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A Sales Forecasting Model for Coatings Industry via Econometric Models

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ABSTRACT

Sales forecasting is the methodology of predicting future values from a known time series data. The preference methodology of sales forecast is selected based on the minimum of the forecast errors given. Knowing that we are persevering in the VUCA realm now, it becomes a challenge for the business to improve the forecast accuracy. The leaders not only focus on agility and resilience in the VUCA environments, but also ensure that all insights, intelligence, and data feed innovation processes continuously. New skills and tools should be used to design and predict in an organisation. Hence, sales forecasting is essential nowadays to ensure our business resilience to the VUCA environment and continuous sustain in this competitive global marketplace. This study aims to identify the preference quantitative methodology: exponential smoothing (ES) or autoregressive integrated moving average (ARIMA) provide more accurate of sales forecasting compared with current practice – judgmental approach for the organisation in this VUCA environment.

1. Introduction

Improvement of sales forecasting accuracy is a big challenge but is a common phenomenon that business need to overcome it. According to the World Economic Outlook published in April 2022 (International Monetary Fund, 2022), the global economy is recovering from the pandemic, but the war of Ukraine significantly slowdown the global economic growth and drives the price inflation pressures accelerated especially on fuel, energy, and food significantly. We are persisting in a VUCA world, as the uncertain of economy recovery is presence and ambiguity of tomorrow's economy.

VUCA reflects the current global economic environment: volatility, uncertainty, complexity, and ambiguity (Dziark, 2019). It commonly used in business strategic to describe the unpredictable environment and uncertainty of market condition. Many experts highly recommended that the leaders should agile and resilience enough from strategic wise to sustain in this VUCA world. (Millar, et al., 2018) recommended that new skills and tools should be used to design and predict in an organisation in VUCA environment. The leaders should ensure all insights, intelligence, and data feed innovation processes continuously. This led

to business transformation actively nowadays in corporation to review and change their operation process from top to bottom level.

Sales forecasting is one of the essential business processes that corporation actively improving their accuracy to predict future revenues trend by certain sales or products categorisation and criteria. It used for monitoring the market volatility, predict the futures trend under VUCA conditions, so that corporation able take proactive strategic to overcome it. The proactive actions included launch sales promotion campaign to sustain or increase the business share, develop new products for the foreseen changed of customer requirement and rise capital investment in foreseen higher demand production line.

In addition, sales forecasting supported the decision makers on negotiating a better raw material price with vendors, managed inventory requirement in more efficiency way, a better logistic arrangement, planned the operation process more effectively, improving sales strategies by negotiating better pricing and targeted margin growth.

However, the accuracy of judgmental sales forecasting will be a big challenge for organisation. It depends on the competency of commercial team to forecast sales. The forecast is unattainable at some point, as the commercial team is too optimistic or pessimistic. It's time-consuming as well that involves various departments. In the current VUCA environment crises nowadays, decision makers required faster, and more regular review sales forecast to anticipate the achievable business performance. But the low accuracy of this judgmental sales forecast caused the decision makers has low confidence level for the predicting result.

This study aims to identify the preference quantitative methodology: ARIMA or ES would provide higher accuracy of sales forecast compared with the current judgmental forecasting that the organisation implementing. Then, we use the result of this study to forecast sales for the organisation in the next twenty months. Finally, we would recommend the preference model of sales forecasts that we should implemented in the organisation by analysed the forecast accuracy.

2. Literature review

VUCA vs VUCA Prime

The US Army War College introduced VUCA concept in year 1987 (Millar, et al., 2018) end of Cold War. (Barber, 1992) described strategic leadership of US Army War College is in volatile, uncertain, complex, and ambiguous environment during the conference. This revealed the new ways of idea and evolution in strategic towards the unpredictable environment and uncertainty market conditions.

Many studies working on how to overcome VUCA environment. Leaders should agility enough to learn, update their competency, capabilities for change and make a better decision (Johansen, 2010). I agreed with (Millar, et al., 2018) that the leaders should flexible, resilience and agile towards VUCA environment. Thus, sales forecasting, budgeting, and strategy would provide foresight view for the organisation.

