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## Causal Factors for Gem and Jewelry Export



**Saranda Phunthong<sup>1</sup>, Wannaporn Saekhow<sup>2</sup>**

B.B.A. in International Trade and Business Logistics,  
International College, King Mongkut's University of  
Technology North Bangkok, Bangkok, Thailand  
E-mail: sarandatpn@gmail.com<sup>1</sup>, ws.yokky@gmail.com<sup>2</sup>

and

**Philippe C. Marinier**

International College, King Mongkut's University of  
Technology North Bangkok, Bangkok, Thailand  
E-mail: philippe.m@ic.kmutnb.ac.th



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B.B.A. in International Trade and Business Logistics,  
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**Philippe C. Marinier**

International College, King Mongkut's University of  
Technology North Bangkok, Bangkok, Thailand  
E-mail: philippe.m@ic.kmutnb.ac.th

## Abstract

The value of exporting gems and jewelry decreased impacted on the condition of exporting Thai gems and jewelry in the past year consisted of the world economic crisis especially in the US, Japanese, and Europe markets which made consumers had to save their moneys. There were both groups of people who did not buy anything and who bought inexpensive jewelry instead such as silver jewelry, imitation jewelry. This affected to entrepreneurs to be encountered with financial liquidity problem, adjusting of the price of gold, and the price of silver. According to the problem, this research would like to causal of factor for gems and jewelry export. This research has the object to investigate the causal factors affecting and mitigate and propose risk strategy of export for gems and jewelry and we used an exemplary case study is A.U.T Internationals Co., Ltd. and to find the problem of the decrease of company's export between 2013 - 2017 by using questionnaire and interview from 16 staffs. The researchers collected the results and analysis to find the cause of the problem of the decrease of company's export is caused by poor economic condition, liquid assets, competitive growth, high cost of production and poor export performance by Pareto Analysis and Cause and Effect Diagram for first object. And we find the risk of company's export and identified the hazard of company's export. And using Failure Mode and Effect Analysis or FMEA to find Risk Priority Number or RPN of all risk of company's export for risk level of export for gem and jewelry and find Supply Chain Risk Strategy for solution.

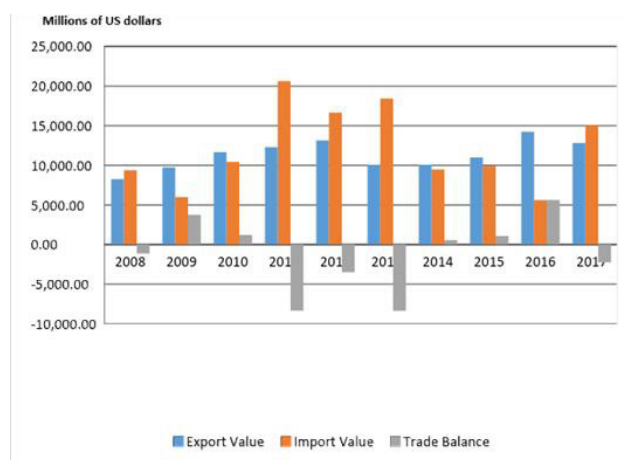
**Keywords:** Causal, Gems, Jewelry

## 1. Introduction

The gems and jewelry industry of Thailand produces important products which drive and improve the economy to be an important center of trading gems and jewelry in the world. This industry contributes benefit to related industries such as mines industry, diamond cutting industry, design industry, setting industry, transportation, insurance and packing industry which cause employment and added value to the economy because every industry requires more employees and also need the capability of employee such as experience or expert. And it can also expand income to

related industries. Thailand has advantages over other countries because Thailand has raw material and expert employees. Gems and Jewelry industry can make more money for Thailand and the government support encourages gems and jewelry industry more than the in past such as exporting, production, marketing and etc. Also, private sectors arrange gems and jewelry fair and it makes the gems and jewelry industry expand rapidly.

