Cross-Industry Standard Process for Data Mining (CRISP-DM) Approach in Determining the Most Significant Employee Engagement Drivers to Sales at X Car Dealership

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Abstract

A car dealership is a car sales business that sells cars and services, which is the benchmark for prospective buyers. Increasing sales within the company are needed in developing business through building loyalty and trust between buyers and businesses. Companies can thrive on innovating and being sustainable when sales are in good shape. This research was conducted to find the correlation between employee engagement and sales. It is focused on making good business decisions to increase sales. This study focuses on determining the driving factors for employee engagement that have a significant effect on sales, the magnitude of its influence on sales, and suggestions for increasing sales from employee engagement. This research was conducted through Multiple Linear Regression modeling with Cross-Industry Standard Process for Data Mining (CRISP-DM) methodology. All independent variables in all models, namely NPBT Sales, NPBT Service, Unit Sales, and Unit Entry, each have a level of determination coefficient of 0.6889, 0.4962, 0.6795, and 0.4968. All models can be explained by 68.89%, 49.62%, 67.95%, and 49.68%, respectively, by the independent variables of each model. Suggestions were also obtained as a framework for maximizing sales based on Project Cycle Management.

Keywords

Car Dealership, Multiple Linear Regression, Employee Engagement, Sales, CRISP-DM

1. Introduction

A car dealership is a form of car sales business that offers the sale of the car unit itself. A car dealership is operated by selling its products through salespeople in promoting car units to potential customers. This business also offers after-sales services such as maintenance, sales of spare parts, car modifications, and warranty claims. The service quality of a car dealership is a benchmark for prospective buyers in considering their decision to buy products and

services from a dealership (Konrad 2019). On this basis, the car dealership must continue to develop its plans to generate a good flow of sales for the company.

Sales increase can generally be done by restructuring the organization's decisions to achieve its goals. People indicators, especially employee engagement, can identify the correlation with sales performance. Employee engagement measures the extent to which employees feel passionate about their work, are committed to the organization, and put the maximum effort into it. Engaged employees can see the whole company, understand its goals, and how it can fit in. This leads to better decision-making. Organizations with engaged employees can be ahead of their competitors. Engagement is a key differentiator in development and innovation (Bridger 2018).

The existence of employee engagement is not always able to provide a definitive assessment in an analysis. This is because employee engagement is a science in studying human behavior, which is challenging to learn. Humans are born in this world with different perspectives and behavior from one another. The challenge that is big enough to model employee engagement in explaining sales performance is a complex problem, but the modeling can be mapped through Multiple Linear Regression. This modeling aims to find the correlation between the dependent and independent variables. The level of complexity in measuring employee engagement is a challenge that is very profitable if successful. This can be achieved through the Multiple Linear Regression method, which correlates the relationship between employee engagement and sales.

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This research was conducted with the specific aim of finding the correlation between employee engagement and sales. This will be assisted through Multiple Linear Regression modeling supported by the CRISP-DM methodology. With the achievement of a result that shows that employee engagement drivers are dominant in influencing sales, it will produce quantified knowledge based on research results to be directly applied by the car dealership. Knowing the dominant employee engagement drivers can form good business decisions in competing with competitors. Sales performance can be significantly boosted by implementing good employee engagement within the company.

2. Literature Review

Employee engagement has a statistically significant relationship with performance. Low employee engagement at work could negatively affect performance (Motyka, 2018). Two definitions of employee engagement are a multi-faceted construct (cognition, emotions, and behaviors) and a unitary construct (a positive state of mind, a dedicated willingness, the opposite of burnout). Employee engagement has a positive relationship with individual performance and organizational performance. (Sun and Bunchapattanasakda, 2019).

The organizational aspect is vital for a salesperson to achieve the target of getting a customer. How salespeople achieve effective intra-organizational resource alignment, what effective alignment is, and how firms can facilitate the adequate provision of resources are all critical questions whose answers can enhance sales performance. The importance of quality that firms can give through employee engagement plays a significant factor in enhancing sales performance (Evans, 2012).