The uncertainty nowadays become an expected phenomenon in business management (Çiçeklioğlu, 2020). The COVID-19 pandemic worsens the VUCA situation and caused the tumultuous global economic. Instead of wandering at the status quo, we need to convert volatility, uncertainty, complexity, and ambiguity of VUCA into VUCA prime: vision, understanding, clarity and agility (Sthapit, 2020) that introduced by Robert Johansen (a Distinguished Fellow for Institute for the Future) in year 2017 to manage VUCA world in positive way.

Volatility x Vision (V)

Volatility is inconsistency or instability scenario that the magnitude of change is unknown (Bennett & Lemoine, 2014). (Papulová & Gazova, 2016) stated that today's business in VUCA world is barely predictable and more dynamic than prior period. "The more volatile the environment is, the more and agile things change" (Kraaijenbrink, 2018).

But we can counteract to the volatility with a clear vision, enable perceive the market development even lack of relevant information (Saleh & Watson, 2017). Vision should rise above volatility, when the environment is turbulent and changing unpredictably (Hillson, 2017). Vision is better overcome in new market competition or economic recession (Lawrence, 2013). Thus, the sales activities can be forecasted by obtaining the information about conditions and situations that volatility is existed (Çiçeklioğlu, 2020).

Uncertainty x Understanding (U)

Uncertainty arises from lack of knowledge or inability to anticipate the issues (Hillson, 2017). This is due to the historical data are losing their relevance and it is hard to use as base to predict the futures. Thus, understanding could reduce uncertainty and we able forecast accurately in higher confidence level (Hillson, 2017). It can be done by enhance our understanding by explore and experiment the uncertainty environment that we are facing. (Bennett & Lemoine, 2014) recommended to invest in information analysis networks by collecting, interpret and share the outcome for the analysis that lower down the uncertainty level.

We able to anticipate possible future result by systematic sales forecasting approach with highlighted the confidence levels even under the uncertainty environment. Just that we need to remember that "the more uncertain the environment is, the arduous it is to predict" (Kraaijenbrink, 2018).

Complexity x Clarity (C)

Complexity referred to the environment that has numerous interconnected and diversity between causes and factors that we need to consider (Kraaijenbrink, 2018). These factors can be arisen from internal or external environment of the organisation, intertwines together that caused the confusion and difficult to understand (Lawrence, 2013). "The more complex the world is, the harder it is to analyse" (Kraaijenbrink, 2018). Therefore, we need clarity to counter complexity (Hillson, 2017). We must focus on the key elements of the problem and simplify the process to avoid the unnecessary confusion. Clarity allowed us to look through the contradiction and complication of the future that yet to see by anyone else (Johansen, 2010).

Leaders should act and make quick decisions, communicate clearly on the chaos that we are facing (Lawrence, 2013). Further, we should simplify the complication pertaining to sales forecasting analysis so that it reduces the complexity throughout the process.

Ambiguity x Agility (A)

Ambiguity defined the scenario that their causes and effects are unclear, and hard to verify (Sullivan, 2012). This is due to the information collected is too inaccurate, or dispute that caused the vagueness and fuzziness to make a clear decision or conclusion (Kraaijenbrink, 2018). It normally happened when we entered new opportunities, emerging market or launch new products (Bennett & Lemoine, 2014).

However, (Hillson, 2017) recommended agility overcomes ambiguity, flexibility, adaptability and respond quickly to the changing environment to counterwork with the challenges that we are facing. (Bennett & Lemoine, 2014) suggested experimentation is necessary to minimise the ambiguity, perform few hypotheses tests and learnt from the results to resolve the ambiguity that we are facing into certainty (Hillson, 2017).

Sales Forecasting

Despite of Niels Bohr, father of the atomic model and physic Nobel 1922 laureate, remarked that "It is very hard to predict, especially the future.", but, mathematician Stanislaw M. Ulam insights that noted in his book "Adventures of a Mathematician", that mathematics would extremely change this Niels' perspective (Ulam, 1976). The insight of Ulam brought the transformation of forecasting knowledge nowadays.

Prediction defined as a statistical approach that effective and efficiently in business forecasting accurately based on the available data collected, either historical data or knowledge of future events that will influence the forecasts (Hyndman & Athanasopoulos, 2021). (Sajtos, 2011) is more clearly defined the sales forecasting is a process that provides sales volume estimation for   expected future sales of a particular product or product category for entire organisation in a particular geographic over a definite range of period.