Nowadays, the real cost of exporting gems and jewelry of Thailand is in the US dollar (exclude gold). In the first quarter of this year, it can expand more since the overall picture of the world economy gives a sign that it is going to be better which increases the consumption of luxurious products. Also, the price of raw materials is stable at the lower point at this time. When averaging Thai Baht appreciation, the prices of Thai instant products and Semi-finished products do not raise more. Along with the reputation of Thai products which are accepted in the world market, this gives more benefit to the demand of Thai gems and jewelry. Entrepreneurs have to observe the risk factors which can deteriorate the exportation to the rest of this year such as the trade war between the US and China, the stability of the political situation in the EURO zone such as Germany which might have new election or the risk of secluding Catalonia from Spain and the “Brexit” issue of the United Kingdom. Also, the debt condition in the economic system in China which is in a high level can impact badly on the confidence of consumers. Moreover, there is an issue of Thai baht fluctuation and the more intensity of the competition which entrepreneurs in foreign country might use many strategies to seize more market share in this year. Also, according to Import and Export Value of Gems and Jewelry report of The Gem and Jewelry Institute of Thailand (Public Organization), the value of exporting gems and jewelry decreased (9.92 percent) from the former value of 14,246.83 million dollars in 2016 to 12,832.96 million dollars according to the customs tariff, part 71 in 2017. It was the in the third place of importance of exporting products (5.42 percent of the overall exporting products). However, when deducting those export values from exporting unprocessed gold (45 percent), we found out that the real value of exporting gems and jewelry was 7,117.58 million dollars which rose up from the previous year by 2.15 percent. For importing gems and jewelry, it increased in value of 75.19 percent from 8,611.30 million dollars to 15,086.30 million dollars, however; when considering the balance trade of gems and jewelry, we found that Thailand had a trade deficit of 2,253.34 million dollars in 2017 as can be seen in the Figure 1 This resulted from importing more products in many categories especially gold which covered the most importing proportion with 73 percent and cut diamond, gold jewelry and cut stone follows.



**Figure 1** Import and Export Value of Gems and Jewelry between 2008 and 2017

For the factors which impacted on the condition of exporting Thai gems and jewelry in the past year consisted of the world economic crisis especially in the US, Japanese, and Europe markets which made consumers have to save their moneys. There were groups of people who did not buy anything and who bought inexpensive jewelry instead such as silver jewelry or, imitation jewelry. This affected to entrepreneurs to be encountered with financial liquidity problems, and adjusted of the price of gold, and the price of silver. In the first quarter of 2009, both gold and silver which are the main metals in manufacturing jewelry, adjusted the price to be higher consistently and fluctuated to even higher prices causing the higher cost of manufacturing gems and jewelry. The source of raw metals such as Burma and Madagascar had more obstacles in importing raw materials. In Burma's case, the US announced Tom Lantos Block Burmese Jade (Junta's Anti-Democratic Efforts) and prohibited importing products which consisted of Jade and Ruby from Burma to manufacture jewelry for exporting. This had the direct impact on Thai jewelry which was mainly manufactured by raw materials from Burma including the case that the president of Madagascar forbade exporting all raw Gemstones unless those Gemstones had already cut. Since 2009, it continuously effected on selling Gemstones as it was stagnant and Thai jewelry was also removed from GSP rights. In the present, the United States removed the privilege of tariff or GSP of genuine jewelry which is made of Thai gold resulting in exporting gold jewelry to the US in the past year faced with purchasing recession and restriction in trade measurement. However, that measurement did not affect only Thailand but it also affected the Thai's competitor countries such as China or India. They were all faced with Thai baht appreciation which was on the highest appreciation at that time. This impacted on value of exporting Thai gems and jewelry which were sold in term of the US dollars. When converting into Thai baht, it decreased and resulted in gems and jewelry industry and other related companies being adversely imported. The objectives of the study were to: 1) investigate the causal factors affecting export for gems and jewelry, 2) mitigate and propose risk strategy of export for gems and jewelry.

