Evaluating international market selection with multi-criteria decision making tools – a case study of a metal company in Indonesia

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Abstract: With the era of globalisation, firms have the opportunity to expand their operations beyond the country's boundary. Expanding business to an international market can give firms benefits such as economic of scale leading to cheaper cost, higher asset utilisation, as well as knowledge to international exposure. However, entering international market also poses its own challenges and risks. To make a sound business decision, firms wish to enter international market need to do a proper analysis and evaluation. The study is based on a case of a medium-size Indonesia company that wishes to export its metal-derivatives products to the international market. The study used a systematic international market selection (IMS) approach using a combination of analytical hierarchical process (AHP) and goal programming (GP). It chose 12 (sub) criteria, representing generic and product-related considerations. Based on the preliminary screening, it narrowed down the alternatives to 15 countries, and using the combination of AHP-GP recommended three countries to enter.

Keywords: multi-criteria decision making; MCDM; goal programming; analytical hierarchical process; AHP; international market selection; IMS; Indonesia.

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1 Introduction

With the era of globalisation, firms nowadays can expand its operation beyond its national border. However, starting their operation in foreign soil is a complex and complicated process. Before deciding to export, companies must weigh benefits and consequences in order to make it a success (Górecka and Szałucka, 2013).

Before conducting international market selection (IMS) study, companies must answer some basic questions such as: clear reason why they want to enter into international business; define suitable product(s) to be delivered to foreign market; determine products' distinct features in terms of price, quality and other characteristics and verify whether they are still unique in non-domestic market; consider global product life cycle as well as scope and cost of selling the product to foreign market; and lastly to identify the target export market. The whole process is known as IMS (Root, 1998).

Selecting which foreign market to enter is a crucial decision in international market entry strategy. Prior to decide how to enter a market, companies need to decide which ones to enter from a broad range of available foreign markets. The domestic market most also likely different in term of market size, market potential, socio and cultural differences, or political and economic stability. The diversity and complexities in the process is huge, making the IMS a complicated process that must be well planned. (Górecka and Szałucka, 2013).

Despite its challenge, companies still see international business as a compelling opportunity. By expanding to the export market, companies can also leverage its operation by acquiring economic of scale in its production, expand its brand image, acquire international exposure and skills, etc. (Heizer and Render, 2014).

The trend of international business mainly occurs in developing countries where the labor cost is still competitive and added value to the products are possible for its export markets, such as in Indonesia. Indonesia also has a potential domestic market with about 250 million. Population and promising growth driven by its population's consumption. To complement its domestic operation, many companies in Indonesia seek to expand their business by exporting. Table 1 shows the evolution of non-oil related export of Indonesia from 2009–2013, with medium-size enterprises have enjoyed a healthy growth.

The research is a case study of a medium-size firm in Indonesia producing metal derivatives products. The products are made from aluminium or steel and ranging from retail products like kitchen's metal appliances to materials used in construction projects such as perforated metal façade. Having a stable demand domestically and excess production capacity at home, the company was evaluating to enter export markets. The objective of the research is to assist the studied company to perform a sound IMS analysis and give recommendation which market(s) to enter. The conducted IMS take into account the peculiarity of metal industry and Indonesia as its host country. The analysis used a combination approach of Spies et al. (2014) and Górecka and Szałucka (2013) when selecting the (sub) criteria and Hortacsu and Tektas (2009) in final calculation stage.

Table 1 Indonesia non-oil related export 2009–2013 (see online version for colours)

Non-oil related export	*Value*										*Growth*			
	2009		*2010*		*2011*		*2012*		*2013*		*2010*	*2011*	*2012*	*2013*
Micro enterprise	14,375	2%	16,688	1%	17,249	2%	15,235	1%	15,990	1%	16%	3%	–12%	5%
Small enterprise	36,840	4%	38,001	3%	39,312	3%	32,509	3%	32,052	3%	3%	3%	–17%	–1%
Medium enterprise	111,040	12%	121,206	11%	130,881	11%	118,882	10%	134,071	12%	9%	8%	–9%	13%
Big enterprise	790,835	83%	936,825	84%	953,009	84%	1,018,765	86%	979,215	84%	18%	2%	7%	–4%
Total	953,909	100%	1,112,720	100%	1,140,451	100%	1,185,392	100%	1,161,328	100%	17%	2%	4%	–2%

Source: http://www.depkop.go.id

2 Literature review

2.1 Importance of IMS

A lot of research has been performed in the area of IMS such as by Papadopoulos and Denis (1988), Russow and Okoroafo (1996) Papadopoulos et al. (2002), Shankarmahesh et al. (2005) and Sakarya et al. (2007). As entering the new international market can be risky and costly, companies usually allocate their resources to enter only to the most attractive and limited export opportunities (Papadopoulos and Denis, 1988). The challenge in entering international market lies in IMS and previous literatures have indicated poor market selection as the main reason for export failure (Rahman, 2003).

