The evaluation of the truck and bus bias-tire business

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Abstract

Until now, there are two main types of technology that could produce vehicle tires–bias tires and radial tires. The technology to produce bias tires had been around for decades, then the newer technology was launched to produce what was called the radial tires. As a result, although previously all vehicle used bias tires, now almost all passenger cars use radial tires. The bias tires are suitable only for vehicles that move on rough roads such as trucks and buses. This paper attempts to estimate the declining trend of the bias tire demand. Logarithm function was used to estimate the decline over a decade and the demand was forecasted using the moving average model, the exponential smoothing model, and the double exponential smoothing model. Moreover, SWOT analysis was performed to analyze the bias tires business. The results of this research clearly show that the bias tire demand for trucks and buses was declining rapidly within a couple years. Businesses that can still gain opportunity for the bias tires are the motorcycle tire business, the off-road tire business, and the agricultural vehicle tire business.

Keywords: Bias tires, truck and bus business, **decline trend estimation, SWOT analysis**

1. Introduction

Nowadays, rubber tire production is very important in the rubber industry, since they use a lot of natural rubber to produce the vehicle wheels such as automobiles, bicycles, motorcycles, trucks, bus, farming cars, etc. there are two main types of technology that could produce vehicle tires–bias tires and radial tires.

The technology to produce bias tires had been around for decades. Bias tire consists of body ply with its thread arranged in a cross with diagonal direction one another. The outstanding advantages of bias tires are the strong sidewalls, suitable for off-highway, and typically less expensive than radial tires.

Then the newer technology was launched to produce what was called the radial tires. Unlike bias-ply, Radial tire consists of body ply with its thread arranged vertically to tire diameter. Radial tires are more stable at speed than the bias tire. They have lower heat, lower friction, and lower rolling resistance, so that fuel will be saved due to smaller energy release. Radial has more attractive appearance views from style, wall design, and tread than bias. Besides, they are good and last longer on the highway road.

According to many advantages of radial tires which are greater than bias tires. it makes consumers prefer to use radial tires. As a result, now almost all passenger cars use radial tires. The foreign manufacturers have turned to produce more radial tires as well, but there are a few Thai manufacturers that still

produce bias tires. Therefore, to help Thai entrepreneurs. We significantly need this research to evaluate all aspects of the bias tire business. This research will be used as information for the business owner to adapt, develop in order to compete with the radial tires business. Or probably find the option to change to produce radial tires instead.

Due to one of the bias tire properties is good on the rough surface. The road has been continuously developed to the concrete roads these days so, there is a probability that the demand for bias for trucks and buses would be decreased. This research tried to prove this assumption.

We aimed to study the demand for bias truck and bus wheels and to estimate the decline. The logarithm function was used to estimate the decline over a decade. The demand was forecasted using the moving average model, the exponential smoothing model, and the double exponential smoothing model. Another question was if the bias tires for the truck and bus were actually declining, how long does it take to still exist? Moreover, we analyzed the overall business of the bias wheel industry by using SWOT analysis to make a comprehensive evaluation through both internal and external environments

2. Literature Review

Several forecasting models have been reviewed to forecast truck and bus bias-tire demand in our study. For example, Lee et al. (2012) used moving averages (MA), logistic regression (LR), and back-propagation neural network (BPNN) methods for sales models designed to predict daily fresh food sales. They found that the error percentage obtained by LR was smaller than that obtained by the BPNN and MA models.

Rahamneh (2017) aimed to estimate the number of injuries and fatalities resulted from traffic accidents in Jordan by using the single & double exponential smoothing, The error indicators in this study were the MAPE, MAD, and the MSD. In this study, double exponential smoothing was an appropriate model to measure and analyze the number of injuries and fatalities in Jordan.

Musa (2008) attempted to make a wheat production modeling in Sudan in order to identify a pattern. The researcher used time-series techniques consisted of the arima and exponential smoothing models in wheat production prediction. It was found that the Holt model for the exponential smoothing provided the best prediction.

Rusov (2017) applied linear regression and non-linear regression to predict financial results of an insurance company. Conducted experimental research showed that application of linear regression was valid in certain insurance lines. It was significantly simpler to apply linear regression model when predicting than nonlinear methods.

Moreover, we also reviewed several studies that applied SWOT analysis to observe the four views-strengths, weaknesses, external opportunities, and threats-of a business. For example, Al-Mayahi and Mansoor (2012) used SWOT analysis to identify the internal strengths, weaknesses and external opportunities

and threats on United Arab Emirates government. Then TOWS Matrix was used to develop strategies that use the e-Government strengths to take advantages of opportunities in the external environment and to relieve the external threats. The current state of the UAE E-government project was also examined, and it was evident that the UAE has successfully developed a strong e-government platform for everyday use by both citizens and businesses. However, there were some weaknesses and threats that needed to be addressed, especially in the area of information security (e-Security) and also there was a culture of resistance facing the e-Transform.