## **2. Literature Review**

### *2.1 Theory and Definition*

#### Export

Thailand has been trading with foreign countries for a long time and international trade plays an important role in Thai economic system. In the present, exportations of Thailand are valued at many hundred billion baht. People who do business in exporting their product to foreign countries must have knowledge of exporting products, so researchers have collected information about exporting fundamentals. Gems and jewelry exporters import metals in order to manufacture jewelry. This material is expensive, so there is a way to make them tax-free. This is the source of a pattern of gems and jewelry exportation.

#### Risk

Risk is the potential that a chosen action or activity (including the choice of inaction) will lead to a loss (an undesirable outcome) (Wikipedia, 2011). The notion implies that a choice having an influence on the outcome exists (or existed). Potential losses themselves may also be called "risks". Almost any human endeavour carries some risk, but some are more risk than others.

- Operational Risk

An operational risk is, as the name suggests, a risk arising from execution of a company's business functions. It is a very broad concept which focuses on the risks arising from the people, systems and processes through which a company operates. It also includes other categories such as fraud risks, legal risks, physical or environmental risks while operational risk is the risk of loss resulting from inadequate or failed internal processes, people and systems, external events (Wikipedia, 2011).

- Financial Risk

Financial risk is an umbrella term for multiple types of risk associated with financing, including financial transactions that include company loans in risk of default. Risk is a term often used to imply downside risk, meaning the uncertainty of a return and the potential for financial loss (Wikipedia, 2011).

## Gems & Jewelry

Gems is an ore or a stone or organic substance occurring naturally or obtained from living things (pearl, coral, and amber) or a substance which is synthesized to have the same chemical, physical, or light composition as natural ore. Gems have three main characteristics which are beauty, hardness, and rareness. Moreover, most people wear jewel as their accessory in order to bring prosperity to their life. Also, jewels can be a bequest to children and the value of jewels is consistently increasing.

Jewelry is what humans design, create, and manufacture in order to decorate their bodies to be beautiful. It can be used by both men and women, such as ring, earring, bracelet, necklace, and etc. Jewelry in each county has different shape and style depending on their belief, taste, culture, tradition, weather, and politics in that area. (Information from Thai Encyclopaedia for juvenile, Volume 34, Chapter 4, the copyright belongs to His Majesty King Bhumibol Adulyadej).

Manufacturing jewelry shows a skill and delicacy of each country. Nowadays, technology of manufacturing jewelry has advanced so much. People search for metals and find a new method to manufacture jewelry of increasing quality. Also, they use computers to help them in designing and manufacturing jewelry. Thailand is one of the most important centers of manufacturing and exporting jewelry and makes income by this business. Apart from being an important manufacturer in the world, Thailand also has jewelry markets inside the country which is very popular as can be seen that there are gold jewelry shops in China town; old jewelry stores in Banmho, Bangrak, and Silom; retail shops in department stores and markets. The prices and styles are different in each place. Gems and jewel business is a popular industry and has exporting value which is important for Thai economy. It is also a source of employment.

Added value and enhancing creativity result in expanding of many related product and service businesses such as jewelry stores, goldsmiths, jewellers, machine businesses, and equipment used in packaging productions, teaching and training Institutes, gems and jewelry inspection businesses, design and fashion businesses, and importer / exporter of jewel products & jewelry. Thailand is accepted internationally as the most important center of cutting gemstones. Thailand is also a net exporter of gems and jewelry. Also, jewelry which is exported the most are unprocessed gold, gold jewelry, silver jewelry, diamond, gemstones, and synthetic jewelry.

## 2.2 Literature Survey

Orarigdech, S (1992) studied the development of gems and jewelry industry export of Thailand by using descriptive study method and market share analysis which used Revealed Comparative Advantage (RCA) index to study about manufacturing conditions, foreign market export, and competitive structure in the world market of important Thai export market. Moreover, he also studied and analysed from 1985 to 1989 and the results found out that Thai gems and jewelry in US markets had more market share which resulted from the capability of competition and an expanding of the market. In the Japanese market, the market share increased more because the market expanded mainly, but part of the increase came from competitive capability. In the Hong Kong and Switzerland markets, Thai gems had decreased market share but jewelry had increased market share which resulted from Switzerland's competitive capability.

