habitat molds and regeneration (C ₆)	Consider the ecological development in watershed to improve the environment of ecological habitat.
	7. Integrity of ecological corridors (C ₇)	Set up ecological protection plan and draw up the largest coverage of human activity and the buffer between people and living beings to maintain the continuity and fullness of ecological corridor.
	8. Ecological monitoring and management (C ₈)	Continuously monitor ecological quantity and species development in the area, improve and investigate possible reasons of influence (water quality, air and offtal).
Environmental Construction (D ₃)	9. Ecological potentiality and restriction (C ₉)	Analyze the issues of biological resource, water quality resource and ecological resource.
	10. Peripheral landscapes and natural features (C ₁₀)	Wholly consider the combination of tour landscape and special features in inside and outside planning districts.
	11. Tour facilities (C ₁₁)	Emphasize the harmoniously aesthetic feeling of ecological environment and every facility should take natural material as the core.
	12. Resources of humane industries (C ₁₂)	Lead local humane style and peculiar products (such as culture, fruit, and animal) in the wholly humane industry plan.
Environmental Conservation (D ₄)	13. Potentiality of land development (C ₁₃)	Through considering the traffic convenience and the susceptibility of hinterland size and calamity, set up the development potentiality of regional construction.
	14. Artificial disturbance minimization (C ₁₄)	Artificial disturbance minimizing makes the natural ecology reach the balance.
	15. Prevention of development (C ₁₅)	Delimit the preserve of watershed and forbid developing.

The Best Plan Environment-Watershed Measurement

For the best plan or government authorities, plan engineering not only acquires nice planning and design but also good plan so as to achieve the three goals for planning management with high efficiency and high quality.

The analytic hierarchy process (AHP) method is widely used for multiple attribute decision-making (MADM) and has successfully been applied to many practical decision-making problems. The empirical effectiveness and theoretical validity of the AHP have also been discussed by previous study and this discussion has focused on four main areas.

Via expert questionnaire suggest some factors/criteria of Environment-watershed can join with the same attribute. Thus in the first dimensions of watershed management and erosion control, we join: (1) violent landslide perturbations, to (2) potential debris flow torrents; in the second dimensions of ecological restoration, to join (5) activities of biological

communities, to (6) habitat molds and regeneration; in the third dimensions of environmental construction, to address (7) Landscape tour and natural features, (8) Human industry and resource of land, to take the place of (9) ecological potentiality and restriction, (10) peripheral landscapes and natural features, (11) tour facilities, (12) resources of humane industries, (13) potentiality of land development. In summary, it needs to consider factors / criteria which have to enclose four dimensions and ten factors/criteria, i.e. including: (1) watershed management and erosion control; (2) ecological restoration; (3) environmental construction; (4) environmental conservation. Based on these, 10 evaluation criteria for the hierarchical structure were to use in our study.

The hierarchical structure adopted in this study to deal with the problems of plan assessment for environment-watershed as shown in Figure 1.

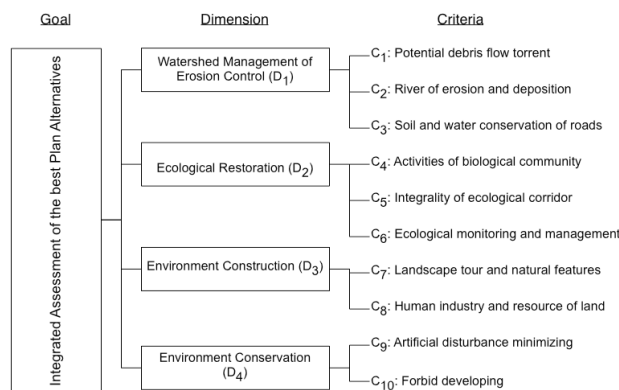


Fig.1. The Hierarchical Structure for the Best Plan Alternatives Assessment.

Wetlands Environment Plan Measurements

Wetland environmental plans are a very important type of plan that relate to human welfare and safety.

The island of Taiwan has approximately 11,846 hectares of wetlands. Thus, a majority of coastal development is directly or indirectly related to wetlands, and development is typically in conflict with the preservation efforts of the wetlands.

Measuring wetland environmental plans involves a number of complex factors, including natural environment, ecological environment, physical environment, human environment, society, and economic issues. There have been considerable research discussions on the landscape of wetlands, the economy, water storage, management modeling, and scenario evaluation. How can the environmental problems of wetlands be solved? The wetlands environmental survey data revealed characteristic values that were used for improving and stabilizing the river canal shape, increasing the activities of biological communities, increasing mold habitats and regeneration, improving structural integrity of the ecological corridor, creating peripheral landscapes and natural environment features, developing tour facilities and resources of human industries, repeating the structural nature of beautiful material, increasing the value of tourism, and protecting the environment.

The four aspects of influence that must be considered in this research are: (1) natural environment; (2) ecological environment; (3) physical environment; and (4) human environment (including both social and economic aspects). Since comprehensive conservation rate in wetlands environmental plan system is an important factor in plan measurements, it was used as a further criterion (Table 2).

Table 2. Dimensions and Criteria for Wetlands Environmental Plan System

Dimensions	Influence Criteria	Statements of Influence Criteria
Natural Environment (D ₁)	1. The degree of connection of river basin (C ₁)	It indicates the degree of connection of river and other wetlands.
	2. Distribution of scenic resources (C ₂)	The distribution is formed by climate, terrain, geological, hydrology, ocean current, zoology, botany ecology and so on.
	3. The impact and monitoring of environment (C ₃)	Understand the impact and response on the ecological environment of the development of wetlands.
Ecological Environment (D ₂)	4. The activity of biotic community (multiplicity) (C ₄)	Carry on the investigation of wetlands' biology species, and understand the composition of region ecology.
	5. Recovery of habitat (molding and regeneration) (C ₅)	The biology or the communities (aggregations) live at a habitat so as to construct a complete ecology corridor.
Physical Environment (D ₃)	6. Improvement of water's quality (C ₆)	The activity of improving water's quality: to take the pH value into consideration, to reserve the original mineral substance and to increase the level of containing oxygen and so on.
	7. Measure of decreasing floods (C ₇)	Decrease the measure of preventing of floods.
Environment of Humanity, Society and Economy (D ₄)	8. Analysis of the form of industrial distribution (C ₈)	Analyze the condition of distribution of wetlands in accordance with current industry.
	9. Usage of land resources (C ₉)	Indicate, under certain technical and economy condition, the land resources which can directly be used for human's production and existence, and bring benefits to humans.
	10. Analysis of villages (C ₁₀)	Analyze the regions which gather large population size.
	11. Ecology-tourism (science education) (C ₁₁)	Let people experience the importance of the maintenance of biological multiplicity by touring in order to achieve the goal of ecology preservation; thus, push ahead the coexistence and advance between ecology preservation and tourism industry.