3. Research Methods

1. Collecting primary data included process flow, costs, sales, customer, manufacturing potential by interviewing major rubber tire businesses in Thailand.
2. Collecting secondary data included
   - Policies from Department of Rural Roads (DRR)
   - Government Policies
   - Agricultural area in Thailand
   - Agricultural truck sales
   - Number of bus and truck registrations
3. Creating estimation model to estimate truck and bus's demand by selecting from both primary data and secondary data
4. Evaluating model reliability to verify the accuracy of the model
5. Doing SWOT analysis of bias tire business

4. Result and Discussion

4.1. Number of newly registered truck and bus

We gathered information to evaluate the truck and bus bias tire business. Using the data from the Department of Land Transport website, from 2010-2019, the trend for the number of registered trucks and buses seemed to be ups and downs as shown in the Table 1 and Figures 1-2.

Table 1 Number of registered trucks and buses

Year	Number of registered trucks	Number of registered buses
2010	64,299	14,225
2011	77,219	11,199
2012	93,935	11,542
2013	108,529	11,785
2014	80,965	13,115
2015	68,981	15,966
2016	65,163	11,482
2017	65,556	11,006
2018	70,405	12,820
2019	68,675	12,395
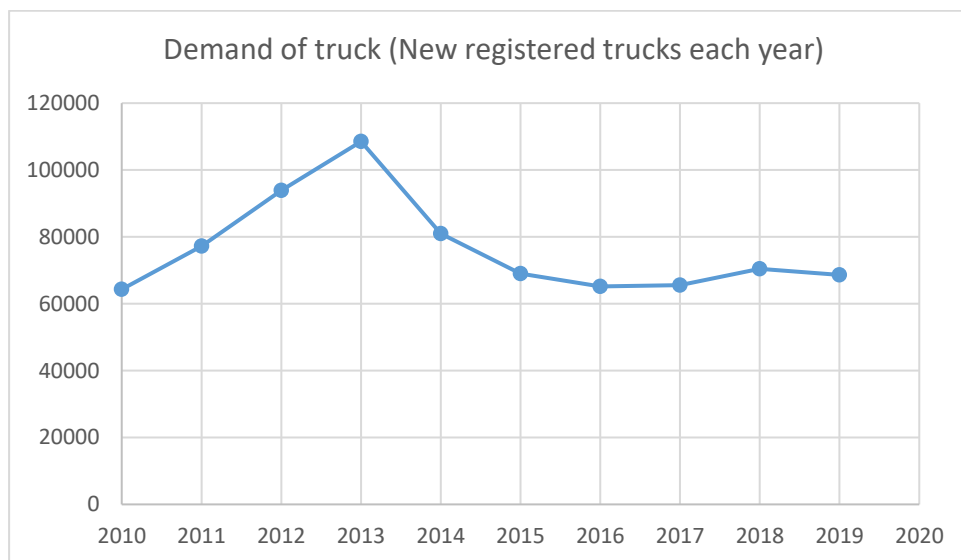
Figure 1: Demand of truck
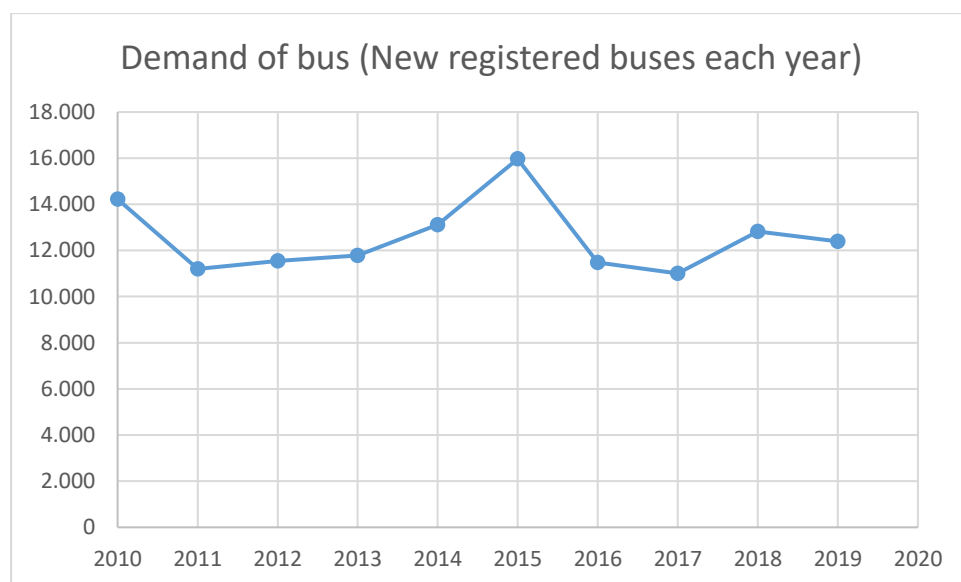
Figure 2: Demand of bus

In Figure 4, demand of trucks had a peak in 2013 and gradually fell in 2014-2015. This may due to the overall economy in Thailand. Also in Figure 5, demand of buses had a peak in 2015.