In overall, sales prediction is essential input for any decision of various functional in the organisations: sales, procurement, supply chain, operation, accounting or finance nowadays (Castillo E., et al., 2015). (Marr, 2016) emphasised that the accuracy of sales forecasting provides a valuable information for inventory management to determine the optimum inventory level that we should maintain to meet the sales demand without any failure on the customer orders,   determine the number of employees that we should recruit for handling the operation process and sustain the high-grade customers services, without facing any shortfall or overflow issues in the organisation.

Many studies proofed that sales forecasting is essential to the business. It should be embedded into resources planning and decision making process to ensure business agile and resilience to the VUCA environment and continuous sustain in this competitive global marketplace (Sajtos, 2011). According (Dairymple, 1975), 92% of the survey's respondents said that sales forecasting was important to their business success. Further, (Chern, et al., 2015) emphasied that sales forecasting is one of the most vital steps of business operation. (Hyndman & Athanasopoulos, 2021) further strengthen sales forecasting play an important role and should integral into decision-making process of the organisation.

Forecasting categorised as *Figure 1* and mainly divided into two types of methodologies: qualitative forecasting and quantitative forecasting (Berenson, et al., 2015).

2.1 Qualitative/Judgmental Forecasting

Judgmental forecasting commonly practiced when lack of historical data (Berenson, et al., 2015), data are incomplete, new products launched, entrance of new competitors, or during VUCA condition that is happening currently, heavily impacted by COVID-19, supply chain disruption and prices pressures. This approach highly relies on personal knowledge, expertise, and foresight (Sajtos, 2011).
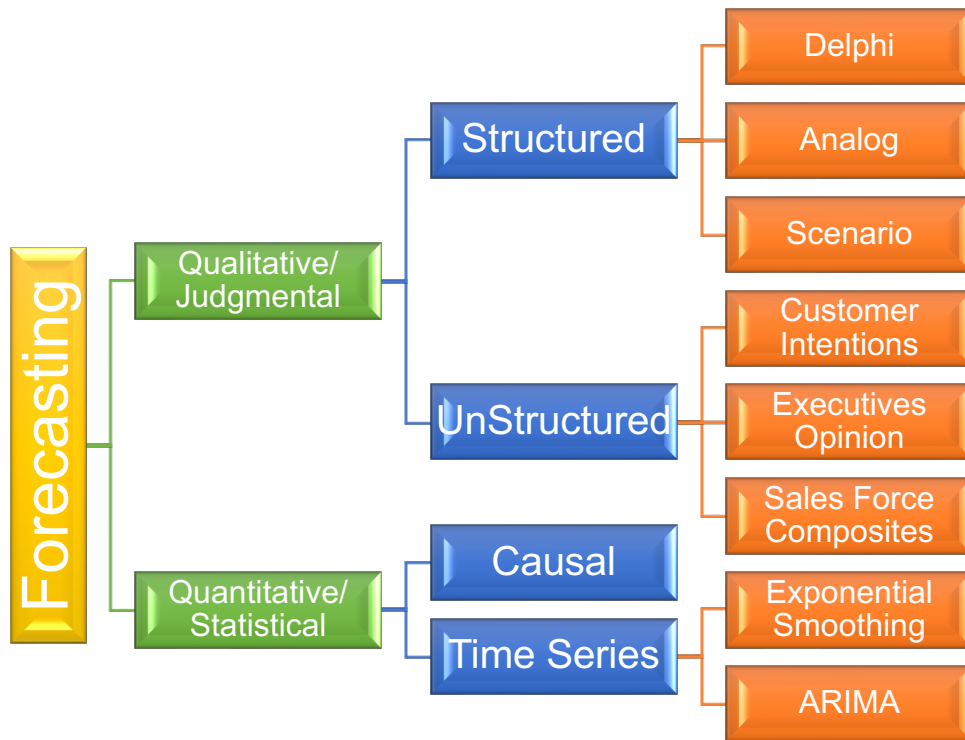
Figure 1 Forecasting Categories

2.2 Exponential Smoothing (ES)

The ES known as one of the well-known approaches that widely used to predict for a seasonal periods dataset (Rahman, et al., 2016). The results generated from this statistical analysis will become more impressive if the parametric for the period is changing slowly.