3. Method

The cross-industry standard process for data mining methodology, commonly known as CRISP-DM, was created in 1996, involving SPSS, Teradata, Daimler AG, OHRA, and NCR Corporation. This method is one of the most famous data mining modeling. The use of this methodology includes six phases that describe the data science application cycle. CRISP-DM is the preferred methodology for solving this study case about employee engagement and sales in the dealership. This methodology consists of business understanding, data understanding, data preparation, modeling, evaluation, and deployment (See Fig. 1).

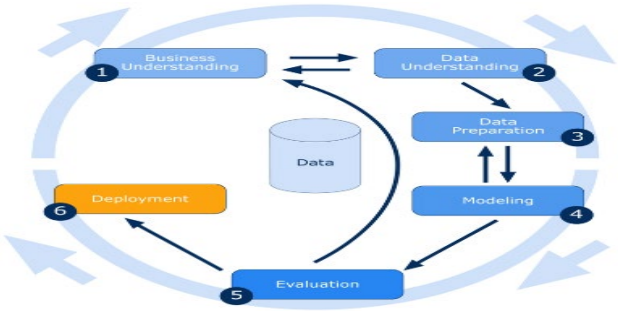

Figure 1. CRISP-DM Process

3.1 Business Understanding

The business understanding phase presents the core of a successful project incorporating data mining. In this phase, the project is defined into three goals: research objectives, examining the situation, and data mining objectives (Schröer et al., 2021). This phase explains the goals that want to be achieved in this research.

- Research Objectives

X Car Dealership wants the right decision to improve sales performance at their dealership. One of the things they focus on in their strategy is utilizing knowledge in the human resources field. With the implementation of data mining, new knowledge can be found regarding aspects supporting sales performance from the human resources aspect.

- Examining The Situation

The stage of examining the situation here functions in describing the resources and limitations of X Car Dealership. This stage will explain each of these aspects in recognizing the research object. The following are the resources and limitations of X Car Dealership:

- Resource

1. The data used are Sales Data for March 2021 and Employee Engagement Data for March 2021
2. Resources Data is stored in a confidential database owned by X Car Dealership.
3. The data used consists of 30 dealership branches at X Car Dealership.

- Limitation

1. The data mining results in this study are in the form of correlations of each independent variable to each dependent variable.
2. The results of Multiple Linear Regression will be used as a reference for positive and negative relationships determining variables that affect sales performance.
3. If there is an incomplete data value, the data will be processed through data preparation.
4. Limitations in the deployment stage are only suggestions because X Car Dealership can only determine major company decisions.

- Data Mining Objectives

The research aims to identify the dominant drivers of employee engagement in affecting sales. Predictive analytics here acted as a primary direction from the data mining objectives. To achieve the desired outcomes in finding the dominant drivers, multiple linear regression is used to find the correlation with the sales variable. The research planning here revolves around the multiple linear regression method to achieve optimal results.(Figure 2)

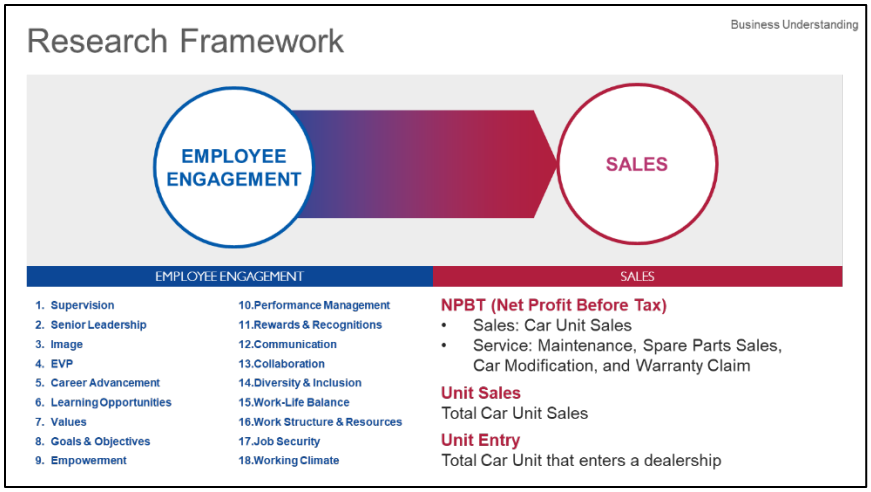

Figure 2. Research Framework

3.2 Data Understanding

The data understanding phase involves data exploration with statistics and data visualization. Understanding data is a critical phase in knowing what actions to take. This phase explains the data through descriptive analysis and visualization (Martínez-Plumed et al., 2021).