Wasinrat, S (1996) studied an analysis of the potential of exporting gems and jewelry industry of Thailand. This aimed to study the factors or determinants of the potential of the exporting gems and jewelry industry of Thailand in order to measure or evaluate potential of the exportation along with studying problems and obstacles which impacted on potential of the exportation in this industry. Also, she used the statistics from her study to introduce the way to improve gems and jewelry exportation of Thailand to have more efficient ability and potential. The frame of this study is based on advantage theory which compares and simulates the stability of market share which used the data from the year 1988 to 1992. The outcome of the study showed that Thailand could export more gems and jewelry in every category. This meant that Thailand had potential to compete with other countries in the world market, the markets which were studied were Belgium, France, Germany, Hong Kong, Israel, Japan, Singapore, Switzerland, and the United States. The results showed that Thailand can export more gems and jewelry in almost every country mentioned excluding the United States. The factors making the exportation expand were the expansion of the world market, components of the product and, competitive ability. Other factors which determine export potential were materials, labour, technology, and design. They all took part in supporting gems and jewelry exportation of Thailand to more efficient ability and potential.

Asawachokechai (2005) studied the conditions and problems in operating Thai gems and jewelry exporting business. This research had an objective to study the conditions and problems in operating Thai gems and jewelry exporting business. The sample groups which were selected in this research were 263 persons from Thai gems and jewelry business managers who are a member of Department of International Trade Promotion, Ministry of Commerce. The tool which was used in the research was a questionnaire. The statistic which was used to analyse was percentages, average, ANOVA standard deviation, and Scheffe Analysis. The statistics were mostly analysed by using SPSS program which showed that the main investigators were Thai citizens who owned medium enterprises which had 50-200 employees and operated their business not more than 15 years. The major exporting market was Europe and it was a medium market. The most sent-off products were silver genuine jewelry. Studying exporting problem found that an overview of problem of operating business was in a high level. The results of considering each side are listed as follows: the problem of market averaged high level; the problem of personnel averaged high level; the problem of export averaged high level; the problem of manufacture averaged high level. Comparing the difference of the problem level averages in operating gems and jewel exporting industry business found that the overall problem of operating gems and jewel exporting industry business were not significantly different in term of 0.05 statistic, however; when considering in each side, it was different in business investigation, size of establishment, and the duration of operating business.

Taweechaitakarn (2005) analysed and studied Thai gems and jewel exporting condition by determining education factors which were Thai gems and jewel exporting condition and, consumption behaviour of partner countries. The scope of the study was to study information which was studied and collected between 1997 and 2004 by using time-series analysis to help in analysing and forecasting the tendency of exporting gems and jewelry. The compiled data method was used as well as separate components or movements from time-series data that it was in multiplicative result. Also, she took International trade method which consisted of Absolute Advantage Theory, Comparative Advantage theory, and Neo-Classic Institute Theory and it showed that competition in the world market divided into three levels which tendency scale of jewelry exportation increased more and more.