4.2. Demand prediction for bias tires

According to our primary data collection by interviewing entrepreneurs, bias sales in 2010 was assumed to be at full capacity of 100%. Then, the sales had been dropping over the years and stayed constant at 20% since 2017 until now. This may due to the fact that smaller businesses had died out which made the sales shift to major businesses resulting in a constant sales since 2017. Hence, if we assumed an exponential drop, the parameter λ could be estimated as follows:

Year 2010: $e^{-0\lambda}$ = 1
$$\vdots$$

Year 2017 $e^{-7\lambda}$ = 0.2
-7λ = ln 0.21
λ = 0.2299

Using the above λ, demands during the unknown years were calculated as shown in Table 2 and Figure 3.

Table 2: Estimation percentage of decrease bias

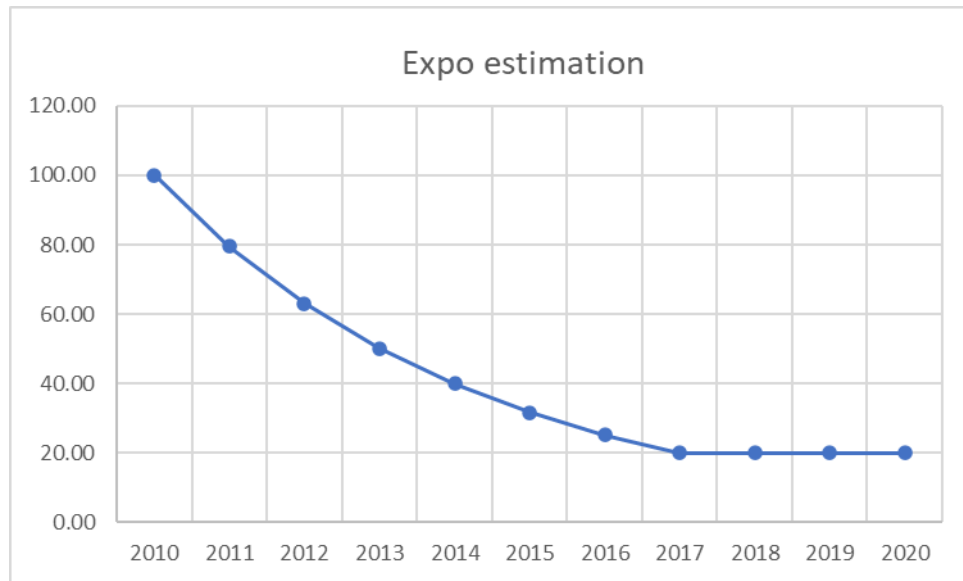| Year	Decrease estimation
2010	100.00
2011	79.46
2012	63.14
2013	50.17
2014	39.87
2015	31.68
2016	25.17
2017	20.00
2018	20.00
2019	20.00
2020	20.00

Figure 3: Estimation percentage of decrease bias

Using the above demand estimations and the data for the number of trucks and buses, forecasting demands for trucks and buses are shown in Figure 4–9 using the moving average method, the exponential smoothing method, and the double exponential smoothing method, respectively.