The datasets come from a dealership in 30 of its branches that's spread all over Indonesia. It consists of sales and employee engagement datasets (See Fig. 2). The datasets were collected in March 2021. The sales dataset consists of NPBT Sales, NPBT Service, Unit Sales, and Unit Entry, while the employee engagement dataset consists of 18 variables displaying the employee experience used in the dealership to measure employee engagement. Employee engagement datasets have 6 points Likert scale that offers options starting from extremely dissatisfied, very dissatisfied, somewhat dissatisfied, somewhat satisfied, very satisfied, and extremely satisfied (See Fig. 3).

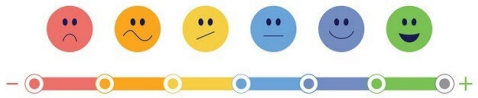

Figure 3. 6 Points Likert Scale in Employee Engagement Datasets.

- Descriptive Analysis

This phase helps to identify characteristics in each variable within the datasets. The analysis will display the minimum value, first quartile, median, mean, third quartile, and maximum value. (Table 1)

Table 1. Descriptive Analysis

	NPBT Service	Unit Sales	...	Working Climate
Min.	161719	57.51	...	4.92
1st Qu.	349341	85.63	...	5.152
Median	539954	104.8	...	5.42
Mean	545434	114.38	...	5.383
3rd Qu.	734516	137.7	...	5.558
Max.	1176715	218.54	...	5.78

- Data Visualization

This phase helps to represent the data in a graph for better visualization than just a number. Quantile-Quantile Plot is used to identify the normality in the residuals within the regression model (See Fig. 4).

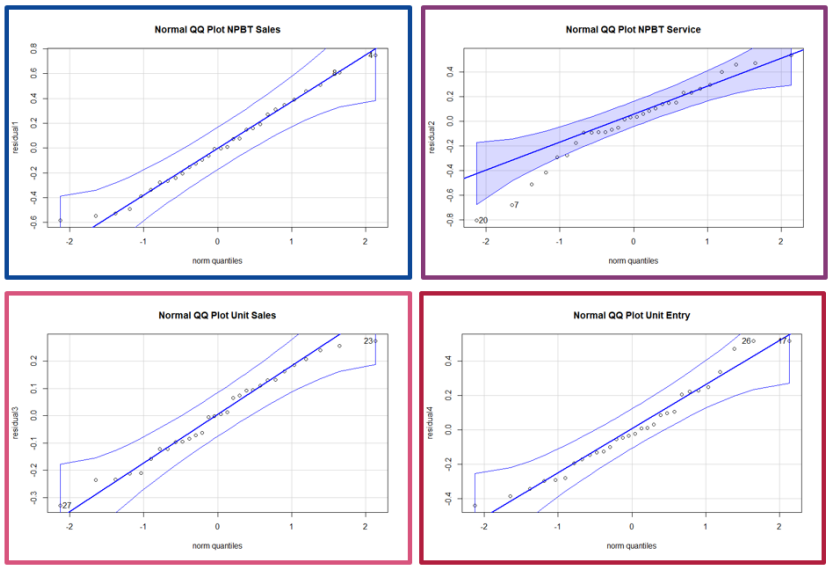

Figure 4. QQ Plot of Unit Sales.

3.3 Data Preparation

The data preparation phase is used to prepare the datasets for the modeling phase. This phase is carried out to create the final and clean datasets. The data preparation phase in this research consists of data cleaning, transformation, and reduction (Taleb 2015).

- Data Cleaning

This phase aims to create a clean data set that can be modeled later in the modeling phase. This phase identifies incomplete or unusual data, such as outliers and missing values. The results show there are no missing values within the datasets. Outliers are founded in observations 3 and 8; thus, it has been deleted.

- Data Transformation

This phase helps to create uniformity within the variables in the datasets. A natural logarithm is used to transform the value in each variable. It returns the number through a logarithm with the mathematical constant e, approximately equal to 2.718281828459 (Ricardo 2022).