3. A HYBRID NOVEL MCDM MODEL FOR EVALUATION AND PLANNING

The main objective of the Hybrid Novel MCDM model proposed in this thesis is environment Problems-Solving for achieving the aspired levels of human welfare, the model includes techniques of idea, logic reasoning, and thinking systems. The MCDM method is aimed at three major classifications: (1) Individual issues/objects evaluation using multivariate statistical analysis and data mining for data process analysis to understand the existing problems for future prospects; (2) Multi-criteria evaluation for selection or improvement, proposal to solve and analyze the problems with feasible alternatives for the "problems-solving"; (3) The identified problems are dealt with multi-objective programming for plan or design. The contents of this Hybrid Novel MCDM model are included in three parts as follows.

This study focuses on the hybrid novel MCDM method for decision making in regional environment. The first part of this section focuses on a method to build the analysis of a five hierarchy systems. The second part of this section focuses on utilizing fuzzy classification to solve the optimal strategy combination. Finally, a summary of some widely used cluster validity function for fuzzy classification is provided, the validity of which index could provide the useful information to determine the critical number of clusters.

Buliding an Analysis Hierarchy System for Evaluation and Planning

In this study, firstly a hierarchy system is established for analysis, evaluation, and planning through scenario writing and brainstorming. Phase 1 includes the overall objectives. Phase 2 the related aspects are considered for achieving goals. The list of criteria is considered in Phase 3, all criteria under consideration are measured using evaluators consisting of individuals with different viewpoints. Phase 4 involves a listing of alternatives/strategies for selection, and finally, the best plan will be selected in Phase5 (Figure 2).

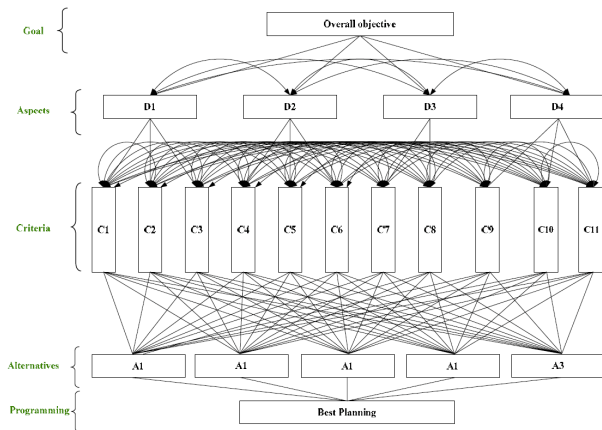


Fig.2. Analysis Hierarchy System for Evaluation and Planning.

Buliding MCDM Model for Regional Environment Plan Strategy

This paper establishes a regional environmental (watershed and coastal wetland) plan system that will exert an influence in the regional environment. When the government, educational circles, and industry work together and plan at the same time, they will collect the relations and different literary composition dimensions and criterion of the regional environment and produce some impact on the regional environment. A watershed environmental plan must consider in detail watershed management and erosion control, ecological restoration, environmental construction, and environmental conservation; a coastal wetland plan must consider in natural, ecological, physical and human environment.

DEMATEL Technique for Building a Network Relation Map (NRM)

The DEMATEL technique was used to investigate and solve the complicated problem group. DEMATEL was developed with the belief that the pioneering and proper use of scientific research methods could help to illuminate specific and intertwined phenomena and contribute to the recognition of practical solutions through a hierarchical structure. DEMATEL has been successfully applied in many situations such as marketing strategies, e-learning evaluations, control systems, and safety problems.

4. EMPIRICAL STUDY ON REGIONAL ENVIRONMENT PLANNING

By applying the multi-criteria decision making method to explore the proposed strategy seeking sustainable development, it is successfully demonstrated that these methods of measurement, improvement, and strategy, therefore it provides a good evaluation planning and appear to be more appropriate in the real regional environment of Taiwan. There are divided into three parts: In the first part, the measures and evaluation to build strategies are provided; in the second part, selection of the best alternative is presented; in the third part, allocation of the optimal resource is presented.

Case Study of the Pei-Keng Brook Envirionment-Watershed Plan Systems

Located in Taiwan, the study area is comprised of four parts. This planning includes the Guoxing town of Nantou County where the Nangang River of the town has a small stream and the Pei-keng creek rises in the Sijiao mountain (1172M), the Cukeng branch rises in the Kandou mountain (1097M), the Juicaihu creek rises in the Juifener mountain (1174M), and the Hongxiashui branch rises in the Heshangtou mountain (955M) (Figure 3). The plan systems are complex and are composed of environmental, software, hardware, and human factors.

Measuring Relationships among Dimensions for Building NRM

This study is aimed at determining the most important plan criteria as well as measuring relationships among criteria for building an NRM (network relation map). A questionnaire was provided to three groups which were comprised of 15 experts-five from the universities of the expert scholars (including Water Resources Engineering and Conservation, Landscape and Recreation, Urban Planning, Environment Engineering, and Architectural Engineering), five from governmental departments, and five from industry-ranking of each criterion with respect to sustainable development using a 5-point scale ranging from 5 (extremely important) to 1 (no effect). The three criteria with the highest scores were extracted from each dimension to construct the system for measuring the environment watershed plan. Since comprehensive conservation rate in environment watershed plan system is an important factor in plan measurements, it was used as a further criterion. The aim is to determine the most important plan criteria as well as measure the relationships among criteria. The watershed experts were thus asked to determine the importance of the relationships among the dimensions. The average initial direct-relation 4x4 matrix A obtained by pair-wise comparisons in terms of influences and directions between dimensions is shown in Table 3.