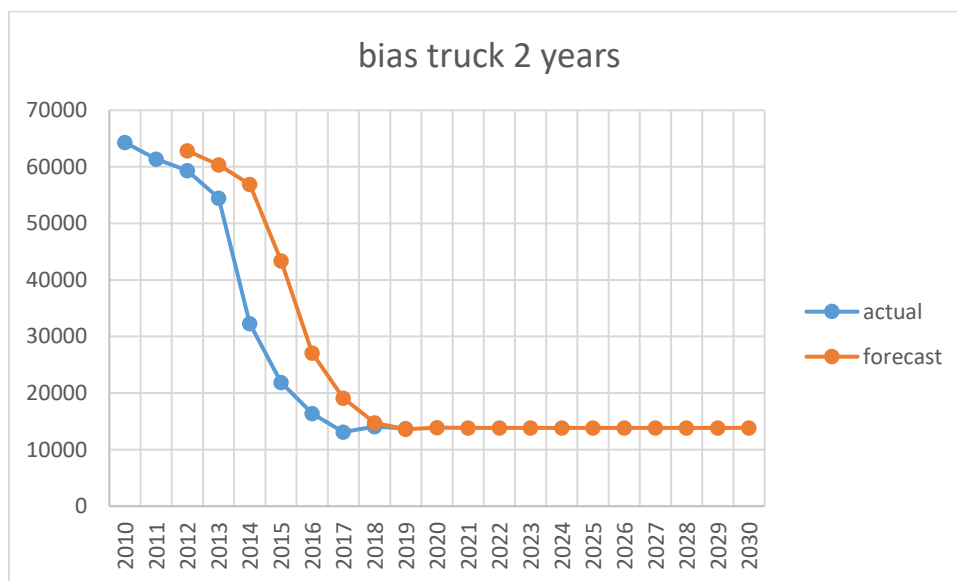### 4.2.1. Moving average method

- Truck

Figure 4: Actual and estimated demand for bias truck by moving average method
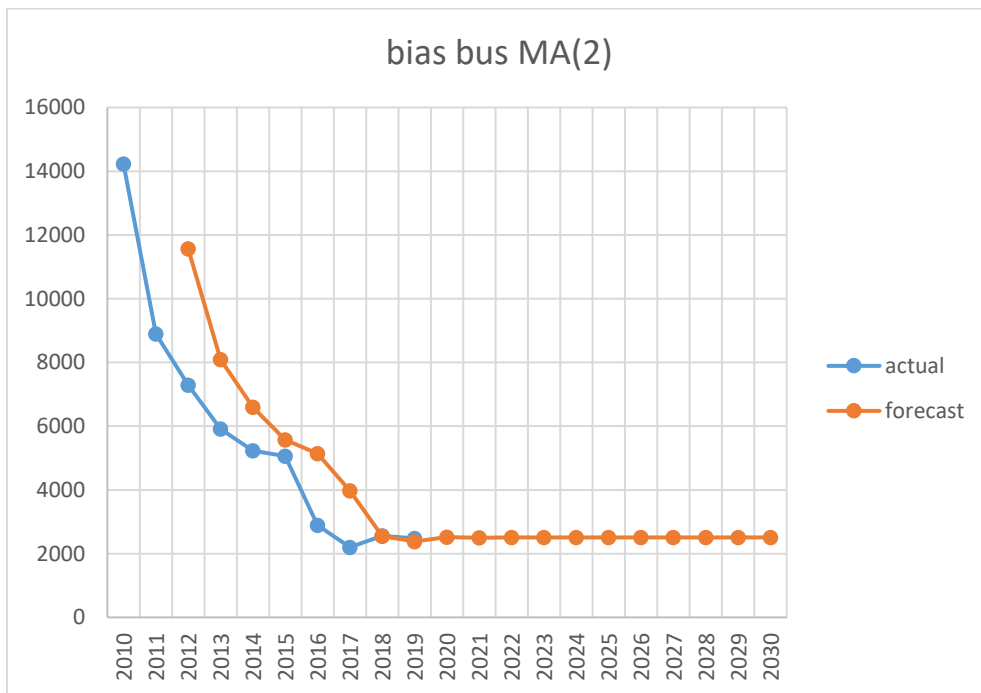
MSE =   158,176,730.31

- Bus

Figure 5: Actual and estimated demand for bias bus by moving average method

MSE =   4,174,202.97

4.2.2. Exponential smoothing method

- Truck

Use alpha = 1; solved for minimum MSE by solver in excel
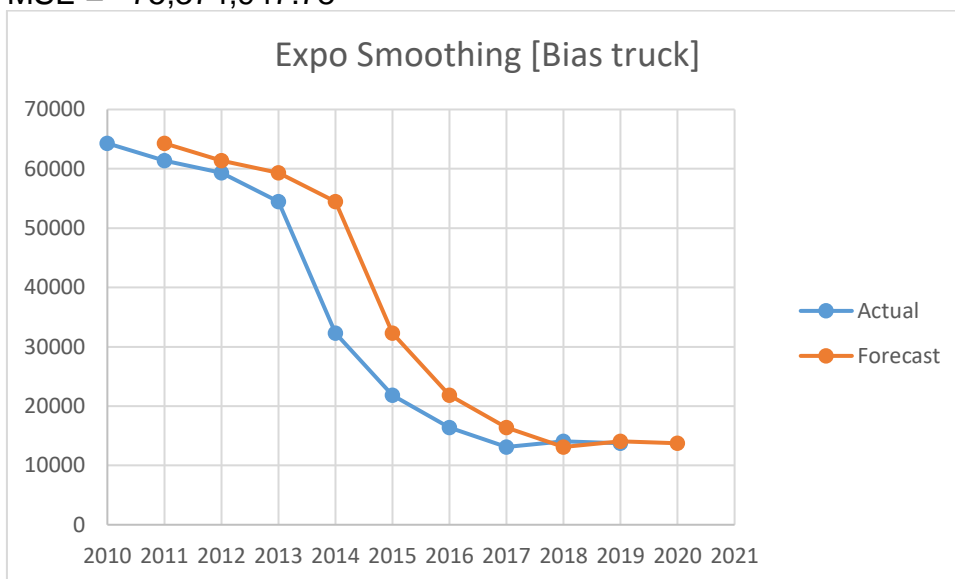MSE =   75,374,947.78