The ES is more suitable to adopt and implement when there have expressed the trend and seasonal mode (Rahman, et al., 2016). It offered the easy and effective categories method for the mode of trend and seasonal by additive and multiplicative calculation that representing the linear and nonlinear respectively (Pegels, 1969). The robustness level of ES has been classified as a good statistical analysis based on several previous study research because it can generate excellent forecasting results which are useful for the future of the business and industry. The ES statistical analysis is one of the excellent statistical approaches which can provide a broad scope in the data producing processes (Satchell & Timmermann, 1995).

2.3 Autoregressive integrated moving average Model (ARIMA)

ARIMA also is one of the statistical analysis methods that can be implemented to times series data (Hayes, 2021). It classified as one of the regression analyses and adapted to measure the correlation between the independent and dependent variables.

ARIMA estimates the direction and movement of the future financial market through the evaluate the discrepancy between the values. It can be adopted to comprehend a dataset or use to forecast the future direction of the business or industry according to the past information and values that have been gathered (Hayes, 2021).

ARIMA can be known as the best and optimal method because its parameter estimator can generate the results of forecasting which is more accurate if compared with other methods (Landsman & Damodaran, 1989). The efficiency deprivation is small if using the comprehensive data although the data model is unknown (Hotta & Cardoso Neto, 1993).

Unfortunately, we need to consider other elements when implementing ARIMA. For instance, there are experts found that the additional outliers on the results of ARIMA forecast modelling (Ledolter, 1989).

2.4 Current Practice in Organisation - Issues

The current sales forecasting approach in our organisation is judgmental method. The work process illustrated in *Figure 2*. Throughout the whole process, the sales personnels accountability on the inputted sales forecasting. However, we realised the forecast accuracy of this approach fully depends on the competency of sales personnel. We always observed the sales forecasts generated by sales personnel is pessimistic, so that they can be achieve the target set. But part of them is too optimistic which caused a widen gap of the forecast errors. Besides that, this approach is time-consuming. The whole work process required the respective personnel to be revised by weekly and reviewed the sales forecast data up to date. The current sales forecast process is laborious, as it is involving various functional department personnel.

Therefore, I fully agreed (Makridakis, et al., 1993) criticized that the judgmental forecasting will inevitably fail as we spent a lot of efforts, the monotony of forecasting process involved that caused the involved human would easily getting bored and became ineffective on forecasting process.

We should improve the current sales forecasting process to more effective and efficient way by simplify the process, reduce the processing time, and less labour efforts under VUCA condition. This can be done by improving the current process from judgmental approach to time series forecasting.
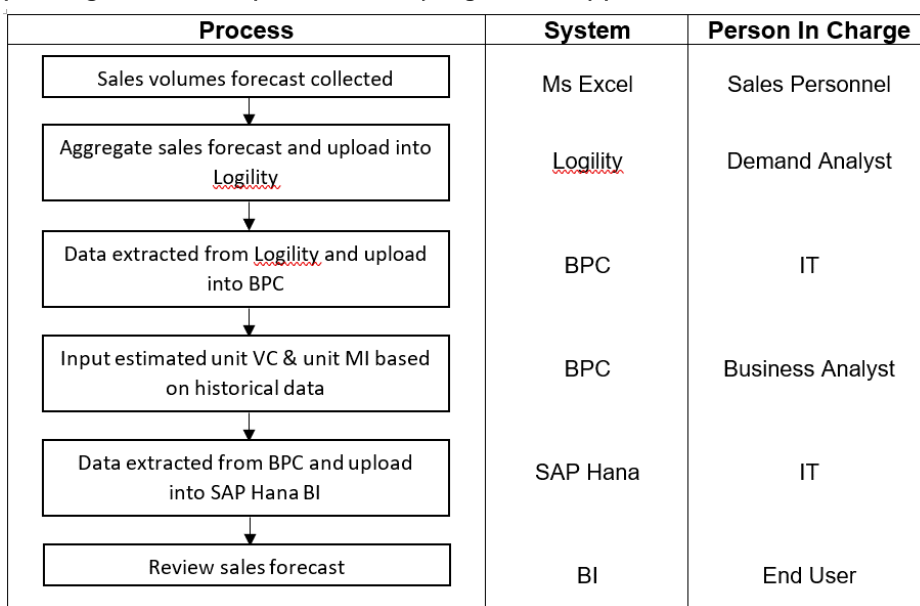
Process	System	Person In Charge
Sales volumes forecast collected	Ms Excel	Sales Personnel
Aggregate sales forecast and upload into Logility	Logility	Demand Analyst
Data extracted from Logility and upload into BPC	BPC	IT
Input estimated unit VC & unit MI based on historical data	BPC	Business Analyst
Data extracted from BPC and upload into SAP Hana BI	SAP Hana	IT
Review sales forecast	BI	End User