Table 3. The Initial Influence Matrix A

Dimensions	Watershed Management and Erosion Control (D ₁)	Ecological Restoration (D ₂)	Environmental Construction (D ₃)	Environmental Conservation (D ₄)
Watershed Management and Erosion Control (D ₁)	0	2.0	2.4	2.4
Ecological Restoration (D ₂)	3.2	0	2.2	2.2
Environmental Construction (D ₃)	3.6	3.0	0	2.0
Environmental Conservation (D ₄)	3.6	3.8	2.8	0

As seen in matrix A, the normalized direct-relation D is calculated from Equation (1) and (2). Subsequently, by using Equation (3), the total-influence T can be derived as shown in Table 4. Finally, using Equations (4) and (5), the sum of the total-influence given and received by each dimension can be derived as shown in Table 5.

$$D = kA \tag{1}$$

$$k = \min \left\{ 1/\max_i \sum_{j=1}^n a_{ij}, 1/\max_j \sum_{i=1}^n a_{ij} \right\} \tag{2}$$

$$T = D(I - D)^{-1}, \text{ where } k \rightarrow \infty, D^K = [0]_{n \times n} \tag{3}$$

$$r = \left[\sum_{j=1}^n t_{ij} \right]_{n \times 1} = [t_i]_{n \times 1} = (r_1, L, r_i, L, r_n)' \tag{4}$$

$$c = \left[\sum_{i=1}^n t_{ij} \right]_{1 \times n} = [t_j]_{1 \times n} = (c_1, L, c_j, L, c_n)' \tag{5}$$

Table 4. The Total Influence Matrix T

Dimensions	Watershed Management and Erosion Control (D ₁)	Ecological Restoration (D ₂)	Environmental Construction (D ₃)	Environmental Conservation (D ₄)	Total Influence Normalized
Watershed Management and Erosion Control (D ₁)	0.793 (w _{D₁D₁} = 0.25)	0.846 (w _{D₁D₂} = 0.27)	0.793 (w _{D₁D₃} = 0.25)	0.745 (w _{D₁D₄} = 0.23)	- (1.00)
Ecological Restoration (D ₂)	1.087 (w _{D₂D₁} = 0.32)	0.731 (w _{D₂D₂} = 0.21)	0.826 (w _{D₂D₃} = 0.24)	0.776 (w _{D₂D₄} = 0.23)	- (1.00)
Environmental Construction (D ₃)	1.192 (w _{D₃D₁} = 0.3)	1.023 (w _{D₃D₂} = 0.26)	0.712 (w _{D₃D₃} = 0.18)	0.821 (w _{D₃D₄} = 0.26)	- (1.00)
Environmental Conservation (D ₄)	1.339 (w _{D₄D₁} = 0.31)	1.201 (w _{D₄D₂} = 0.28)	1.037 (w _{D₄D₃} = 0.24)	0.762 (w _{D₄D₄} = 0.18)	- (1.00)

Accordingly, the IRM of the DEMATEL method can be obtained as shown in Figure 3 using Table 4, and as shown in Figure 4 using Table 5.

Table 5. The Sum of Influence Given and Received on Dimension

Dimensions	r _i	c _i	r _i + c _i	r _i - c _i
Watershed Management and Erosion Control (D ₁)	3.177	4.410	7.587	-1.232
Ecological Restoration (D ₂)	3.419	3.800	7.219	-0.381
Environmental Construction (D ₃)	3.747	3.369	7.116	0.379
Environmental Conservation (D ₄)	4.339	3.104	7.443	1.235

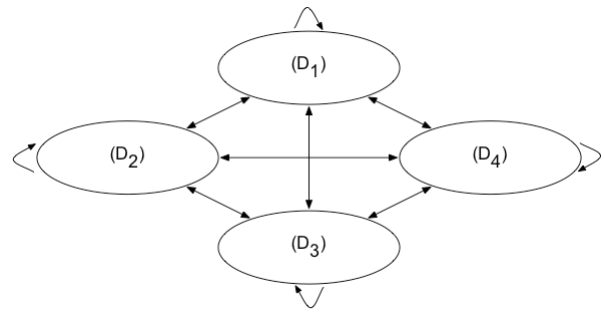


Fig.3. The Impact-Relationship-Map of Relations within Safety Systems.

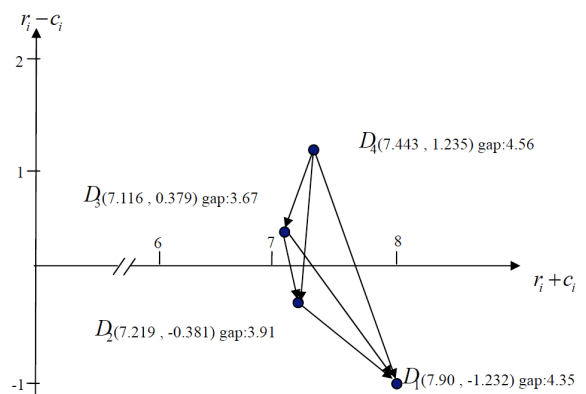


Fig.4. The Impact-Direction Map.

5. DISCUSSIONS FOR MANAGERIAL IMPLICATIONS

This research presented a plan for preserving environment watersheds and coastal wetlands by use of a novel hybrid MCDM method to address dependent relationships among criteria. By using a DEMATEL technique to construct the NRM, along with ANP to decide the relative weights of criteria, a selection plan was proposed in the environment watershed of a fuzzy decision support system for the assessment of alternative strategies.

The results of the empirical case are presented in section four. The discussion is divided into three parts and subsequently four subsections. Firstly, the measures and evaluation is to build strategies. Secondly, selection of the best alternative is highlighted. And thirdly, the optimal resource allocation is presented.

From the results obtained earlier, it is known that the DEMATEL can be used in conjunction with an ANP for determining the relative weights of the criteria. The DEMATEL works in an ANP to construct a new measurement model for environment watershed plan effects in an empirical study: (1) for evaluating Pei-Keng brook environments, and (2) for evaluating Kao-Mei coastal wetland environments. The result was obtained as follows:

In the Pei-Keng brook of watershed environment, the influence dimensions and criteria weight that represented the dimensions affected by the physical environment were calculated (Figure 4).