Figure 6: Actual and estimated demand for bias truck by exponential smoothing method

- Bus

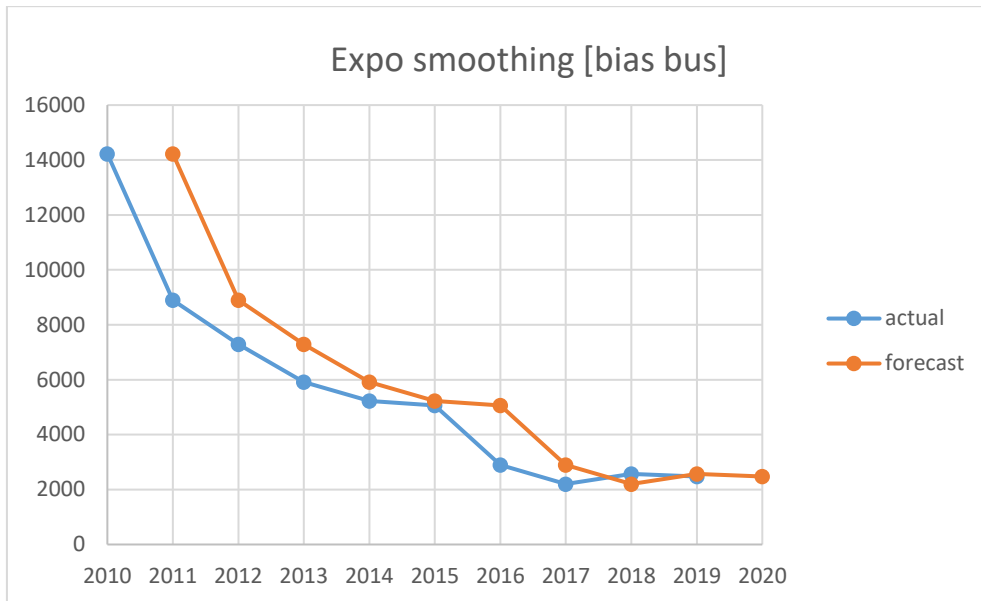Use alpha = 1; solved for minimum MSE

MSE = 4,295,684.00

Figure 7: Actual and estimated demand for bias bus by exponential smoothing method

4.2.3. Double Exponential Smoothing

- Truck

Use alpha = 1, beta = 0.0722; solved for minimum MSE
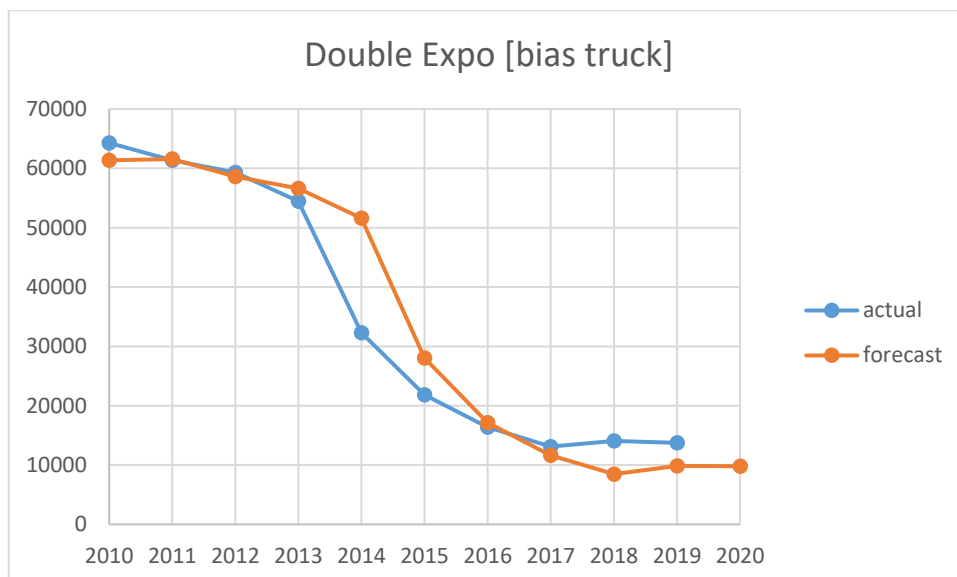
MSE =   51,855,880.73