Figure 2 Current Sales Forecast Process Flow

Proposal Practice in Organisation

For this study, I propose to use the most popular time series forecasting models – ES or ARIMA approach to compare with our current practice – judgmental forecasting. This is due to since 1982, M-Competition result revealed that simple approaches – ES produced more accurate predicting than the complex or sophisticated statistics approaches (Makridakis, et al., 1982). The M2-Competition also revealed that most of the forecasters did not improve the accuracy of forecasting with judgmental information (Makridakis, et al., 1993). M2-Competition clearly found again that simple methods: Dampen, single ES and the combining of smoothing methods generated accurate forecasts for real-life series. Therefore, it revealed that our current judgmental sales forecasting is ineffective. It also concluded that ES methods can do better than judgmental forecasting (Makridakis, et al., 1993).

The M3-Competition result in 1998 strengthen the original conclusions of previous M-Competition that simple models do better than sophisticated models (Makridakis & Hibon, 2000). (Hyndman & Billah, 2003) shown that SES with drift can work better than Theta method in forecasting if we used maximum likelihood approach to optimise the parameters. Thus, the result of these three periods M-Competition lead me to recommend ES or ARIMA forecasting models.

Not only that, the 3 years consecutive survey results conducted by (Jain, 2005-2006; Jain, 2006-2007; Jain, 2007-2008) in year 2005 to 2007, that time series models are the most popular forecasting models that used by most of the industries with 61% compared with causal models and judgmental models, especially chemical industrial used time series models above the average rate.

We do not recommend causal forecasting due to the current VUCA business condition is inconsistent and volatile. As (Armstrong, 1999) emphasized, ES forecasting is more appropriate to use when there is high uncertainty condition is happened. Further, there is less evidence that accuracy of causal forecasting led to better sales forecast.

It's extremely challenging to measures and determine the relationships between independent variables and dependent variables when come to causal forecasting. Before we can forecast the sales, we must be predicting the future value of the independent variables that are challenging task too (Hyndman & Athanasopoulos, 2021).

3   Methodology and Methods
3.1 Training and Test Set

The dataset for this study derived from 100 months of sales volumes from coating industry. We adopt 80% of it as the training data for the forecasting analysis, 20% of the period data apply as the test data. The minimum threshold observation in the training sets for monthly time series data are 42 to ensure we have sufficient data to develop a better forecasting model (Makridakis, et al., 2020). As (Hyndman & Athanasopoulos, 2021) mentioned as well, the sample size of the test data needs to be at least 20% of the total samples data.

3.2 Data Analysis Method

We used SPSS to run the forecasting analysis for ES and ARIMA forecast models. We would perform Shapiro-Wilk test and Kolmogorov Smirnov test to determine whether sample data has been collected from a normally distributed population to justify the ongoing assumption that we made, and the testing result are justified and reasonable. We also perform Augmented Dickey Fuller (ADF) test together with Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test to identify the data collected is stationary or vice versa (Hyndman & Athanasopoulos, 2021).

We would use root mean square error (RMSE), mean absolute percentage error (MAPE), and mean absolute error (MAE) to measure the accuracy level of the forecasting results through SPSS. The values of MAPE, MAE and RMSE is smaller, the precise and accuracy level of the forecasting model will become higher and vice versa. Further, this study would evaluate the coefficient of determination, R^2 and Bayesian Information Criterion (BIC) for selecting the appropriate forecasting model. It used to determine which of the forecasting model – either ES or ARIMA model is the best model that we should use to predict the next 20 months sales data. R^2 value is to measure how fit is the model by measured the variation of the training data (Hyndman, et al., 2005). The highest value of R^2, the preferable forecasting model will be. The BIC value assessed accordance with the mean squared error amid with penalises the parameters and sizes of the series (IBM SPSS Forecasting v27, n.d.). The best forecasting model usually consisted of the minimum BIC value.