The analysis in IMS can be done qualitative or quantitatively, with each approach elaborated using different models (Papadopoulos and Denis, 1988). Andersen and Buvik (2002) as restated by Jansen (2013) mentioned that there are three ways to perform IMS, namely:

1 A systematic approach, where analysis is done by formalised decision process based on factors and their weighing. This approach searches extensive secondary data to get information related to country-market and uses this information to compute optimal decision that can bring competitive advantage to the company.

2 A non-systematic approach which is commonly done based on experiential knowledge of the company and the people involved in IMS decision. This approach usually focuses on geographical markets and international entry modes (Rask et al., 2008). In the analysis, the company generally performs little or no information search, and relies on perceived psychic distance, which has been defined as "factors preventing or disturbing the flow of information between firms and the market..." (Johanson and Vahlne,1977).

3 A relationship approach which uses the foreign customer as the unit of analysis and focuses on the collaboration between the two parties in making the IMS decision.

Table 2 Some of IMS models

IMS models	*Researchers*
• *3 Steps IMS*: preliminary screening ⇒ estimating industry market potential ⇒ estimating company sales potential ⇒ choose the market	Koch (2001), Kumar et al. (1994) and Root (1998).
• *4 Steps IMS*: country identification ⇒ preliminary screening ⇒ in-depth screening ⇒ final selection ⇒ choose the market	Johansson (1997)
• *Decision support model for IMS* using four-step filtering process. The results give market accessibility index per product and indication of growth prospect related to each product-market combination.	Cuyvers (1996), Cuyvers (2004), Pearson et al. (2007), Steenkamp et al. (2009) and Spies et al. (2014)
• *Integrated IMS* with a combination of scientific literature analysis, synthesis and comparative analysis, generalisation and expert survey.	Miečinskienė et al. (2014)

There were several models in performing analysis, Table 2 gives some previous studies addressing IMS model.

In a nutshell, IMS is a sequential processes where each phase is a filtering mechanism to eliminate the less attractive markets and aiming at giving a set of prospective markets as deliverables (Górecka and Szałucka, 2013). A systematic approach in IMS is important as it evaluates different aspects and information from different markets and filters those that only relevant. In summary, most of the IMS models consists of three stages (Koch, 2001; Kumar et al., 1994; Root, 1998):

- Preliminary screening. At this stage typically macro-level indicators are assessed to eliminate countries that do not meet the required objectives.
- In-depth screening. At this stage, industry-specific data, e.g., market size and growth, of the potential market from the previous phase are evaluated.
- Final selection. At this stage, firm-specific information is evaluated such as projected profitability, revenue and cost forecast and the like.

A systematic approach in IMS helps researchers to minimise two possible errors, namely: ignoring the prospective countries and spending too much time investigating poor prospects (Root, 1998). Root also suggested in the preliminary screening firms need to identify potential country regardless the entry mode, although some researchers' think it should be regarded as one decision (Koch, 2001). Albaum and Duerr (2008) distinguished selection of foreign market into two: based on similarities (expansive approach) or by systematic screening from all the possible markets (contractible approach). In general, company adopting a systematic IMS can bring a more efficient international trade practices and enjoys a more rapid export growth than those which limits to only a few alternatives (Cooper and Kleinschmidt, 1985).

To start preliminary screening is a challenge in itself, as data collection and mining can be tedious and overwhelming. To keep the process simple, low-cost yet flexible, most models used macro perspective by focusing on general country indicators (Cavusgil et al., 2004; Papadopoulos et al., 2002). Another possible approach is by using strategic framework like politics, economic, social, and technology (PEST) or politics, economic, social, technology and infrastructure (PESTI) (Nganga, 2015). Some models included industry- or product-specific approach (Douglas et al., 1982; Root, 1998; Whitelock and Jobber, 2004; Sakarya et al., 2007; Kumar et al., 1994).

Nevertheless, there is no unique method of IMS, as each company should adapt the models for its case and context. In general, few stages can be different for each company but initial and final stage are typically common. (Miečinskienė et al., 2014)

With the emergence of small and medium enterprise (SME), especially in developing countries, IMS is also spread and needed by SME. (Musso and Francioni, 2012) did a research on how small firms conduct their IMS, and investigated the primary factors influencing SMEs' choice when performing IMS. Their results suggested that there is a relationship between systematic IMS and firm size, and that SMEs are typically influenced by firm-specific and host country factor.

However, not like multinational firms, the majority of SME do not use a systematic IMS as they have difficulties in recognising the importance of a systematic approach in IMS (Lee and Brasch, 1978; Ellis, 2000; Francioni, 2012; Musso and Francioni, 2012). To SME, decisions to export can be very risky and influences the sustainability of the

companies. Hence, which foreign market to expand to is a very crucial decision to SME (Ellis, 2000; Agndal and Chetty, 2007; Sakarya et al., 2007; He and Wei, 2011). Despite the importance of IMS and its growing necessity for SME, most research related to IMS has occurred to large companies (Douglas and Craig, 1992; Cavusgil and Zou, 1994; Makino et al., 2002) and only few studies were done on Smaller firms. (Brouthers and Nakos, 2005; Francioni, 2012)

2.2 Multi-criteria decision making (in IMS)

Multi-criteria decision making (MCDM) is a methodology commonly used in applications where decision makers try to satisfied selection of alternatives under multi-criteria consideration. A lot of MCDM techniques have been developed and used in real life application due to its relevance and strength.