Tripatrapachorn, Teerawitayalert, and Pakdeekul (2009) studied the impact of environment and competitive factor of gems and jewelry exportation industry of entrepreneur in Bangkok. The type of this research was descriptive research with the pattern of studying sample groups who were Thai entrepreneurs operating gems and jewelry exporting business in Bangkok area and entrepreneurs who were registered with department of International Trade Promotion. They examine 197 people out of 388 populations by using a questionnaire as a tool which asked for typical information and surveyed for an opinion from entrepreneurs about environment and competitive factors which had an impact on changing in exportation in the past year. The result was most entrepreneurs did a company business and exported their goods to foreign countries which were mostly in Asia, America, and Europe sequentially. In 2008, there was an increasing rate of export around 10-20 percent and an increasing rate of export was less than 3 percent in 2009. Moreover, consuming the source of materials both in country and overseas was the cause of ordering materials from overseas because materials in the country was inadequate. The budget spending in present of the entrepreneurs is in the commercial bank. Entrepreneurs also marketed overseas by contacting with foreigners by themselves. Problems and obstacles in operating international business were economic problems, budget problems, and financial liquidity problems. An impact of economic environment, society, culture, technology, politics, and law had both good and bad effect in small to medium level. Also, the impact of approaching- industry competition of a new competitors had both good and bad effect in small to medium and the part of intensity of competition between same industry business, replaceable products and services, negotiable of customers and material sellers had both good and bad effect in small level.

Tongtawat (2015) studied gems and jewelry industry manufacture management strategy at Maesod district, Tak province. The objectives were to bring the strategy of gems and jewelry industry to be the goal in managing manufacturing factors in 5 areas which are materials, labour, budget, tools, and equipment. Technology informants who were specialists and had knowledge and experience in gems and jewelry industry at Maesod district, Tak province were interviewed for 17 persons. He studied their opinions and ideas by using Delphi technique 3 times. The tools which were used to collect data were an interview, a scale questionnaire, and the statistic which used was Median frequency and Interquartile range. The result of this strategy can be summarized as follows: Materials – specialists had consistent opinions that importing materials to Maesod district was flexible because there were a law and supporting measurement in importing gems from Burma to the market in Maesod pragmatically by creating reliability.



### 3. Research Methodology

#### 3.1 Populations and Samplings

Populations in this research are gems and jewelry entrepreneurs who were used in the qualitative research. Population in this research has two parts. Part one, the survey results by using questionnaire and interview from 10 staffs of A.U.T. International Co., for Pareto Analysis and Cause and Effect Diagram as follows:

1. Representative from production part (Setting) (2 people)
2. Representative from production part (Plating) (2 people)
3. Information Officer (1 person)
4. Assistant production (1 person)
5. Representative from financial part (1 person)
6. Representative from purchasing part (2 people)
7. Assistant auditor and Control (1 person)

In part two, the population and samplings are FMEA team consisting of entrepreneurs and technicians of A.U.T. International Co., many from fields 6 in total as follows:

1. Gems and jewelry entrepreneur (1 person)
2. Representative from manufacturing part (1 person)
3. Representative from quality controlling part (1 person)
4. Representative from purchasing part (1 person)
5. Representative from general coordinator part (1 person)
6. A technician from manufacturing part (1 person)

#### 3.2 Research Instrument

In this research, we used a tool for collecting data which is qualitative and quantitative method

##### Qualitative method

###### *Interview*

This study selected interviews as a tool to collect information which aimed to compile information by asking questions. The basics of the questions, the discussion, and the responsiveness between the interviewer and interviewee were a form of in-depth interviewing in order to examine the quality of detail in the conversation which was usable. In-depth interview for collecting data from the case study, the accuracy of content from the experts in the form of non-structure interviewing consisted of opened-question and specific interview. The interviewee did not know about the question in advance and there was no the exact answer so, there was a chance to get full opinion from this interviewing.

###### *Cause and Effect Diagram*

Using the diagram, the researchers analyzed the root cause of intellectual problems occurring and affecting the company. The diagram or chart shows cause and effect and consists of two parts: the skeleton of a fish which includes factors that cause the problem and the fish head showing the main problem. By convention, draw head on the right and the fish (fishtail), on the left.

### *Supply chain risk evaluation*

From the study, the company is experiencing problems or potential risks, or other factors that impact on the business. The researchers chose to evaluate the risk of the supply chain as another tool to help measure the risk potential. This is a risk that suppliers may face. Risk assessment of the supply chain helps reduce the risk of business and supply chain based on the long international network of manufacturers who often have a complex network of its own suppliers. The potential of these businesses is based in the supply chain. The supply chain has become a critical factor in business success. In addition, the risk assessment of the supply chain is more efficient, the researchers chose to study the Sloan pattern of supply chain risk to select each factor to suit the potential risks/impacts of the company. The analysis framework is evaluated in a Failure Mode Effects Analysis (FMEA).