Then, we compare the sales forecast result between existing judgmental qualitative approach and quantitative statistical approach: ARIMA and ES method to recommend the best statistical model that should implement to provide the highest forecast accuracy amid with the lowest forecast errors of sales forecasting.

4. Result and Findings

From this study, we observed that the data is almost stationary, there is consistent seasonal pattern with the sequence of every 12 months for year 2014 to 2019, except for year 2020 as the whole global market was hit by covid-19 pandemic that the sales trend became VUCA and in plummet mode. We found sufficient evidence that the sales data collected is normal distributed as the p-value for the Shapiro-Wilk test and Kolmogorov-Smirnov test were not less than 0.05.
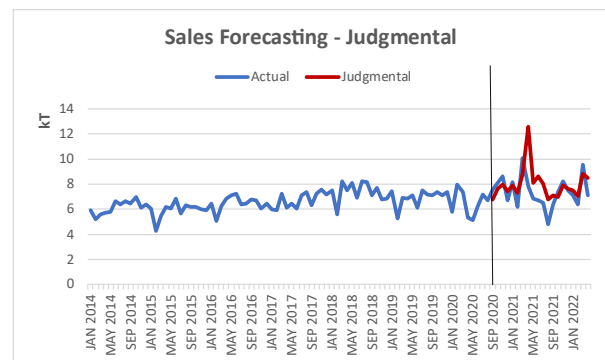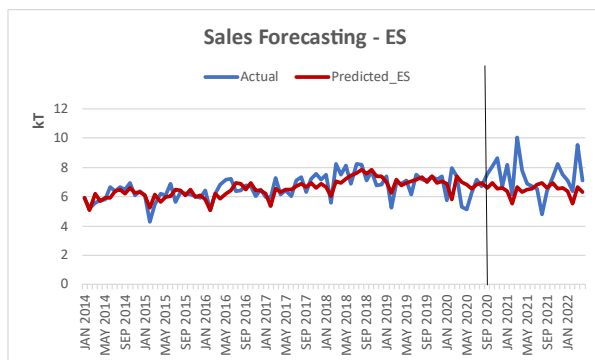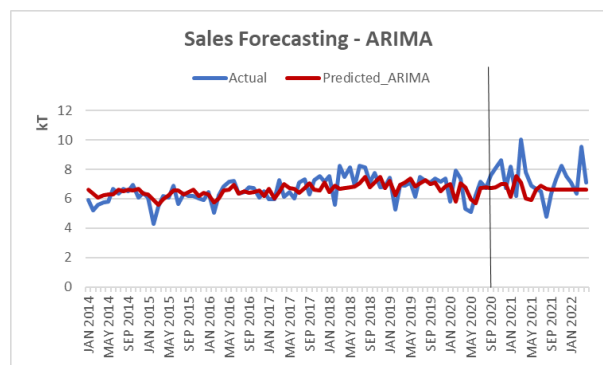
Figure 3 Sales Forecasting by Various Models

The graph that illustrated in *Figure 3* is the forecasting results that generated from judgmental, ES and ARIMA forecasting models through analysed the 80 months (January 2014 to August 2020) sales volume historical data (in blue colour graph line) amid with 20 months (September 2020 to April 2022) forecasting sales data (in red colour graph line) by using SPSS. The pattern of the forecasting results found ES model has smaller discrepancy than the ARIMA and judgmental model. I summarised the forecast errors, R^2 and BIC that have been analysed for the 20 months test data by using ES, ARIMA and judgmental model in Table 1.

Table 1 Forecast errors summary via ES, ARIMA and judgmental forecasting.

Forecasting model	RMSE	MAPE	MAE	R-square	Normalized BIC
ES with simple Seasonal	1,470	15.148	1,158	0.411	26,776
ARIMA(1,0,0)(00,0,1)	1,433	15.216	1,160	0.276	27.051
Judgmental	1,483	15.922	1,119		

We observed that the forecast accuracy level of the ES forecasting results is higher than the ARIMA and judgmental forecasting. This is because the value of MAPE, and MAE of the ES is lower than the value generated from ARIMA and judgmental approach.