The simplest yet classical MCDM technique is analytical hierarchical process (AHP) first introduced by Saaty in the1980s (Saaty, 2008). In its progress, research nowadays combines AHP with other MCDM techniques to enhance the result, e.g., by combining with technique for order preference by similarity to an ideal solution (TOPSIS) (Bhutia and Phipon, 2012; Oey and Nitihardjo, 2016; Mansor et al., 2014).

The Second common tool accompanying AHP in application is goal programming (GP). GP is one of the oldest MCDM tool used to optimise multiple objectives by minimising the deviation of each objective from the desired target. For a single goal or objective, the GP problem then becomes a linear programming (LP) model. While in certain constraints LP can give infeasible solutions, GP is superior as it still gives a satisfying solution. The steps in developing a GP models are similar to LP. The main difference between the two is while LP maximises or minimises a single objective, GP minimises the deviations between the target values of the objectives and the realised results (Orumie and Ebong, 2014).

While AHP is considered as multi-attribute decision making (MADM), GP is a multi-objective decision making (MODM) tool. Combining the AHP and GP brings a balance between the two sub-sets of MCDM and give more objectivity on the result. Several studies using combination of AHP and GP in IMS has been done in the past using different criteria as consideration as a result of product or host country specifics.

With the merit and relevance of MCDM in IMS process, previous studies have been performed using these techniques, amongst many are:

- Górecka and Szałucka (2013) applied and evaluated few MCDA methods based on outranking mechanism using Exprom II with veto threshold. They identified 15 selected variables for considerations covering economic, cultural, social and political aspect to assess market's attractiveness. They then used Promethee II and Electre III methods, in order to get sensitivity and robustness analysis.
- Sener (2014) evaluated new market selection for a Turkish porcelain company using AHP assessing eight main criteria namely operating assets, communication infrastructure of the target market, economic growth rate, proximity to other markets, competitive advantage in the target market, demand, the functioning of the legal system and trade agreements with the target market-exemption.
- Hortacsu and Tektas (2009) developed a model of IMS for assisting an international retailer in selecting which country to enter. They used a combination of AHP and GP

method in solving the case. However, the criteria are quite a high level ones involving ethical, cultural, geographic and economic proximity.

3 Methodology

The steps of this research can be grouped into three main areas as indicated in Figure 1 framework of thinking, i.e.:

- In the preliminary screening, extensive literature review was conducted in order to gain insights on previous studies on IMS. Based on that, relevant criteria and sub-criteria to the case were selected. Once sub-criteria selected, it was followed by searching and collecting the relevant secondary data from the internet. The process was iterative, as some of the sub-criteria do not have data or even proxy data available for the majority of the countries. The result of this stage was the decision tree upon which AHP process will be done and the list of prospective countries to be assessed.
- In the AHP groups, the weight of each of the criteria and sub-criteria were calculated. It was done based on questionnaires sent to three stakeholders in the company. The result of this stage was the geo-mean of global weights of each sub-criterion
- In this last stage, the GP model was constructed. The generic GP model is as following:

  Determine X = (x_1, x_2, x_3, …, x_i … x_n)

$$\text{Min} \quad Z = f\left(d_i^+, d_i^-\right) = \sum_{i=1} P_i\left(d_i^+, d_i^-\right) \tag{1}$$

  Subject to

$$\sum_{j=1}^{n} a_{ij}x_j + d_i^- - d_i^+ = \alpha_i \quad i = 1, ..., n \tag{2}$$