The environment watershed plan strategy is shown in

Table 6. It can reduce environment-watershed and emphasize the goal of a sustainable environment. The strategy and the program continue to question the use of expert interviews with key design, according to papers in section 2 of the structure to aggregate the characteristics of the dimensions and criteria. The watershed area of the Pei-Keng brook designed four items of ten issues and interviews with experts capable of successfully guiding a regional environment for the sustainable environment and living comfortable, safe environment for advice of the best planning.

Table 6. Environment-Watershed Plan Strategy

Formula	Strategy
P1	Control sand production, clear silt, and dredging, prevent soil barrier lakes that sand blocks form, increase river drain-off water and the source of water conservation ability.
P2	Set up the integrity of the ecological corridor, improve the diversified cache environment, and monitor the quantity of development of the ecological species.
P3	Engage in ecology and land utilization to investigate, channel writing style dose and industry's characteristics into locals, in order to be regarded and planned as the natural and harmonious aesthetic feeling of the environment.
P4	Delimit the ecological sensitizing range and protection zone, reduce artificial disturbance, and allow the ecology to reach its natural equilibrium.

6. CONCLUSIONS

The present study established a hybrid causal model of the regional environment plan effect, the relational structure, selection of the best alternative, and resource allocation. The optimization design model was verified through satisfactory statistical techniques in order to confirm its efficiency for use in further researches. Traditionally, the plan is based on the number of storm water catastrophes, human environment criteria, usage of land resources, analysis of the form of industrial distribution, ecology tourism, the analysis of villages, and possibly "land and monitored" rates during audits.

Based on several aspects of environment watershed plan systems, the DEMATEL and ANP methods were combined to form a hybrid MCDM approach that considers interdependence among a range of criteria and their weighting.

The regional environment plan ranking indicates the criterion that has the best plan record in Pei-Keng brook watershed, Environmental Conservation, Environmental Construction, Ecological Restoration, Watershed Management and Erosion Control.

In the proposed model, DEMATEL was used for determining the influence factors and ANP was applied for determining the most important criteria / factors which will influence the efficiency of the environment watershed plan effect. The DEMATEL technique was used for comparing pairs of mutual relationships to the survey materials and for clarifying the essence of the problem.

An empirical testing of the approach was carried out using a Taiwanese case study, which illustrated its usefulness. Thus, the crux of the problem could be determined based on the novel hybrid MCDM model method. It can be concluded that the model is well suited for dealing with decision problems whose constructs are complicated and whose criteria are interdependent. It

may help in making strategic plans for the Taiwan's Soil and Water Conservation Bureau and Council of Agriculture to conduct an annual plan for evaluations and an optimal project of the regional environment.

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Separation of PCE via Liquid-Liquid Extraction and Reverse Micellar Extraction for Surfactant Recovery

Kuntida Krisorncharoen and Punjaporn Weschayanwiwat

Abstract— This study aimed to investigate two extraction techniques: liquid-liquid extraction (LLE) and reverse micellar extraction (RME) coupled with ultrafiltration (UF) for tetrachloroethylene (PCE) removal and surfactant recovery purposes. In this study, we imitated the surfactant solution similar to one pumped out of the contaminated site, which contains 4%AMA (anionic surfactant), 3%NaCl and 10,000 ppm solubilized PCE. The LLE using five extracting solvents varying the equivalent alkane carbon number (EACN) was investigated to determine the partitioning of PCE from surfactant solution into solvent phase and eventually the %PCE removal. The RME is another extraction technique based on Winsor type II microemulsion formation. The result showed that EACN of extracting solvent and the surfactant solution:solvent volumetric ratio were crucial parameters governing the extraction efficiency of LLE. Moreover, other parameters (molecular structure and functional groups, etc.) also affect the PCE partitioning and PCE removal in LLE. For RME, the surfactant solution: solvent volumetric ratio used in this study (ranged from 40:1 to 5:1) did not show significant effects on the surfactant removal (84.9-86.9%) and PCE removal (96.7-98.4%). Furthermore, an UF followed with RME was used as an additional downstream process to concentrate reversed surfactant micelles in retentate while passing PCE and solvent in permeate..

Keywords— Watershed, Wetland, Multiple Criteria Decision Making, MCDM.

1. INTRODUCTION

Tetrachloroethylene (PCE) is a volatile chlorinated hydrocarbon widely used as a solvent in the chemical industries, a dry-cleaning fluid in the textile industries, and a metal-degreasing agent in electroplating industries. Moreover, PCE is a nonflammable, colorless liquid that belongs to a class of chemicals known as volatile organic compounds (VOCs) meaning that PCE easily evaporates into the air. PCE moves easily through soil and ends up contaminating to the groundwater. PCE does not mix very well with water but over time may dissolve in sufficient amounts to become a health concern. PCE is denser than water and tends to sink to the bottom of aquifers [1]. PCE may stay in groundwater for several months without being broken down. Under some conditions, PCE may stick to the soil, present in surface water and contaminate into water sources, groundwater, and aquatic life. Thus, the clean-up activities tend to be more problematic as compared to clean-up of oil spills.

Surfactant-enhanced aquifer remediation (SEAR) is a promising technology using a surfactant solution to remedy the subsurface contaminated by nonaqueous

phase liquids (NAPLs). The term “surfactant” is a truncation of surface active agent. Surfactants can help the extraction of organic contaminants from an aquifer by reducing interfacial tension (IFT) between NAPLs and groundwater, and by increasing the solubility of the contaminants. Surfactants are molecules that consist of hydrophilic and hydrophobic moieties referred to as heads and tails, respectively as shown in Figure 1. The hydrophobic interior cores of surfactant micelle can promote the solubilization of NAPLs in the micelles leading to desorption of these compounds from soil media. The solution containing solubilized contaminants in surfactant micelles can then be treated to separate surfactants and contaminants [2]. Since surfactant costs are significant in large-scale implementation of SEAR, the decontamination and reuse of surfactant solutions are desirable [3]. Recovery of surfactant solution is very important in the development of the surfactant-based remediation. In addition, reducing the volume of wastewater, recycling of used surfactant solutions will reduce chemical costs for the treatment of hydrophobic organic contaminated soils and groundwater [2].