Figure 8: Actual and estimated demand for bias truck by double exponential smoothing method

- Bus
Use alpha = 0.5006, beta = 1; solved for minimum MSE by solver in excel
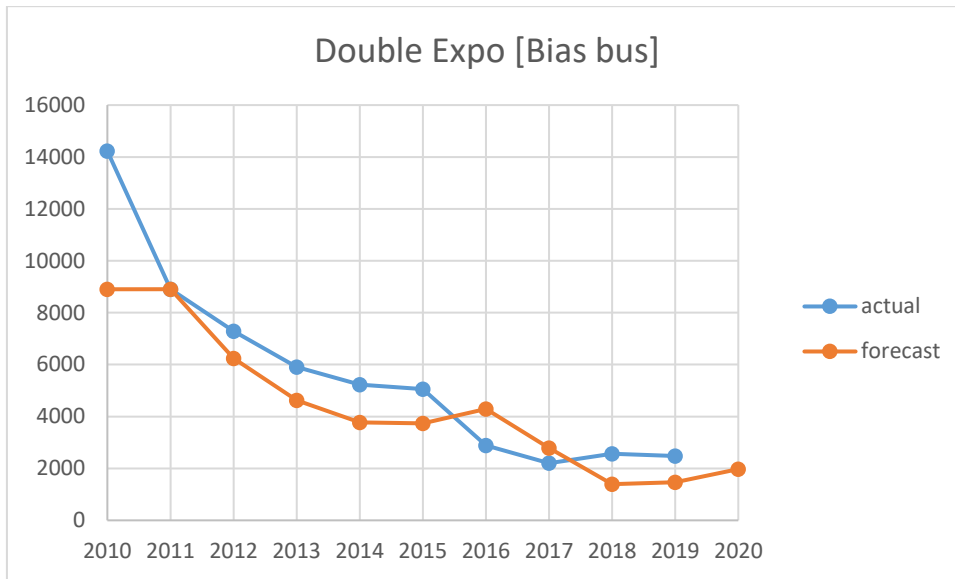MSE =   3,958,896.38

Figure 9: Actual and estimated demand for bias bus by double exponential smoothing method

Table 3 provided a summary of the MSEs for all three methods and for trucks and buses. From this table, the double exponential smoothing method seemed to yield the smallest MSEs for both trucks and buses.

Table 3 MSE Comparison

Method	MSE for truck	MSE for bus
Moving average	158,176,730.31	4,174,202.97
Exponential smoothing	75,374,947.78	4,295,684.00
Double expo	51,855,880.73	3,958,896.38

The minimum MSE is the Double Exponential method.

However, the forecasted demand prediction from figures above could be somewhat misleading to see the trend of current demand for trucks and buses as steady line in the recent years. As mentioned, this may due to the fact that we only interview the existing bias-tire truck and bus manufacturing companies. But many other companies may have already died out of their business, their demands were then shifted to those bigger companies whom we interviewed. Hence, overall, the domestic demand for the entire country should still be in the declining rate. This would be confirmed with the data regarding to the length of the unpaved roads in the section below.

4.3. Number of unpaved roads.

We have gathered information from the Department of Highways websites. It shows the length of unpaved road from 2014 to 2018 according to the table and figure below.

Table 4: The length of road each surface type

Unit: Kilometer

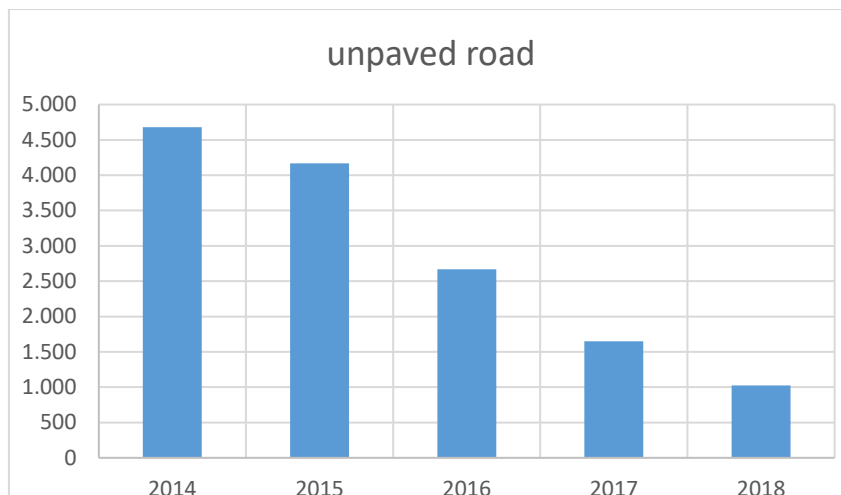| Surface Type	2014	2015	2016	2017	2018
Concrete	3,591.903	3,711.811	3,931.014	4,255.490	4,480.866
Asphalt	90,789.312	91,437.905	93,017.069	94,069.339	94,494.264
Unpaved	4,679.003	4,170.170	2,670.234	1,650.717	1,023.523
Total	99,060.218	99,319.886	99,618.317	99,975.546	99,998.652