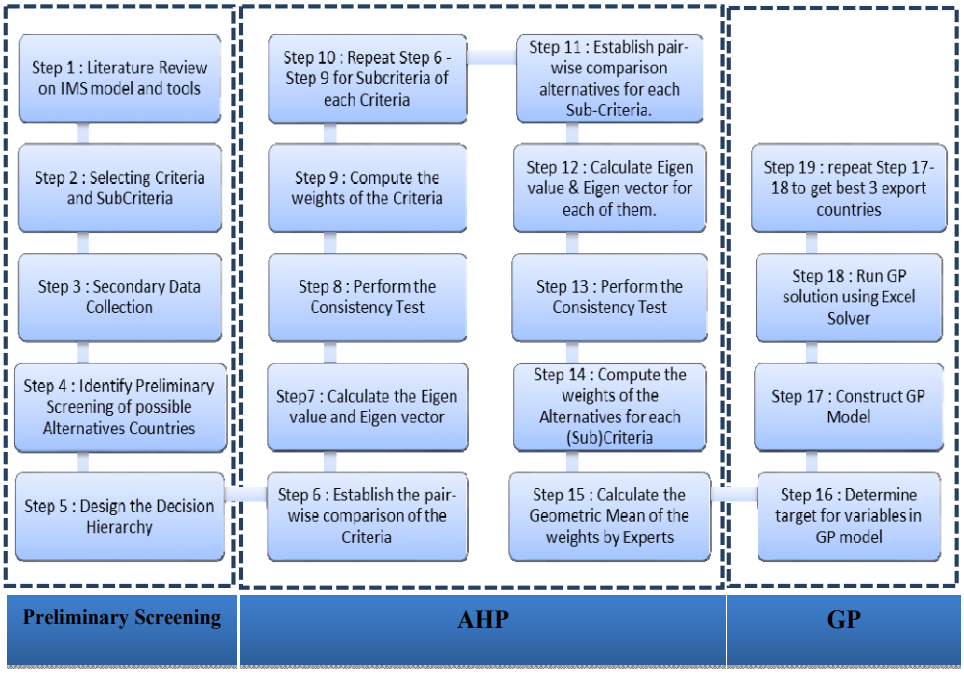
$$\sum_{j=1}^{n} x_i \le r_i \quad j = 1, ..., n \tag{3}$$

  where

x_j	mean value of variable j
d_i^+, d_i^-	under and over deviations of variable i from target value
P_i	priority weight of deviational variables of the i^{th} goal
a_{ij}	j^{th} technical coefficient value for the i^{th} goal
α_i	target value for the i^{th} goal
r_i	upper limit of the i^{th} resource.

The GP model aims to minimise the sum of deviations (d_i) from each goal (Gi). Each goal is assigned a priority weight (P_i) that shows its relative importance. The constraint (2) reflects the objectives set by decision makers, while constraint (3) represent the availability of upper/lower limit of resources.

Figure 1 Framework of thinking (see online version for colours)



The GP model was solved using Microsoft excel solver. In each run, the most favourable country was chosen. The model then re-ran by eliminating the variables related to the already chosen country. From this model, three most favourable countries were chosen.

4 Analysis and discussion

4.1 Sub-criteria and reasoning

For criteria, it was decided to have four groups relevant for typical IMS, namely strategic, marketing, supply chain and risk considerations. Some of the sub-criteria used data or indicators that consider relevant for exporting metal product such as those intended by the studied company. As the product will be related to the construction industry, 'construction spending' is chosen as one of sub-criteria. The company also have some retail product, and therefore 'population growth of high and middle class' was also chosen as sub-criteria to give an indication of usage of metal appliances in the middle-class household. The reasoning and data source of all the chosen sub criteria can be seen in Table 3.

Table 3 Sub-criteria, indicators, reasoning and data sources

Criteria	*Sub-criteria*	*Indicators*	*Reason*	*Data source*
Strategic	Market value	GDP per capita (USD)	According to steelonthenet.com, countries with high level of income per capita rather to have low steel consumption as an effect of no more infrastructure are built in developed countries.	http://data.worldbank.org/indicator/NY.GDP.PCAP.CD
	Economic growth	GDP growth (%)	The growth of GDP impacts to the increase long-term investment such as purchasing property (http://marketrealist.com, 2014).	http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG
	Consumption growth	Interest rate (%)	Steel producers and processors are benefited from the decrease of interest rate percentage as they need borrowings for capital. Markets are eager to invest in buying automotive and real estate as the interest rate decreases (EY Global Steel Outlook 2014–2016).	http://data.worldbank.org/indicator/FR.INR.RINR
Marketing	Construction industry growth	Construction spending (Billion USD)	Based on EY Global Outlook 2014, construction work such as housing and public construction projects creates the highest demand for steel products such as (bars, sections, galvanised sheet and plate).	IHS Global Construction Executive Summary 2013
	Potential market growth	Population growth of middle and high income groups	The growth of income increases the number of middle class population which also increases the property sales demand (http://marketrealist.com, 2014).	http://data.worldbank.org/country; http://data.worldbank.org/indicator/SP.POP.GROW
	Industry performance	Steel demand surplus and deficit (thousand metric tonnes)	Demand of steel products depends on the economic condition of a country and how the construction, automotive and other industry perform (EY Global Steel Outlook, 2014).	https://www.worldsteel.org/steel-by-topic/statistics/steel-statistical-yearbook-.html
Supply Chain	Lead time	Physical distance (Km)	Distance between two countries in export and import activities impacts to its delivery lead time and freight costs. While price competitiveness determines the success of steel producer (EY Global Steel Outlook 2015–2016).	https://www.distancecalculator.net/
	Birocracy	Corruption index (rank)	Corruption minimise the profitability opportunity of entering a new market as long as creating risks and more costs (http://export.gov, 2016).	http://www.transparency.org/news/feature/corruption_perceptions_index_2016
	Transportation cost	Freight cost (USD)	Transportation cost becomes one of the factors to determine pricing for products. Meanwhile, the market demands competitive pricing which pushes the freight cost to be more tight (EY Global Steel, 2014).	http://worldfreightrates.com/en/freight
Risks	Net profit amount	Corporate tax rate (%)	Corporate tax rate imposed by government influence firms' profit and risk	http://www.tradingeconomics.com/country-list/corporate-tax-rate
	Political risk	Global competitiveness index (scale)	competitiveness as the set of institutions, policies, and factors that determine the level of productivity of an economy, which in turn sets the level of prosperity that the country can achieve.	http://www3.weforum.org/docs/GCR2016-2017/05FullReport/TheGlobalCompetitivenessReport2016-2017_FINAL.pdf
	Currency risks	Currency fluctuation (%)	Pricing of imported or exported stee products associated with exchange rate fluctuation. Steel producer countries becoming cost competitive because of currency fluctuations (EY Global Steel, 2015–2016; Haffman, 2005).	http://www.tradingeconomics.com/currencies