- Data Reduction

This phase helps reduce the data to help achieve the optimal result. The data reduction phase is used later when the t-test of each variable is displayed. The purpose of doing this is to minimalize the high range of p-value produced in the t-test to improve the significance level. The rule is to remove the variables that exceed the p-value of 0.5 (See the red column in Table 2.).

Table 2. Data Reduction Table

Independent Variables	***p-value* (t-test)**			
	Model 1 (NPBT *Sales*)	**Model 2 (NPBT *Service*)**	**Model 3 (*Unit Sales*)**	**Model 4 (*Unit Entry*)**
Supervision	0.0128	0.9336	0.08714	0.2529
Senior Leadership	0.1042	0.3596	0.07464	0.16439

Independent Variables	*p-value* (t-test)			
	Model 1 (NPBT *Sales*)	**Model 2 (NPBT *Service*)**	**Model 3 (*Unit Sales*)**	**Model 4 (*Unit Entry*)**
Image	0.1249	0.8843	0.13881	0.17385
EVP	0.0054	0.0454	0.00721	0.00272
Career Advancement	0.2944	0.0461	0.23669	0.24419
Learning Opportunities	0.9576	0.6758	0.29449	0.58835
Values	0.2583	0.1597	0.55047	0.95232
Goals Objectives	0.6732	0.1933	0.89423	0.76277
Empowerment	0.1999	0.4874	0.64885	0.29346
Performance Management	0.2018	0.5112	0.20462	0.54078
Rewards Recognition	0.697	0.383	0.84149	0.22666
Communication	0.0291	0.7406	0.04646	0.21425
Collaboration	0.5146	0.2434	0.82785	0.55045
Diversity Inclusion	0.9866	0.7832	0.75702	0.77653
Worklife Balance	0.4449	0.9989	0.17765	0.48458
Work Structure Resources	0.0625	0.1506	0.15434	0.0293
Job Security	0.4186	0.8324	0.45658	0.37959
Working Climate	0.0125	0.9214	0.23174	0.04918

4. Result and Analysis

4.1 Modelling

The modeling phase develops a model that identifies patterns and information hidden in the datasets. Multiple linear regression acts as the data mining method to determine a dominant factor in employee engagement that affects unit sales. The classical Assumption Test helps achieve an optimal regression model result. The regression model is tested using F-test and t-test to determine the significance level.

- Classical Assumption Test

This phase is required in the regression model to ensure a better fit. The desired result is to fit the BLUE (Best Linear Unbiased Estimator criteria), an estimator to determine that a regression model is unbiased and linear. This phase consists of a normality test, multicollinearity test, heteroscedasticity test, and autocorrelation test (Ainiyah et al. 2016). The results can be seen in Table 3 and Table 4. Multicollinearity has a required VIF Value of less than 10 to be accepted, while the rest of the test has a required p-value of more than 0.05 to fulfill the criteria of each test.

Table 3. Classical Assumption Test

	Normality Test	Heteroscedasticity Test	Autocorrelation Test
p-value NPBT Sales	0.634	0.4557	0.5359
p-value NPBT Service	0.696	0.487	0.1001

	Normality Test	Heteroscedasticity Test	Autocorrelation Test
p-value Unit Sales	0.7213	0.3772	0.285
p-value Unit Entry	0.7197	0.5416	0.2379

In Table 3, all test criteria yielded results > 0.05, which means that all tests have reached the criteria for each test.

Table 4. Classical Assumption Test (Multicollinearity Test)

	VIF (Variance Inflation Factor)			
	NPBT Sales	NPBT Service	Unit Sales	Unit Entry
Supervision	0.13819921	[redacted]	0.1819526	0.0977522
Senior Leadership	0.18940764	0.07897728	0.194998	0.1719051
Image	0.1742496	[redacted]	0.2275531	0.1524458
...	...	...	...	...
Working Climates	0.21718194	[redacted]	0.2665017	0.1864733

Multicollinearity test for each modeling on the new data sets resulted in a VIF value < 10. These results can be seen in Table 4. Therefore, it can be concluded that the new data sets do not have independent variables that have multicollinearity.

- Multiple Linear Regression

This method is a linear regression with more than one predictor (Chi et al., 2020). In this case, each model has its predictors based on the data reduction phase's results. The results from this method show each predictor's value that determines its positive or negative correlation (See Fig. 5).