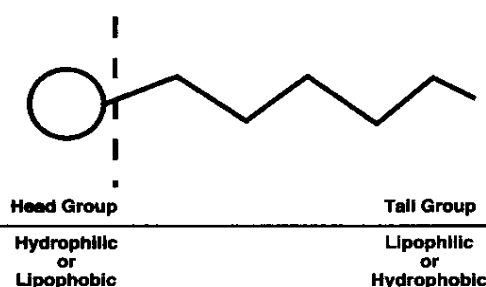


Fig. 1. General Representation of Surfactant Molecule.

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2. THEORETICAL BACKGROUND

2.1 Supersolubilization condition

The supersolubilization concept takes advantage of the fact that the interfacial tension (IFT) continually decreases and the solubility enhancement continually increases as suggested by the Chun Huh relationship [4]. Salinity scans are typically conducted to find the optimum electrolyte addition to maximize the contaminant solubilization. By operating near the Winsor type I-III microemulsion boundary, it is possible to maximize the solubility enhancement while minimizing the vertical migration potential [5]. The ionic surfactant solutions, which form the Winsor type I microemulsion at certain electrolyte concentrations closed to the Winsor type I-III transition boundary, show an ultralow IFTs without forming Winsor type III microemulsion. Such systems have extremely high contaminant solubilization capacities compared to solutions at lower electrolyte concentrations [3]. A generic diagram of Winsor type I-III-II microemulsion transition is shown in Figure 2.

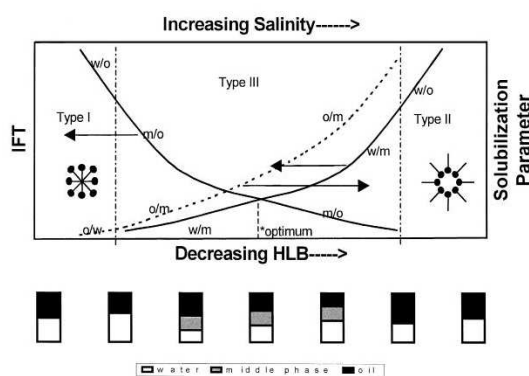


Fig. 2. Illustration of Phase Behavior and Interfacial Tension (IFT): oil is o; w is water; m is middle phase.

2.2 Liquid-liquid extraction

Liquid-liquid extraction (LLE), sometimes referred to as solvent extraction also has the potential to recover the surfactant for regeneration by removing contaminant into the solvent as the rule of thumb "like dissolve like". The driving force behind LLE is the equilibrium distribution coefficient (K_d) for the contaminant-aqueous-solvent solution [6]. Furthermore, the distribution of a solute depends on its preference for one or the other liquid, which is closely related to its solubility in each one of them. However, the disadvantage of LLE or solvent extraction technique is the high potential for the extracting solvent contamination in the aqueous stream. Hence, the utilization of the suitable solvent (i.e. nontoxic and low solubility solvent), the efficiency of the extraction column can be maximized.

2.3 Reverse micellar extraction (RME)

The hydrophile-lipophile balance (HLB) is a parameter that characterizes surfactants in terms of their abilities to produce optimum emulsions with given oil. As the surfactant HLB decreases, the transition of microemulsion system is induced in the order of Winsor

type I-III-II [7]. While an ionic surfactant possesses a certain HLB value, an electrolyte addition alters its effective HLB value and thus facilitate to the Winsor type II microemulsion formation.

A Winsor type II (water-in-oil) microemulsion will form when a low HLB surfactant system is in contact with a hydrophilic solvent. Micelles break up and migrate into solvent phase and re-aggregate into the reversed micelles, and the micellar-solubilized contaminant is released during the micelle breakup. The contaminant molecules will also be extracted into the solvent phase, promoted by both the disappearance of micelles and the high affinity of the solvent phase for the contaminants. A small amount of water with dissolved electrolyte will be accumulated in the reversed micelle interiors, and the contaminant concentration in the water will be its water solubility.

Therefore, the aqueous solution will be decontaminated of both contaminant and surfactant after RME, while electrolyte and some portions of solvent will be left in the aqueous phase [3].

2.4 Ultrafiltration process

The ultrafiltration (UF) membranes contain pores in the range 1-100 nm [8]. An UF is a relatively low pressure membrane process used in a water treatment. UF has rapidly increased in the last decade due to stricter regulations for water quality, decreased cost, improved membrane materials and modules, simplicity of installation and improved reliability when compared with conventional treatment process such as sedimentation and sand filtration. The principle application comprises the removal of undesirable products such as particles, colloids, high molecular weight materials, bacteria and viruses from an effluent stream in order to obtain more purified water [9]. It has been applied either to remove organic and inorganic solutes of environmental concern from aqueous wastes, as well as preconcentration step in some analytical determinations. The separation procedure is based on the association of solutes to added micellar aggregates, successively removed from the bulk solution through an UF membrane. The membrane pore-size has to be small enough to block the aggregates in the retentate, and large enough to allow acceptable flux rates in the system [10].

3. MATERIALS AND METHODS

3.1 Materials

The following surfactants were used without further purification, sodium dihexyl sulfosuccinate (trade name of Aerosal MA or AMA with 80% active) purchased from Fluka Company and sorbitan monolaurate (trade name of Span-20 with 100% active) supplied by East Asiatic (Thailand) Public Company Limited.

Tetrachloroethylene or PCE (EACN = 2.9) was used as contaminant with 95% purity and purchased from Aldrich Company.

Five extracting oils with different EACNs were used in this study as follows: 1) dodecane ($C_{12}H_{26}$, EACN = 12) purchased from Aldrich Company, 2) palm oil

(C₁₆H₃₂O₂, EACN = 13) purchased from Lamsoon (Thailand), 3) sunflower oil (C₁₈H₃₂O₂, EACN = 18) purchased from Healthymate (Thailand), 4) octadecane (C₁₈H₃₈, EACN = 18) and 5) squalane (C₃₀H₆₂, EACN = 30) purchased from Aldrich Company. All extracting oils have purity higher than 99% and were used as received.

3.2 The phase behavior studies

The phase behavior studies were conducted in 12 mL centrifuge tubes with teflon screw caps where equal volumes of aqueous surfactant solution and PCE was added into the tube. The concentration of AMA was held constant at 4 wt% and a salinity scan was conducted using NaCl. The phase transition of Winsor type I-III-II microemulsion was observed visually and confirmed by interfacial tension measurement (IFT). The NaCl concentration that causes the supersolubilization condition was determined. In addition, the concentration of solubilized PCE at the supersolubilization condition was analyzed by gas chromatography (GC) equipped with headspace autosampler.