### *Hazard Identification*

A tool which is used in this process to recognize the existing danger and determine the danger characteristics by pointing out which dangers should be considered by using 3 questions:

1. Is there a source of the danger?
2. Who or what was the harm?
3. How did the dangers happen?

It is the indication of dangers in the gems and jewelry exportation part. Unapparent or less happening dangers do not have to list the procedure in the document form.

### Quantitative method

#### *Pareto*

Pareto analysis is used to study the effect of exporting gems and jewelry and it shows us the problems which cause the most loss, the type of high frequency problems, and it also shows the ratio of the occurring problem. When comparing to other problems, we would know the sequences and the significance of the factors which have an impact on exporting gems and jewelry. Moreover, the factors which have an impact on exporting gems and jewelry can be separated and analyzed by using Cause and Effect diagram. This diagram shows the relationship between qualitative characteristic and the factors which relate to the description. Quality characteristics are the effect from the cause which is the factors of the cause of characteristics. In other word, it is a diagram using to analyze how the causes are related and connected and an effect would be appeared at the last step.

#### *Failure Mode Effects Analysis (FMEA)*

The tool which is used for analyzing the failure and the impact or FMEA is the method to determine the tendency of failure conditions which might affect gems and jewelry exportation. It is an assessment of the risk along with the failure in any form. The order of the significance of failure conditions is up to the urgency of that failure condition and to protect the situation, it will operate before or after depending on the severity of the effect. The result of doing FMEA is a FMEA table which shows the fragile point of the process where the failure can occur. Moreover, the table also shows the risk level of the failure in each part, the necessity of the parts which is fixing or being fixed in order that the products can be more complete.

### *3.3 Research Instrument Development*

The studies were originally conducted as a form of qualitative research interviewing. After that, developing research tools with the advice of our which are qualitative tools including pareto / cause and effect diagram. Also, quantitative research tools included supply chain risk evaluation, hazard identification, and Failure Mode Effects Analysis (FMEA).

### *3.4 Data Collection*

To collect data for the study, the research was conducted to collect data using interviews with the company general manager and staff. This research also studied documents, so it is comprised of primary data and secondary data.

In the study, researchers collected information from sources that met the objectives of the study as follows:

## **4. Anticipated Results and Conclusoin**

### *4.1 Introduction*

This research studied about causal factors for gems and jewelry exports and offered investigation about the causal factors affecting export for gems and jewelry to mitigate and propose risk strategy of export for gems and jewelry by using exemplary case study of A.U.T International Co., Ltd.

A.U.T. Internationals Co., Ltd. was established in 2002 as one of the gems and jewelry companies in Thailand that operates about jewelry manufacturing and has extensive experience in gem and jewelry business with international customers worldwide and they also understand different needs and requirements of customers in different markets. With 16 years of experience, their professional and experienced product development teams have worked with specialist and great designers to have ideas and concepts to make real gems and jewelry pieces. They have developed long-term trust gained from customers who make their famous gems and jewelry brands and have key regions to export, including US, Europe and Russia. The company consists of many design teams which are capable to design and very creative and they also have diamond and gems setting service for customer order such as prong setting, diamond tipped, v prong setting, pave setting, invisible setting, channel setting, bezel setting, flush setting, tension setting, bar setting and etc. A.U.T. Internationals Co., Ltd. has production base or industry in Thailand and has distribution base of its own. The marketing channel of the company includes A.U.T. Internationals Co., Ltd office 8 floor, contact by telephone number, email and WhatsApp for order the product.