Figure 5. Multiple Linear Regression Results

- F-test

This test aims to analyze all the predictor's significance levels within the datasets simultaneously to the dependent variable. The result for each model is less than 0.05 alpha level. Thus, it explains that the predictors are significant simultaneously to the independent variable as its dependent variable. (Table 5)

Table 5. F-Test Results

	NPBT Sales	NPBT Service	Unit Sales	Unit Entry
p-value	0.001459	0.006304	0.00104	0.01766

- t-test

This test analyzes one predictor's significance to its dependent variable. The lower p-value indicates a more robust significance level for its dependent variable and vice versa. The result can be seen in Figure 6. The lower the p-value, the more significant it is, and vice versa.

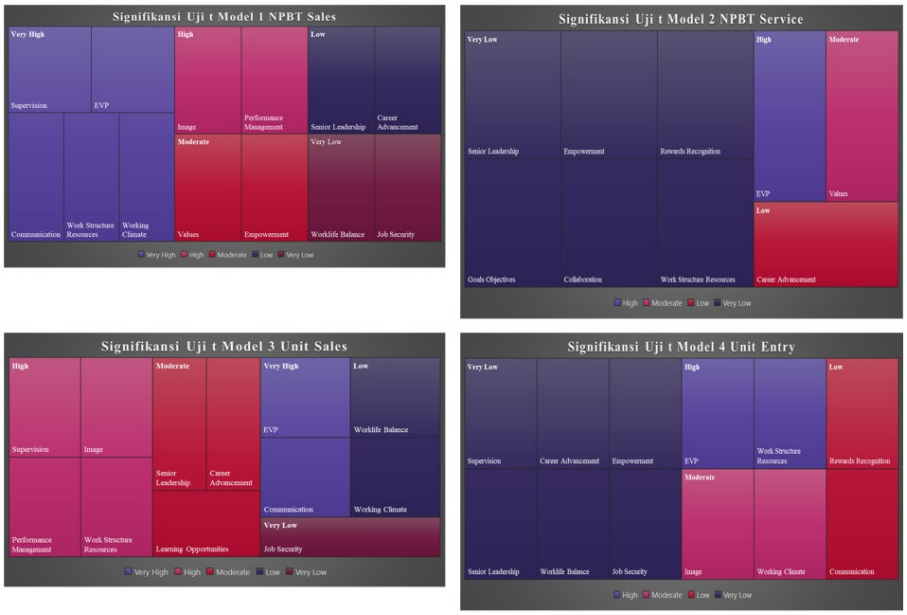

Figure 6. t-test Results

4.2 Evaluation

The evaluation phase is a phase that's used to measure the precision level of a model. This phase functions as a validation tool for the model that is developed. The accuracy of a model can be improved through the CRISP-DM cycle.

The evaluation stage is one of the stages that will be used to check the level of precision and accuracy of a model (Purbasari et al., 2021). The evaluation required for this multiple linear regression model can be tested through the coefficient of determination (R^2) as a benchmark. The coefficient of a determination here describes the strength of the relationship between the independent and dependent variables. The number for the coefficient of determination was produced through a multiple linear regression on each model.

The coefficient of determination has a scale of 0 – 1, which indicates that the greater the value of the coefficient of determination, the greater the ability of the independent variables in the model to explain the dependent variable (Arya et al., 2020). The results of the coefficient of determination can be seen in Table 6.

Unlike the case with engineering, where the coefficient of determination close to 1 is an excellent indicator, the coefficient of determination in human behavior has a value that tends to be below 50% in general (Abelson 1985). Therefore, the coefficient of determination on NPBT Service and Unit Entry below 50% is still said to be good. (Table 6)

Table 6. Coefficient of Determination Results

	NPBT Sales	NPBT Service	Unit Sales	Unit Entry
Coefficient of Determination	68.89%	49.62%	67.95%	49.68%

4.3 Deployment

Deployment is implementing new knowledge obtained from the CRISP-DM stages that have been passed (Plotnikova et al., 2021). Project Cycle Management is one method that can be implemented to produce a development framework consisting of five stages, namely initiation, identification, formulation, implementation, and evaluation and audit (Melecký and Staníčková 2018). This method is helpful for good planning before a project starts. The stages for implementing the framework can be seen in Table 7.