3.3 Liquid-liquid extraction study (LLE)

Five extracting solvents varying EACNs were used including dodecane (EACN = 12), palm oil (EACN = 13), sunflower oil (EACN = 18), octadecane (EACN = 18) and squalane (EACN = 30). The surfactant solution with certain amount of solubilized PCE at supersolubilization condition as obtained from phase behavior study was prepared. The equilibrium time was determined using one solvent (palm oil) at the specific surfactant solution:solvent volumetric ratio (5:1). The concentration of PCE in both phases was analyzed by GC. The time at which the concentrations of PCE in both phases remain constant defined as the equilibrium time.

The surfactant solution was blended with pure extracting solvent at the volumetric ratios of 1:1, 5:1, 10:1, and 20:1 in the test tubes in such a way to minimize the headspace volume in order to avoid the loss of PCE into air phase. The concentration of PCE in aqueous and extracting solvent phases were analyzed using GC and the mass balance of PCE with the closer of material balance of PCE between phases of 10% were carried out to assure the reliability of experiment.

The PCE partitioning among phases and the PCE removal from surfactant aqueous solution to solvent phase could be revealed. The best surfactant solution:solvent volumetric ratio was determined and then applied to other types of extracting solvents. As a consequence, the relationship between the PCE removal and extracting solvents' EACN was investigated.

3.4 Reverse micellar extraction study (RME)

The RME was studied only with palm oil. The surfactant aqueous solution obtained from preliminary study in the presence of solubilized 10,000 ppm PCE at the fixed volumetric ratio of surfactant solution:solvent at 1:1 was used to form the Winsor Type II microemulsion by salinity scan with NaCl. If the Winsor type II microemulsion could not be formed solely by AMA, the second surfactant needed to be added to help reducing

the HLB of the system. The total amounts of surfactant(s) along with the extracting oil presenting in the aqueous phase were analyzed using total organic carbon analyzer (TOC). The suitable NaCl that can form Winsor type II microemulsion with the least amount of surfactant(s) was selected. The effect of surfactant solution:solvent volumetric ratio was studied and applied to the above surfactant(s)-oil-NaCl system at 4 ratios including 5:1, 10:1, 20:1, and 40:1. The selected volumetric ratio of surfactant solution:solvent was determined by considering the Winsor Type II microemulsion system that has the least amount of remaining surfactant(s) and PCE in the aqueous phase.

3.5 Ultrafiltration (UF)

The prepared palm oil solution at the same surfactant compositions with the best surfactant solution:solvent volumetric ratio as obtained from 3.4 with 50,000 ppm PCE. This solution was used as the palm oil feed solution for UF stirred cell unit (Amicon Stirred Ultrafiltration Cell, Model 8400). The regenerate cellulose membrane with 5,000 Dalton cutoff was used to block the passage of surfactant reversed micelles in the retentate stream. The effect of applied nitrogen (N₂) gas pressure on the UF cell was studied. The concentration of PCE in the permeate and retentate stream were analyzed and the percentage of PCE removal could then be evaluated.

4. RESULTS AND DISCUSSION

4.1 Phase behavior study

According to the visual observation of the phase transition between Winsor type I-III-II microemulsion, the 4%AMA/3%NaCl system was found to exhibit the Winsor type I microemulsion (oil in water) closed to a boundary of Winsor type I-III microemulsion prior to form the middle phase microemulsion at 4%NaCl. By the solution appearance as shown in Figure 3, it was found that the one before the Winsor type I-III transition showed the milky-like surfactant solution, which is generally used to identify that the surfactant system is at the supersolubilization region where the solubilization of solute in the surfactant micelles is maximum. This surfactant solution was corresponded to the work done by [11], which also used AMA as the surfactant in the field demonstration for surfactant-enhanced solubilization of DNAPL. In addition, the concentration of solubilized PCE at this supersolubilization condition was found to be about 12,000 ppm measured by GC. Consequently, this 4%AMA/3%NaCl system was used to represent the supersolubilization system for PCE and PCE at concentration of 10,000 ppm was applied throughout the experiment as a base PCE concentration.

4.2 Effect of EACN of solvent on liquid-liquid extraction

4.2.1 Equilibrium time determination

The concentration of PCE in solvent remained constantly at 4 days. Thus, 4 days was used as the equilibrium time for this liquid-liquid extraction and applied for the rest of the experiments.

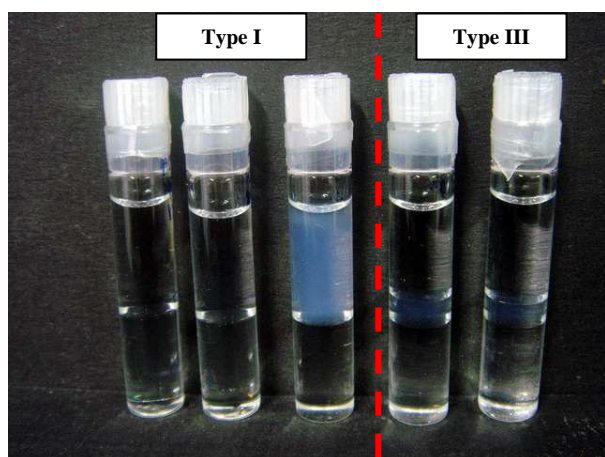


Fig. 3. The Phase Transition of Microemulsion Solution by Scanning with NaCl in the System Containing of 4%AMA.

4.2.2 Effect of surfactant solution:solvent volumetric ratios

Palm oil was used to determine the optimal surfactant solution:solvent volumetric ratio. At the equilibrium time (4 days), the concentration of the PCE in both palm oil and surfactant aqueous phases was analyzed and the material balance of PCE was carried out to assure the reliability of the data. The deviation of mass of PCE in material balance was less than 10%. The distribution of PCE between phases ($[PCE]_{\text{solvent}}/[PCE]_{\text{aqueous}}$) and %PCE removal from surfactant aqueous phase to extracting oil phase at different surfactant solution:solvent volumetric ratio were shown in Table 1.