### *4.2 Conclusion*

This research has the object to investigate the causal factors affecting and mitigate and propose risk strategy of export of gems and jewelry. We used an exemplary case study of A.U.T Internationals Co., Ltd. and to find the problem of the decrease of company's export between 2013 - 2017 by using questionnaire and interview from 10 staff. The researchers collected the results and analysis to find that the cause of the problem of the decrease of company's export is caused by unfavourable economic condition, non-liquid assets, competitive growth, high cost of production, and poor export performance by using Pareto Analysis. The cause of the problem was found by using Cause and Effect Diagram for first object. The risk of company's export and the hazard of company's export were also found. Using Failure Mode and Effect Analysis or FMEA to find Risk Priority Number or RPN of all risk of company's export for risk level of export for gem and jewelry allowed the researchers to find Supply Chain Risk Strategy for solution.

## 5. Suggestions

Since the period of time for the independent study is limited, so our information is not long-term information which resulted inadequate information. Also, some part of information cannot be publicized because it is confidential information, so our information does not cover all parts. As all research we have studied above, strategies were mentioned which can reduce the risks and which are very useful to take it as a good approach for the entrepreneurs; however, it depends on them individually how they apply this to their company. Sometime, the approaches which the researchers have introduced may not be suited for some entrepreneurs because of their visions and points of view. Also, for those of people who are interested in the result of this research, they can utilize it in development or knowledge application. Moreover, this research can be studied more in the future by random of adding more population so that it will have more variety and be more specific.

## References

Automotive Industry Action Group (AIAG). Potential Failure Mode and Effects Analysis (FMEA). 3rd edition. July, 2002.

Asawachokechai, J. (2005). The studying of the condition and problems in operating Thai gems and jewelry exporting business. (Master dissertation). Industrial Education, King Mongkut's University of Technology North Bangkok.

Duangpatra, J. The Analysis of Strategies for Developing Thai Gems and Jewelry Industry, Chulalongkorn University.

Orarigdech, S. (1992). The development of Thai gems and jewelry industry export. (Master dissertation). Term paper of Economic Development section, National Institute of Development Administration.

Ploypanichareon, K. (2004). Failure Mode and Effect Analysis. Bangkok: Asiapress.

Rinwong, S. (2009). [online]. Thai gems and jewelry in 2010: still depending on the direction of gold growth. [cited 2 Jun. 2018]. Available from: URL: <https://positioningmag.com/50073>.

Siamrath. (2015, November, 24). The Gem and Jewelry Institute of Thailand.

Taweechaitakarn, N. (2005). Analyzation of Thai gems and jewel export condition. The faculty of economics, Chiang Mai University.

Jantasom, T. (2010). The application of FMEA and AHP to improve the bleaching process in sample factory. (n.d.). (master's thesis, Silpakorn University).

The Gem and Jewelry Institute of Thailand (Public Organization). [online]. Thailand's Gem and Jewelry Import-Export Performance 2016. [cited 2 Jun. 2018]. Available from: URL: [https://infocenter.git.or.th/Content\\_View.aspx?id=2228&lang=EN&mail=1](https://infocenter.git.or.th/Content_View.aspx?id=2228&lang=EN&mail=1)

Tongtawat, R (2015). The Management Strategy of Production Factors of the Gems and Jewelry Industry in Measod District Tak. Master Thesis (Strategic Development), Graduate School, Kamphaeng Phet Rajabhat University.

Tripatrapachorn, T, Teerawitayalert, P and Pakdeckul, P (2009). “The study of an impact of and competitive factor of gems and jewelry export industry of entrepreneurs in Bangkok.” *Journal of Industrial Education*. Vol.3 (1) : 86-94.

Wasinrat, S. (1996). An analysis of export potentials of Thailand's gemstone and jewelry industry. Master Thesis (Economics), Faculty of Economics, Chulalongkorn University.

Wongjirattikarn, S. and Rattanagueungwarn, S. (2013). Improvement of Preventive Maintenance Planning of an Automobile Shaft Manufacturer. Master Thesis (Engineering), Faculty of Engineering, Chulalongkorn University.