Table 7. Project Cycle Management Framework

PROJECT CYCLE MANAGEMENT FRAMEWORK	
STAGES	**ACTIVITY**
Initiation (Define the framework and establish general principles)	Identify employee engagement needs in maximizing Sales. This stage is an exploration stage regarding development needs that can be carried out to maximize sales.
	Define goals. This stage is further reasoning about the problems faced to maximize sales.
	Give responsibility. This stage is the determination of the person in charge of the activity, which can be in the form of a team or individual.
	Check the efficiency of work practices that the company has carried out. Work practices are how an organization carries out its work in the work environment.
	Designing timelines. This stage is the scheduling of how activities will be carried out, which is adjusted to other organizational schedules
Identification (Identify project ideas and verify their feasibility)	Identify the problem of employee engagement factors on sales performance
	Process Analysis. This stage explains the relation of the sales process to employee engagement in a systematic way.
	Organizational Analysis. This stage explains where the corporate defines an organization's work practices in its evaluation of employee engagement to maximize sales.

PROJECT CYCLE MANAGEMENT FRAMEWORK	
STAGES	**ACTIVITY**
	Limitation Analysis. This stage explains the limitations related to achieving the ideal conditions that will be implemented in order to maximize sales.
	Emergency needs analysis. This stage is a preventive measure when things go wrong.
Formulation (Detailed planning and project preparation)	Planning work practices by increasing employee engagement in increasing sales
	Make preventive plans in order to overcome the things that can interfere.
	Develop a priority scale. This stage describes the possibilities that can be decided realistically.
Implementation (Implementation, monitoring, and reporting)	Project planning maximizes engagement level. This activity is in the form of a formulation of the running of the project.
	Implementing projects by timelines and resource capacity considerations
	Monitoring process that aims to monitor every activity carried out in maximizing sales.
Evaluation and Audit (Outcome and activity analysis)	Evaluation of results. This stage clearly defines achieving the desired target after implementing the project.
	Action re-planning maximizes engagement levels with the knowledge gained that can significantly maximize sales in natural systems.

5. Conclusion

Based on the results of the t-test on Model 1 NPBT Sales, it is known that the Supervision, Image, EVP, Values, Empowerment, Performance Management, Communication, Work Structure Resources, and Working Climate variables have a partially significant effect on the NPBT Sales variable because they have more p-values. Smaller than 0.05. Therefore, these variables can affect the rise and fall of NPBT Sales. All independent variables in Model 1 NPBT Sales have a coefficient of determination of 0.6889. NPBT Sales can be explained as much as 68.89% by the independent variables contained in the final model. Therefore, it can be concluded that the Supervision, Image, EVP, Values, Empowerment, Performance Management, Communication, Work Structure Resources, and Working Climate variables significantly influence the determination coefficient of 68.89%.

Based on the results of the t-test on Model 2 NPBT Service, it is known that the EVP and Values variables have a partially significant effect on the NPBT Service variable because they have a p-value smaller than 0.05. Therefore, these variables can affect the ups and downs of NPBT Service. All independent variables in Model 2 NPBT Service have a coefficient of determination of 0.4962. NPBT Service can be explained as much as 49.62% by the independent

variables contained in the final model. Therefore, it can be concluded that the EVP and Values variables significantly influence the level of the coefficient of determination of 49.62%.

Based on the results of the t-test on Model 3 Unit Sales, it is known that the Supervision, Senior Leadership, Image, EVP, Career Advancement, Learning Opportunities, Performance Management, Communication, and Work Structure Resources variables have a partially significant effect on the Unit Sales variable because they have a p-value. Value is less than 0.05. Therefore, these variables can affect the ups and downs of Unit Sales. All independent variables in Model 3 Unit Sales have a coefficient of determination of 0.6795. Unit Sales can be explained as much as 67.95% by the independent variables contained in the final model. Therefore, it can be concluded that the variables Supervision, Senior Leadership, Image, EVP, Career Advancement, Learning Opportunities, Performance Management, Communication, and Work Structure Resources have a significant effect with a coefficient of determination of 67.95%.