Table 4a Result of preliminary screening of alternatives – strategic criteria

Strategic								
Market value			*Economic growth*			*Consumption growth*		
GDP per capita (USD)			*GDP Growth (%)*			*Interest rate (%)*		
Country name	*2015*	*Rank*	*Country name*	*2015*	*Rank*	*Country name*	*2015*	*Rank*
Bulgaria	6,993	8	Bulgaria	3.62	9	Bulgaria	5.17	8
Bangladesh	1,212	15	Bangladesh	6.55	3	Bangladesh	5.51	9
China	8,028	7	China	6.91	1	China	4.81	5
Iraq	4,944	10	Iraq	3.02	12	Iraq	0.00	1
Israel	35,728	3	Israel	2.51	14	Israel	0.66	2
Kenya	1,377	14	Kenya	5.65	5	Kenya	6.36	13
Malaysia	9,768	4	Malaysia	4.97	6	Malaysia	4.97	6
Mauritius	9,252	5	Mauritius	3.47	10	Mauritius	7.48	15
New Zealand	37,808	2	New Zealand	3.39	11	New Zealand	5.88	10
Philippines	2,904	12	Philippines	5.91	4	Philippines	6.25	11
Romania	8,973	6	Romania	3.66	8	Romania	3.74	4
Singapore	52,889	1	Singapore	2.01	15	Singapore	3.65	3
Thailand	5,815	9	Thailand	2.83	13	Thailand	6.33	12
Sri Lanka	3,926	11	Sri Lanka	4.79	7	Sri Lanka	5.15	7
Vietnam	2,111	13	Vietnam	6.68	2	Vietnam	7.32	14

Table 4b Result of preliminary screening of alternatives – marketing criteria

Marketing												
Construction industry growth			*Potential market growth*				*Industry performance*					
Construction spending (Billion USD)			*Population growth of middle and high income groups*				*Steel demand surplus and deficit (thousand metric tonnes)*					
Country	*Rating*	*Rank*	*Country*	*Income*	*Population growth*	*Rank*	*Country*	*Production*	*Use*	*Surplus (deficit)*	*Rank*	
Bulgaria	0	10	Bulgaria	Upper middle	–0.64	15	Bulgaria	543	1,368	–825	12	
Bangladesh	24.2	5	Bangladesh	Lower middle	1.20	7	Bangladesh	100	4,209	–4,109	6	
China	1,786.6	1	China	Upper middle	0.51	11	China	803,825	700,350	103,475	15	
Iraq	0	10	Iraq	Upper middle	3.21	1	Iraq	-	3,387	–3,387	7	
Israel	0	10	Israel	High	1.98	3	Israel	300	3,110	–2,810	8	
Kenya	4.3	9	Kenya	Lower middle	2.61	2	Kenya	20	1,824	–1,804	9	
Malaysia	32.1	3	Malaysia	Upper middle	1.42	6	Malaysia	3,784	11,629	–7,845	4	
Mauritius	0	10	Mauritius	Upper middle	0.13	13	Mauritius	-	121	–121	14	
New Zealand	22.3	7	New Zealand	High	1.89	4	New Zealand	793	1,067	–274	13	
Philippines	24.6	4	Philippines	Lower middle	1.56	5	Philippines	968	10,186	–9,218	3	
Romania	0	10	Romania	Upper middle	–0.47	14	Romania	3,352	4,266	–914	11	
Singapore	23.6	6	Singapore	High	1.19	8	Singapore	501	5,100	–4,599	5	
Thailand	32.8	2	Thailand	Upper middle	0.34	12	Thailand	3,718	19,458	–15,740	1	
Sri Lanka	0	10	Sri Lanka	Lower middle	0.93	10	Sri Lanka	30	1,028	–998	10	
Vietnam	15.5	8	Vietnam	Lower middle	1.08	9	Vietnam	5,647	21,226	–15,579	2	