Figure 10: The length of unpaved road graph

We have estimated the next other year data by using regression analysis. We calculated by using data regression analysis in MS Excel and obtained the parameters a and b as:

a = 5787.8533, b= -983.0413.

So, the regression equation was $\hat{Y} = -983.0413.X + 5787.8533$

The plot of the estimated length of unpaved road was shown in Figure 11. From this graph, it was found that the trend for unpaved road seemed to approach zero if not now then it should come in the near future.
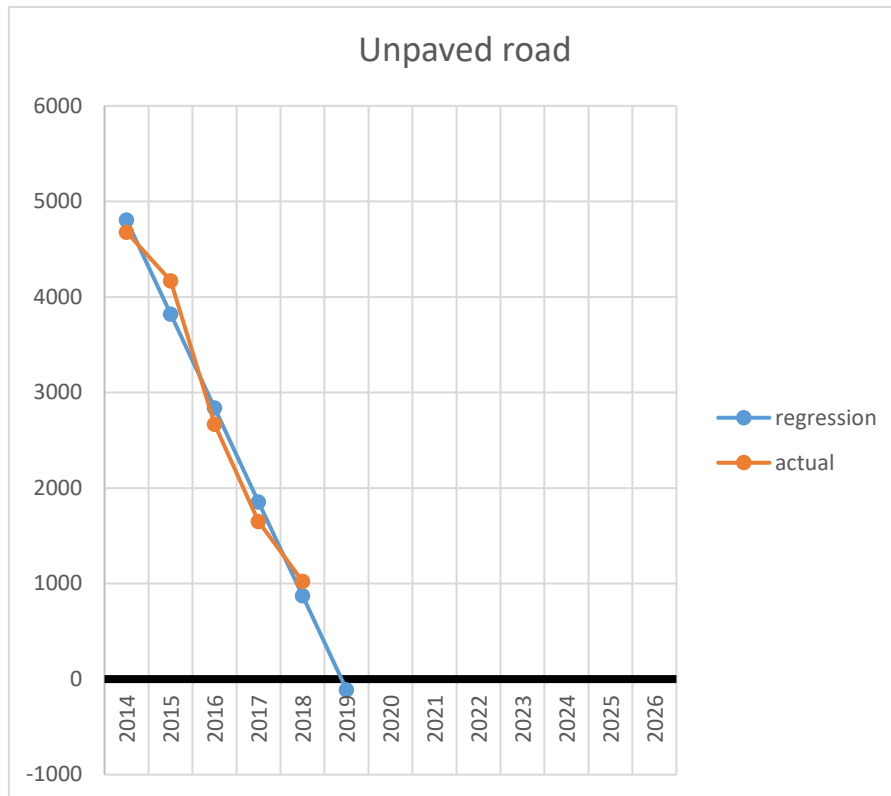
Figure 11: Unpaved road regression plot

4.4. SWOT Analysis

Additionally, SWOT analysis was performed to study the bias-tire business as discussed below.

Strength of bias tires

- Sidewall of bias tire is more durable. Making for a smooth ride on rough surfaces.
- Thicker sidewall is more resistant to cuts and punctures.
- In the past, Bias was less expensive than radial tires.
- Bias tire is easier to repair. If sidewall is broken, it can be patched and reuse it. In contrast, if radial tire's sidewall is broken, it needs to be replaced the new whole tire.
- Used-bias tire can be retreaded.
- Bias's starting business cost is less expensive than radial tires

Weakness of bias tires

- Radial tires industry is the main competitor of bias tires. There is more new modern technology manufacturing in the radial tire, while bias tire manufacturing is underdeveloped, conventional.
- Radial tires can hold up heavier loads.
- Radial tire has longer service lifetime on paved road or flat surface.
- Radial tire has higher endurance than bias tire.
- Changing bias tires is more difficult than radial tires.
- Bias tires need more rim layers.