Table 1. The Effect of the Surfactant Solution:Solvent Volumetric Ratios in Liquid-Liquid Extraction on %PCE Removal and Distribution Coefficient of PCE by Using Palm Oil as Extracting Solvent

Surfactant solution :solvent volumetric ratios	[PCE] initial (ppm)	[PCE] aqueous (ppm)	[PCE] solvent (ppm)	% PCE removal	$\frac{[PCE]_{\text{solvent}}}{[PCE]_{\text{aqueous}}}$
1:1	9,782	1,662	7,667	83.0	4.6
5:1	9,964	3,653	26,288	63.3	7.2
10:1	9,959	4,571	64,674	54.1	14.1
20:1	9,986	6,478	67,686	35.0	10.4

The results showed that PCE can partition from surfactant aqueous phase to extracting oil phase followed a rule of thumb “like dissolve like” but the partitioning ability depends greatly on the surfactant aqueous solution: solvent volumetric ratio used. The distribution coefficient of PCE ($[PCE]_{\text{solvent}}$ divided by $[PCE]_{\text{aqueous}}$) was found to increase with increasing surfactant aqueous solution: solvent volumetric ratio. In another word, the distribution coefficient of PCE increases with decreasing the volume of extracting oil used. In this case, a decrease in volume of extracting oil used caused a reduction in the %PCE removal, meanwhile increasing the concentration of PCE in the oil phase resulting in a greater PCE distribution coefficient. As the reduction of volume of extracting oil reached a certain point, the distribution

coefficient cannot be improved since the volume of extracting oil is inadequate to induce the PCE partitioning into the extracting oil phase.

From this study, the ratio of 10:1 was selected to be an optimal surfactant solution:solvent volumetric ratio using 3 main criteria including (1) the %PCE removal from surfactant solution to extracting solvent, (2) the used volume of extracting solvent and (3) the distribution coefficient of PCE. At the 10:1 ratio, although the %PCE removal from surfactant solution into the extracting solvent (palm oil) phase was not the highest (54.1%) but the highest PCE distribution coefficient of 14.1 was obtained at this ratio.

The greatest PCE removal of 83.0% was found at volumetric ratio of 1:1, which is about 30% higher than one obtained at 10:1 ratio. However, the 1:1 ratio used the volume of extracting oil 3 times greater that of 10:1 and yielded an obvious lower distribution coefficient of PCE. Consequently, the volumetric ratio of surfactant solution:solvent at 10:1 was further used to study the effect of EACNs of extracting solvent in LLE on PCE removal from surfactant aqueous solution.

4.2.3 Effect of EACNs of extracting solvents

Two groups of selected extracting solvents used in this study were vegetable oil (non-alkanes) and alkanes at varied EACN values as shown in Table 2. The results showed that alkane showed a greater extraction performance than the vegetable oil although having the similar EACN values as can be seen by a comparison between dodecane and palm oil (EACN = 12-13); and octadecane and sunflower oil (EACN = 18). This can be explained by even at the same EACN of extracting oils, the different functional groups of solvent are influential to the affinity of solvent to PCE. The vegetable oils are classified as fatty acids containing the carboxyl groups (-COOH) as the main functional group. Thus, the affinity of PCE to partition into these polar oils is less than that of straight chain hydrocarbon or n-alkane. Reference [12] stated that solutes have differing solubilities in different solvents due to variations in strength of the interaction of solute molecules with those solvents.

The significant improvement of the PCE distribution coefficient by EACN was found in the system of alkanes but a slight improvement was also evidenced in the system of vegetable oils. However, the result was not in agreement with squalane (straight chain hydrocarbon with EACN = 30) which was the extracting solvent having the highest EACN used in this study. It was possible that squalane has too high degree of hydrophobicity or in another word, too nonpolar for PCE to dissolve. Since PCE has low EACN value (EACN = 2.9) and $\log K_{ow}$ of 3.40, PCE was relatively non-polar compound if compared with water but quite polar if compared with squalane resulting in a less favorable in PCE partitioning into squalane solution. This finding also confirms the “like dissolve like” phenomenon.

Table 2. The Effect of the EACNs of Extracting Solvents in Liquid-Liquid Extraction on %PCE Removal and Distribution Coefficient of PCE with Constant Surfactant Solution:Solvent Volumetric Ratio of 10:1

Extracting solvents	EACN	[PCE] initial (ppm)	[PCE] aqueous (ppm)	[PCE] solvent (ppm)	%PCE removal	[PCE] solvent
						[PCE] aqueous
Dodecane	12	11,263	4,397	50,978	84.3	49.4
Palm oil	13	9,959	4,571	64,674	54.1	14.1
Sunflower oil	18	10,039	3,254	58,778	67.6	18.1
Octadecane	18	8,949	941	81,079	89.5	86.2
Squalane	30	10,263	3,805	50,978	57.2	11.6

Therefore, EACN solely cannot be used if solvents applied are not in the same homologous series. Thus, other physical-chemical properties of compounds, i.e., functional groups, water solubility, log K_{ow} , etc. should be considered. In addition, besides the extraction performance, other factors determining the suitability of compounds to be used as the extracting solvent should also be incorporated such as cost, availability, and toxicity of the solvents.

It should be noted that in this LLE, most of surfactant and electrolyte still remained in the aqueous solution, only PCE partitioned out of surfactant micellar aqueous solution and moved into the extracting solvent phase due to the affinity between PCE and extracting oil or "like dissolve like" rule as discussed in the section 4.2.2. So most of surfactant, electrolyte and some PCE were remained in the aqueous solution because HLB surfactant system with this extracting solvent was not low enough to force the transition from Winsor type I into type microemulsion II or reversed micelle where surfactant can move into the extracting solvent phase as already explained in section 2.1.

4.3 Reverse Micellar Extraction (RME)

4.3.1 Reverse micellar extraction with palm oil

Palm oil was used as the extracting solvent because of its non toxicity, cheap price, and it is environmentally friendly. Moreover working with palm oil as the extracting solvent in the area of microemulsion was challenging since very limited studies were done on palm oil due to its complexity in structure. So this step aimed to investigate the surfactant systems that can form the Winsor type II microemulsion with palm oil.

From the rule thumb of Winsor type II microemulsion, the surfactants with low HLB, more lipid loving, tend to make a water in oil microemulsion (Winsor type II microemulsion) while those with high HLB are more hydrophilic and tend to make an oil in water microemulsion (Winsor type I microemulsion).