Table 4c Result of preliminary screening of alternatives – supply chain criteria

Supply chain								
Lead time			*Birocracy*			*Transportation cost*		
Physical Distance (Km)			*Corruption index (rank)*			*Freight cost (USD)*		
Country	*Km*	*Rank*	*Country*	*CI rank*	*Rank*	*Country*	*Freight cost*	*Rank*
Bulgaria	9,950	14	Bulgaria	69	7	Bulgaria	1,149	10
Bangladesh	3,730	6	Bangladesh	139	13	Bangladesh	790	7
China	4,203	8	China	83	9	China	503	1
Iraq	8,240	11	Iraq	161	15	Iraq	2,180	15
Israel	9,024	13	Israel	32	3	Israel	1,071	9
Kenya	8,462	12	Kenya	139	13	Kenya	816	8
Malaysia	1,441	2	Malaysia	54	5	Malaysia	714	3
Mauritius	6,501	9	Mauritius	45	4	Mauritius	1,477	11
New Zealand	7,561	10	New Zealand	4	1	New Zealand	2,005	13
Philippines	1,751	3	Philippines	95	11	Philippines	769	6
Romania	10,001	15	Romania	58	6	Romania	2,120	14
Singapore	1,144	1	Singapore	8	2	Singapore	707	2
Thailand	2,337	5	Thailand	76	8	Thailand	721	4
Sri Lanka	3,804	7	Sri Lanka	83	9	Sri Lanka	1,543	12
Vietnam	1,766	4	Vietnam	112	12	Vietnam	765	5

Table 4d Result of preliminary screening of alternatives – risk criteria

RISK								
Net profit amount			*Political risk*			*Currency risks*		
Corporate tax rate (%)			*Global competitiveness index (scale)*			*Currency fluctuation (%)*		
Country	*Tax rate*	*Rank*	*Country*	*GCI score*	*Rank*	*Country name*	*Rate*	*Rank*
Bulgaria	10.00%	2	Bulgaria	4.44	8	Bulgaria	3.81%	9
Bangladesh	25.00%	11	Bangladesh	3.80	14	Bangladesh	4.05%	10
China	25.00%	11	China	4.95	5	China	5.92%	14
Iraq	15.00%	3	Iraq	0	15	Iraq	0.09%	5
Israel	25.00%	11	Israel	5.18	3	Israel	–5.21%	1
Kenya	30.00%	14	Kenya	3.90	13	Kenya	2.69%	7
Malaysia	24.00%	10	Malaysia	5.16	4	Malaysia	8.21%	15
Mauritius	15.00%	3	Mauritius	4.49	7	Mauritius	0.00%	3
New Zealand	0.00%	1	New Zealand	5.31	2	New Zealand	0.00%	3
Philippines	30.00%	14	Philippines	4.36	9	Philippines	5.90%	13
Romania	16.00%	6	Romania	4.30	11	Romania	5.00%	12
Singapore	17.00%	7	Singapore	5.72	1	Singapore	3.23%	8
Thailand	20.00%	8	Thailand	4.64	6	Thailand	–1.39%	2
Sri Lanka	15.00%	3	Sri Lanka	4.19	12	Sri Lanka	4.32%	11
Vietnam	20.00%	8	Vietnam	4.31	10	Vietnam	2.20%	6

4.2 Preliminary screening of alternatives

For each of the sub-criteria, data for top 50 countries were analysed and top 15 countries were selected as alternatives. This is the result of preliminary screening of the country, which is shown in Table 4a–4d.

4.3 AHP model and result

Based on the complete criteria and sub-criteria, the AHP decision tree was constructed, as indicated in Figure 2. In each decision's intersections, AHP weighing were calculated based on input from pair-wise comparison questionnaires. As there were three decision makers, the weight of each criterion and sub-criteria were averaged using geometric mean. A sample of weight calculation of criteria from 1 decision maker is shown in Table 5. To get the composite weight of all the three decision makers, the geometric mean for each sub-criteria were calculated. Summary of AHP result is as per shown in Table 6.

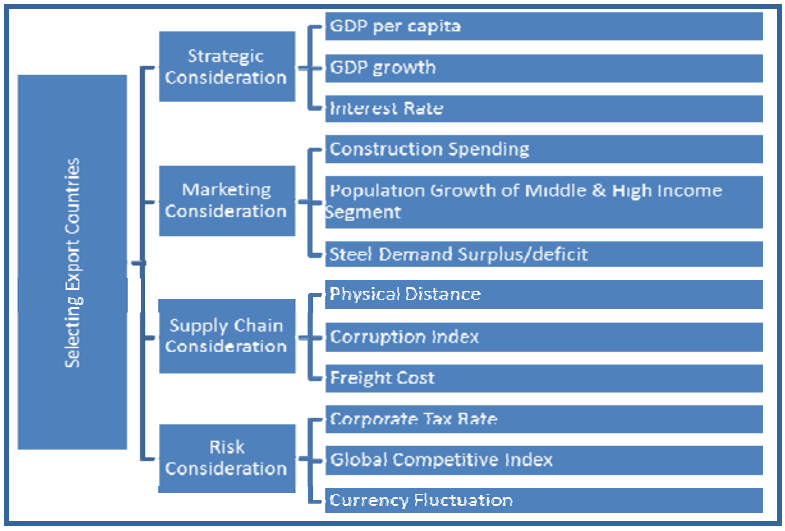
Table 5 Sample AHP calculation of criteria for criteria from decision maker 1