Opportunities of bias tires

- Almost Motorcycle uses bias tires. Especially, Motorcycle is popular in South East Asia. And there is no market exploring from China. Because the Chinese government would not like to let Chinese people riding a motorcycle for safety reasons, so bias tires have an opportunity in the motorcycle.
- Bias tires can use in ATV off-road vehicles.
- Agricultural vehicles use bias tires because they are good on the rough surface. Thailand also mainly supports agriculture, so there tends to be a higher demand for bias agriculture tires in the future.
- Industrial vehicles, for example, road roller, wheel loader, excavator, they can use bias tires. At the present, the construction industry is expanding in Southeast Asia. There are many constructions of various routes following economic development planning.
- We can adapt the production method to use the same material but change the degree of laying a ply to 90 degrees like radial styles.
- If you would like to change to produce radial tires for agriculture instead. You still can use the same machines (It saves around 70 % when compared with all new investment)

Threats of bias tires

Marketing based threats
- Nowadays, Assembly truck company has changed to provide radial tires since the first wheel-assembling process. The former was the bias tires. In consequence, after customers purchased and used for a while and acquired to change the tires. Almost of customers will use the same kind of tire which came with the truck.
- Chinese government has supported radial tire production, as a result, more manufacturers produce radial tires. The radial tires businesses were larger. Then, the radial tire price has decreased according to the economics of scales. The radial tires have more competitive price than bias tires.
- Bias tires raw-material suppliers are less than in the past.
- Chinese capitalists come and invest radial tires production in Thailand. They produce in bulk quantity results to lower costs, which is following to economics scale concept. Thus, the radial tire price is currently less expensive than bias tires in Thailand.
- Bias tires are good on the rough surface such as unpaved road, At the present, the unpaved road has developed.

5.   Conclusions and suggestions

In this study, we conducted two main schemes to understand the bias-tire trucks and buses business including the demand forecast, the SWOT analysis. The demand forecast shows that the trend of bias trucks and buses demands has been decreasing over the years; however, due to the we only interview the existing bias-tire truck and bus manufacturing companies. But many other companies may have already out of their business, their demands were then shifted to those bigger companies whom we interviewed. Hence, overall, the domestic demand for the entire country should still be in the declining rate. This would be confirmed with the data regarding to the length of the unpaved roads

If we consider the trend of the length of unpaved roads in Thailand, it is quiet obvious that the trend is downward quite steeply. So, if a truck and bus bias-wheels business is relying on the length of unpaved roads, it seems to come to the end.

Regarding to SWOT analysis. We can conclude the important strength of bias wheel is good on the rough surface, and there are many weaknesses when compare to the radial tires.

As we know from the estimation that truck and bus bias-wheels business is going to out. We will focus on the other opportunities for bias tires in SWOT analysis. There are many opportunities for bias tires such as motorcycles wheels, off-road vehicles wheels, agricultural vehicles wheels. However, we need to study more details about it.

Basically, Motorcycles wheels is interesting industry because there is no market exploring from China. Due to The Chinese government would not like to let Chinese people riding a motorcycle for safety reasons.

References

- Department of Land Transport. Retrieved from https://web.dlt.go.th/statistics/

- Mathur, K. & Solow, D. (1994). Management Science: The art of decision making. Prentice Hall, USA.

- Lee, W.I. & Chen, C.W. & Chen, K.H. & Chen, T.H. & Liu, C.C. (2012). A comparative study on the forecast of fresh food sales using logistic, regression, moving average and bpnn methods. *Journal of Marine Science and Technology, Vol. 20*, (No. 2), pp. 142-152.

- Al-Mayahi, I.& Mansoor, S.P. (2012). UAE E-goverment: SWOT analysis and TOWS matrix. 10th International Conference on ICT and Knowledge Engineering, 21–23 November 2012, Bangkok, Thailand (doi:10.1109/ICTKE.2012.6408556).

- Rahamneh, A.A.A.A. (2017). Using single and double exponential smoothing for estimating the number of injuries and fatalities resulted from traffic accidents in

Jordan (1981-2016). *Middle-East Journal of Scientific Research 25 (7):* 1544-1552. (DOI: 10.5829/idosi.mejsr.2017.1544.1552).

- Rusov, J. (2017). Applying regression models to predict business results. *FME Transactions* (2017) 45, 198-202. (DOI: 10.5937/fmet1701198R).

- Musa, F.J.A, (2008). Use of Arima and Exponential Smoothing Models for Forecasting Wheat Production in Sudan for the Period (1970-2005) (Comparative Study), Sudan University of Science and Technology, Faculty of Science, PhD Thesis un published