In this study, we imitated the supersolubilization solution for PCE removal, the surfactant solution contained 4%AMA and 3%NaCl. However, this system

cannot form Winsor type II microemulsion with palm oil although the NaCl and $CaCl_2$ were added in help decreasing HLB of the system. The precipitation of salt in surfactant aqueous solution was observed if an excessive electrolyte concentration was used. In addition, the phase separation between surfactant and water can be observed in some cases because of the density of components in the system was altered resulted from the salt added. Thus, the HLB of AMA used in this system was too high to form Winsor type II microemulsion with palm oil since AMA is normally soluble with water with high degree of hydrophilicity. In many cases, a mixed surfactant system will produce better emulsification than a single surfactant [13].

From phase behavior study, the closest formula of surfactant system to the original formulation that can form the Winsor type II microemulsion with palm oils was 2%AMA/1%Span-20/20%NaCl with the surfactant solution:solvent volumetric ratio of 1:1. This formation of Winsor type II microemulsion was confirmed using TOC analyzer to assure the removal of surfactant from aqueous to oil phase.

4.3.2 Effect of surfactant solution:solvent volumetric ratios

In previous study (section 4.3.1), the system of 2%AMA/1%Span-20/20%NaCl at the surfactant solution:solvent volumetric ratio of 1:1 could form Winsor type II microemulsion with palm oil. This section aimed to study the effect of surfactant solution:solvent volumetric ratio on the percentages of PCE and surfactant removal from aqueous into palm oil phase and to investigate the best ratio suited for this reverse micellar extraction.

From the results, there was insignificant effect of surfactant solution:solvent volumetric ratio on both the %surfactant and %PCE removal from aqueous phase into the palm oil as shown in Figure 4.

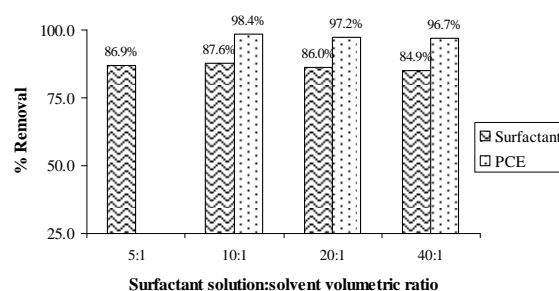


Figure 4. Effect of Surfactant Solution:Solvent Volumetric Ratio on %Surfactant and %PCE Removal in Reverse Micellar Extraction Using Palm Oil

Due to an almost independence of surfactant solution:solvent volumetric ratio, RME was proven to be very attractive extraction technique since high extraction efficiency can be achieved and remained although the least volume of extracting solvent was used, unlike the LLE where the volume of surfactant solution and extracting solvent was one of the main parameter governing the degree of extraction. This result agreed

with [3], since they stated that one advantage of RME over typical solvent extraction was that almost complete surfactant and contaminant removal achieved with formation of an ideal Winsor type II microemulsion with the least amount of solvent used. Therefore, the surfactant solution:solvent volumetric ratio of 40:1 was selected to further study in ultrafiltration process to separate surfactant reversed micelles from PCE and palm oil.

4.4 Effect of applied pressure on ultrafiltration (UF) for PCE removal

The main purpose of this study was to concentrate surfactant reversed micelles into the retentate stream while passing PCE and palm oil into the permeate stream. The applied pressure of N₂ gas was varied at 30, 40, 50, and 60 psi in the UF cell. The %PCE removal was evaluated as shown in Table 3. Moreover, the material balance of PCE where less than ±12% deviation of PCE mass was measured to assure the reliability of the experiment.

Table 3. The Percentage of PCE Removal at Various Applied Pressures

Pressure (psi)	Termination time (minute)	[PCE] initial (ppm)	[PCE] permeate (ppm)	[PCE] retentate (ppm)	%PCE removal
30	32.5	73,655	62,799	71,002	76.0
40	26.1	63,230	64,322	57,126	77.6
50	19.2	72,573	72,787	66,276	77.2
60	25.2	70,157	63,051	68,472	75.7

There was no significant change in %PCE removal upon altering applied pressure as illustrated in Table 3. Since more than 75% of PCE could separate from retentate into permeate phase for all applied pressures, while only 25% of PCE still remained in the retentate stream. Although the highest pressure utilized in this study (60 psi) which closed to the maximum allowable pressure for this Amicon stirred cell (70 psi), the performance of this separation process was the same as the lowest applied pressure (30 psi). This result was similar to ones obtained by [14]. They found that the degree of separation of organic polymer from wastewater water by UF process was insensitive to pressure if applied at the relatively low pressures (14.5, 29.0, and 43.5 psi, respectively).

5. CONCLUSIONS

The prediction of the LLE efficiency based on EACN may be acceptable for the same applied homologous series solvents. However caution should be taken if the differences of physical and chemical properties between solute and solvent are obvious. Since EACN solely cannot be used if the applied solvents are not in the same homologous series. Thus, other physical-chemical properties of compounds, i.e., functional groups, water solubility, log K_{ow}, etc. should be considered.

RME has high extraction efficiency even using small volume of the extracting solvent, thus receiving less volume of PCE waste production. Furthermore, the

environmentally friendly solvent (palm oil) applied here for the first time worked very successfully in the field of environmental management with consuming less time (only 1 day for equilibrium time). However, the complexity of surfactant preparation of Winsor type II microemulsion for RME technique and the additional separation process of PCE from surfactant were the main disadvantages.

In this study, UF process was proven to be an effective way to retain surfactant reversed micelles in the retentate stream. In this case, the UF unit was needed to fulfill the surfactant recovery purpose since without the decontamination of PCE from solvent, the surfactant solution was not ready to be reused. So, high operational costs may result from the complexity of that surfactant preparation and the downstream separation process. Unlike the LLE, PCE partition from surfactant aqueous solution to solvent phase, the surfactant was simultaneously decontaminated and ready to be reused. Thus, the extraction efficiency of the LLE can be increased by selecting a suitable type of solvent to have a high affinity to PCE but caution on toxicity of solvents needed to be considered. In summary, a trade-off decision process should be done by considering all involved advantages and disadvantages for extraction technique selection.

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