Step 1: Comparison matrix based on pair-wise questionnaires						
Criteria	*Strategic*	*Marketing*	*Supply chain*	*Risks*		
Strategic	1	1/5	1	1/5		
Marketing	5	1	3	3		
Supply chain	1	1/3	1	1/3		
Risks	5	1/3	3	1		
Total	12	1 6/7	8	4 1/2		
Step 2: Normalisation to calculate weight						
Criteria	*Strategic*	*Marketing*	*Supply chain*	*Risks*	*Eigen vector*	*P vector*
Strategic	0.083	0.107	0.125	0.044	0.090	0.364
Marketing	0.417	0.536	0.375	0.662	0.497	2.185
Supply chain	0.083	0.179	0.125	0.74	0.115	0.470
Risks	0.417	0.179	0.375	0.221	0.298	1.258
Total	1	1	1	1	1	3.019
Step 3: Checking the consistency						
Lamaba max				4.188		
CI				0.063		
RI				0.900		
CR				0.070		
				Acceptable		

Table 6 Summary of AHP Result

Criteria and sub-criteria	*DM1*		*DM2*		*DM3*		*Geometric mean for 3 DMs*		
	Weight criteria	*Weight sub-criteria*	*Weight criteria*	*Weight sub-criteria*	*Weight criteria*	*Weight sub-criteria*	*Weight criteria*	*Weight sub-criteria*	*Global weight of sub-criteria*
Strategic	0.090		0.067		0.159		0.114		
GDP per capita		0.260		0.106		0.405		0.236	0.0269
GDP growth		0.633		0.633		0.480		0.609	0.0694
Interest rate		0.106		0.260		0.115		0.155	0.0177
Total		*1*		*1*		*1*		*1*	
CR = CI / RI		*0.033*		*0.03*		*0.025*			
Market size	0.497		0.291		0.077		0.258		
Construction		0.106		0.074		0.11		0.094	0.0243
Population		0.260		0.283		0.26		0.268	0.0692
Steel demand		0.633		0.643		0.63		0.638	0.1646
Total		*1*		*1*		*1*		*1*	
CR = CI / RI		*0.033*		*0.056*		*0.033*			
Supply chain	0.115		0.151		0.501		0.238		
Distance		0.158		0.134		0.193		0.197	0.0468
Corruption		0.655		0.120		0.083		0.230	0.0548
Freight cost		0.187		0.746		0.724		0.573	0.1361
Total		*1*		*1*		*1*		*1*	
CR = CI / RI		*0.025*		*0.011*		*0.057*			
Risk	0.298		0.491		0.263		0.390		
Tax rate		0.777		0.405		0.115		0.415	0.1618
GCI		0.155		0.480		0.405		0.390	0.1522
Currency risk		0.069		0.115		0.480		0.195	0.0762
Total		*1*		*1*		*1*		*1*	
CR = CI / RI		*0.071*		*0.025*		*0.025*			
Grand total	*1*		*1*		*1*		*1*		*1*

Figure 2 Decision tree of AHP (see online version for colours)



4.4 GP model and result

The GP model for the case study is as per (Hoffman, 1998; Hortacsu and Tektas, 2009), which is to select the country with the minimum total deviation from the target goal, i.e.:

Determine $X = (x_1, x_2, x_3, ..., x_i ... x_{15})$

$$\text{Min } 2.69d_1^- + 6.94d_2^- + 1.77d_3^+ + 2.43d_4^- + 6.92d_5^- + 16.46d_6^+ + 4.68d_7^+ + 5.48d_8^+ + 13.61d_9^+ + 16.18d_{10}^+ + 15.22d_{11}^- + 7.62d_{12}^+$$

Subject to:

$$\text{G1} \quad 6{,}993X_1 + \ldots\ldots\ldots\ldots 2{,}111X_{15} - d_1^+ + d_1^- = 4{,}952.14$$
$$\text{G2} \quad 3.62X_1 + \ldots\ldots\ldots\ldots 6.68X_{15} - d_2^+ + d_2^- = 3.00$$
$$\text{G3} \quad 5.17X_1 + \ldots\ldots\ldots\ldots 7.32X_{15} - d_3^+ + d_3^- = 7.84$$
$$\text{G4} \quad 0.0X_1 + \ldots\ldots\ldots\ldots 15.5X_{15} - d_4^+ + d_4^- = 131.07$$
$$\text{G5} \quad 0.64X_1 + \ldots\ldots\ldots\ldots 1.08X_{15} - d_5^+ + d_5^- = 0$$
$$\text{G6} \quad -825X_1 + \ldots\ldots\ldots\ldots -15{,}579X_{15} - d_6^+ + d_6^- = -420.5$$
$$\text{G7} \quad 9{,}950X_1 + \ldots\ldots\ldots\ldots 1{,}766X_{15} - d_7^+ + d_7^- = 10{,}403.5$$
$$\text{G8} \quad 69X_1 + \ldots\ldots\ldots\ldots 112X_{15} - d_8^+ + d_8^- = 83$$
$$\text{G9} \quad 1{,}149X_1 + \ldots\ldots\ldots\ldots 765X_{15} - d_9^+ + d_9^- = 2{,}181.29$$
$$\text{G10} \quad 10\%X_1 + \ldots\ldots\ldots\ldots 20\%X_{15} - d_{10}^+ + d_{10}^- = 25\%$$
$$\text{G11} \quad 4.44X_1 + \ldots\ldots\ldots\ldots 4.31X_{15} - d_{11}^+ + d_{11}^- = 4.27$$
$$\text{G12} \quad 3.81X_1 + \ldots\ldots\ldots\ldots 2.2\%X_{15} - d_{12}^+ + d_{12}^- = 2.59\%$$

x_i binary value – $x_i = 1$ if located in country j or zero otherwise

d_i^+, d_i^- : over and under achievement from target for goal i.

As the target of GP model, Table 7 shows the selected target value and its reasoning.

Table 7 Target value for GP model

No.	*Sub criteria => goals*	*Target value*	*Reason/remarks*
G1	GDP per capita (USD)	≥ 4,952.14	2nd quartile of the data
G2	GDP growth (%)	≥ 3%	2nd quartile of the data
G3	Interest rate (%)	≤ 7.84%	2nd quartile of the data
G4	Construction spending (billion USD)	≥ 131,07	Average
G5	Population growth of middle and high income groups	≥ 0	Upper middle to high; positive growth
G6	Steel demand surplus and deficit (thousand metric tons)	≤ –420.5	2nd quartile of the data
G7	Physical distance (Km)	≤ 10,403.5	2nd quartile of the data
G8	Corruption index (rank)	≤ 83	2nd quartile of the data
G9	Freight cost (USD)	≤ 2,181.29	2nd quartile of the data
G10	Corporate tax rate (%)	≤ 25%	2nd quartile of the data
G11	Global competitiveness index (scale)	≥ 4.27	Average
G12	Currency fluctuation (%)	≤ 2.59%	Average

The GP model was calculated using Microsoft excel solver, each time giving the best-selected country. To select the next best-selected country, the model was reran by excluding the already-selected country. Based on the model, three best countries were selected, namely: Thailand, Malaysia and Singapore. The summary result of the GP model for those three selected countries is shown in Table 8.

5 Conclusions and limitations

The study recommended three countries as a starting point for IMS's of the studied company, i.e.: Thailand, Malaysia and Singapore. The study considered four group criteria in performing IMS, and demonstrated a combination of some generic as well as product- or industry-related sub-criteria. In the analysis, the study also combined both subjective approach by using AHP and objective approach by using GP. The study demonstrated that a systematic IMS can be done for a middle-size firm using secondary data and proper methodology. Nevertheless, it should be noted that the selected sub-criteria may be case sensitive and different case may require different sub-criteria. From the preliminary screening of alternatives, few of the top 15 countries, such as Iraq and Israel were not intuitive, and may require further research or sensitivity analysis. The study was also a static analysis, which only valid under the current set of data. Further elaboration or recalculation may be required when market dynamics change.

Table 8 Summary of GP result

Goals	*Weight*	*Target*	*Best three countries*					
			Thailand		*Malaysia*		*Singapore*	
			Data	*Deviation*	*Data*	*Deviation*	*Data*	*Deviation*
GDP per capita	2.69	> 4952,14	5,814.8	-	9,768.3	-	52,888.7	-
GDP growth	6.94	>3.00	2.8	-	5.0	-	2.0	1.0
Interest rate	1.77	< 7.84	6.3	-	5.0	-	3.7	-
Construction	2.43	> 131.07	32.8	98.3	32.1	99.0	23.6	107.5
Population growth of middle and high income	6.92	> 0	0.3	-	1.4	-	1.2	-
Steel demand	16.46	< –420,5	–15,740.0	-	–7,845.0	-	–4,599.0	-
Distance	4.68	< 10403,5	2,337.0	-	1,441.0	-	1,144.0	-
Corruption	5.48	< 83	76.0	-	54.0	-	8.0	-
Freight cost	13.61	< 2181,29	721.4	-	714.3	-	707.2	-
Tax rate	16.18	< 25%	20%	-	24%	-	17%	-
GCI	15.22	> 4,27	4.6	-	5.2	-	5.7	-
Currency risk	7.62	< 2,59%	–1.4%	-	8.2%	0.1	3.2%	0.0
Min Z				238.9		241.0		268.2

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