Based on the results of the t-test on Model 4 Unit Entry, it is known that the Image, EVP, Work Structure Resources, and Working Climate variables have a partially significant effect on the Unit Entry variable because they have a p-value smaller than 0.05. Therefore, these variables are variables that can affect the ups and downs of Unit Entry. All independent variables in Model 4 Unit Entry have a coefficient of 0.4968. Unit entry can be explained as much as 49.68% by the independent variables contained in the final model. Therefore, it can be concluded that the variables Image, EVP, Work Structure Resources, and Working Climate have a significant influence, with a coefficient of determination level of 49.68%.

Research can be carried out within a certain period. The current study was only conducted for one month. This causes a lack of material that can be researched in order to improve the accuracy of the modeling results obtained from this study. Data sets can be developed further. This development can be done through the identification of new independent variables. Identifying this new independent variable has a function in further exploring the factors that influence sales variables.
Further research should also be aligned according to the organization under study. Every organization has its own culture and system. This stage is critical in producing research that can describe the organization well.

References

Abelson, R. P., “A variance explanation paradox: When a little is a lot,” *Psychological bulletin*, 97(1), p.129, 1985.

Ainiyah, N., Deliar, A., and Virtriana, R., “The classical assumption test to driving factors of land cover change in the development region of northern part of west Java,” *The International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences*, vol. 41, pp. 205, 2016.

Arya, D., Rochmawati, L., and Sonhaji, I., ”Koefisien Korelasi (R) dan Koefisien Determinasi (R2).” *Jurnal Penelitian,* pp. 289-296, 2020.

Bridger, E., Employee Engagement: A Practical Introduction, United Kingdom: Kogan Page, 2018.

Chi, J., Qu, Y., Zheng, Q., Yang, Z., Jin, W., Cui, D., and Liu, T.,“Relation-based test case prioritization for regression testing.” *Journal of Systems and Software 163,* 1 May 2020.

Evans, K. R., McFarland, R. G., Dietz, B., & Jaramillo, F., “Advancing Sales Performance Research: A Focus on Five UnderResearched Topic Areas,” *Journal of Personal Selling & Sales Management*, 32(1), 89–105, 2012.

Konrad, A., *Customer retail Experience as a new approach for creating dealership sales loyalty in the automotive industry*, Proceedings of The 14th IAC 2019, 2019.

Martínez-Plumed, F., et al., "CRISP-DM Twenty Years Later: From Data Mining Processes to Data Science Trajectories," *in IEEE Transactions on Knowledge and Data Engineering*, vol. 33, no. 8, pp. 3048-3061, 1 Aug 2021.

Melecký, L. and Staníčková, M., “Complexity of the Project Cycle Management and Logical Framework Approach: Challenges or Standards in the EU Case?.” *on European Integration 2018*, p.1035, 2018.

Motyka, Błażej., “Employee engagement and performance: a systematic literature review" *International Journal of Management and Economics*, vol.54, no.3, pp.227-244, 2018.

Plotnikova, V., Dumas, M., and Milani, F., “Adapting the CRISP-DM Data Mining Process: A Case Study in the Financial Services Domain,” *In International Conference on Research Challenges in Information Science,* pp. 55-71, 11 May 2021.

Purbasari, A., Rinawan, F. R., Zulianto, A., Susanti, A. I., and Komara, H., "CRISP-DM for Data Quality Improvement to Support Machine Learning of Stunting Prediction in Infants and Toddlers," *2021 8th International Conference on Advanced Informatics: Concepts, Theory and Applications (ICAICTA)*, pp. 1-6, 2021.

Ricardo, H., "The Equivalence of Definitions of the Natural Logarithm Function." *The College Mathematics Journal,* pp. 1-7, 4 Mar 2022.

Schröer, C., Kruse, F., and Gómez, J. M., "A Systematic Literature Review on Applying CRISP-DM Process Model*," Procedia Computer Science,* vol. 181, pp. 526-534, 2021.

Sun, L. & Bunchapattanasakda, C., "Employee Engagement: A Literature Review," *International Journal of Human Resource Studies, Macrothink Institute*, vol. 9(1), pages 63-80, 2019.

Taleb, I., Dssouli, R., and Serhani, M. A., "Big Data Pre-processing: A Quality Framework," *2015 IEEE International Congress on Big Data*, pp. 191-198, 2015.

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