Besides, the normalised BIC value for ES forecasting is lesser than ARIMA model. Moreover, the R^2 value of the ES forecasting is higher than the ARIMA forecasting model. This is because the greater the capabilities of the sales volume that can be interpreted by the future sales volume forecasting, the greater the accuracy and precise level of the forecasting outcomes. Thereby, the ES forecasting approach can be defined as the more adequate forecasting approach that can be used to anticipate the future sales volume by using the relevant historical data based on the several forecasting outcomes that have been discussed and generated compared with the ARIMA as well as judgmental forecasting approach.

5.0 Conclusions and Recommendations

5.1 Conclusion

In conclusion, the ES forecasting is the most appropriate forecasting approach compared with ARIMA and judgmental forecasting to predict the future sales volume of the company in the VUCA environment based on the analysis results of this study.

The pattern of graph in ES forecasting approach easy for people to interpret and comprehend to the current trend and direction. Additionally, ES forecasting analysis also is very easy to learn, generate a high accuracy and consistent level of forecasting results. The only need for ES forecasting are the latest stationary smoothing actual data. The more the recent number of data, the greater the exponential smoothing heavily weighted.

5.2 Implications of the Study

The outcome generated from this study will act as a reference for other companies to forecast their company's sales in the future. In addition, the time series forecasting analysis also provide many advantages in many aspects such as management, business, politics etc. First, there will assist the management to understand and comprehend the variable behaviour (Theintactone, n.d.). This is because the historical data of the variable used by the time series forecasting analyses are set up in a well-organized method. Thereby, the management team also can easily know and comprehend the property of the alteration that occurs within all these variables or data through detailed information and observation.

Thus, there will have many outcomes and information that can be determined and mentioned in the financial planning such as the number of productions, sales volume, revenue generated, and others by employing the time series forecasting analysis. All these financial planning can become their company goals for the future periods. Thereby, this is one of the benefits of the time series forecasting evaluation that can help those relevant parties to establish and prepare detailed future planning for the development of their company.

In addition, the implication of this study also has given some advice and suggestion for the company to equilibrium their investment in forecasting. Before making any investment decision, the company should evaluate the lever of two or more two variables at the same time rather than only making an investment and decision on only one variable (Theintactone, n.d.). This is because there has high possibility will exist the influence of the synergistic analysis between those forecasting variables. Thus, the finding of this research will give a lot of benefits and advantages for other companies.

5.3 Limitation of the Study

We found some limitations and it will give the impacts for the entire process of this research study. It is difficult and challenge for time series forecasting analysis to obtain and select the most suitable measurement to predict the variables if the forecasting analysis only recapitulation from one single variable (Philosophy, 2019). Thus, it is very difficult for time-series forecasting analysis to generate and determine the high accuracy and conformity level of the appropriate model to express the variable data.

The second limitation is the lack of consideration of the types of goods that promote by the company are the significant components that will give impact the forecasting analysis (Litvak, n.d.). The forecasting analysis will

generate different outcomes with the mixture adoption of new technology or launching new products with existing products in the market.

The competition level also can be classified as one of the significant elements that will give direct influence the forecasting results. This is because the greater the competitors and substitute products exist in the current market, the greater the difficulty for the implementation of the sales forecasting. In these factors of competition level normally will involve some additional information about the sub-elements such as the number of substitute products and the number of competitors in the current market (Litvak, n.d.).

Furthermore, the sales forecasting also will be influenced by the price of goods. Although it's only small alteration of the price, but it also influences the future sales volume trend. The price of goods normally will give a greater influence on those IT businesses because they need the innovation of the technology to provide the power and capability on their products (Litvak, n.d.). For instance, the innovation of technology can enhance the obsolete and old different types of products become more challenging to the evaluation of the forecasting approach.

5.4 Recommendations of the Study

The future research suggested to take into consideration those external factors that have been discussed in the previous section that will give impact the forecasting analysis and the outcome that will be generated such as types of goods, development of the economy, the achievement of technological and others.

The future study encourages to determine and understand the general error that will obtain from the accurate forecasting results. Under-forecasting and over-forecasting are the general forecasting error that will always occur in the forecasting procedure (Lowe, 2020). An appropriate action shall be taken to minimise these two forecasting errors. Otherwise, it will distort the whole forecasting results and conclusion or decision that has been made. As (Johansen, 2010) stated that *"future forecasts cannot help you plan unless you are willing to listen, and you cannot listen for the future if you are overwhelmed by the present."*

Acknowledgment

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