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Assessing Supplier Risk Over Time Using Lean Six Sigma, Cox Proportional-Hazards Modeling, and Linear Regression

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Abstract: The Department of Defense contracts a multitude of suppliers at the beginning of each fiscal year within the aerospace industry. In our case study, we specifically look at purchasers within the aerospace industry. Such purchasers must decide which supplier contracts to grant at the beginning of each year. Our research focused on the application of statistical analysis to improve risk assessment among these aerospace purchasers. Currently, there is no standardization across the DoD for supplier risk assessment regarding three main considerations: (1) Is a plant likely to close, (2) When is a plant likely to close, and (3) How long will the plant close? This research focuses on the application of several methods to improve risk assessment within aerospace purchasers and address each consideration both independently and mutually. Using a combination of Lean Six Sigma processes, Cox-Proportional Hazards models, and advanced Linear Regression techniques we aim to improve the perceived risk of the supplier framework and its respective financial capabilities in order to assess the contract candidates quickly and correctly. First, we addressed the first consideration of is a plant contracted by the DoD likely to close by addressing the process used by the DoD to evaluate suppliers for contracting through Lean Six Sigma. The process of Lean Six Sigma combines two approaches known as Lean and Six Sigma in an effort to reduce inefficient waste in systems and other processes. Through the Define, Measure, Analyze, Improve, and Control (DMAIC) methodology, we were able to focus on using data as the basis for improving the cycle of supplier assessment by the DoD and transforming qualitative data collected by the DoD to more user-friendly data types. The time period of assessing the previous qualitative data by the DoD was significantly labor intensive by a small group of government employees and did not allow a proper assessment of each supplier. Roughly less than a quarter of all suppliers were assessed. The most efficient improvement came from transforming the data to quantitative data easily that is easily inputted into a model for assessing overall risk based on rating conversions developed by Dr. Isabella Sanders. We were able to measure the predicted benefits of these changes to the contracting process through man-hours saved and the percentage of successful contracts compared to previous years. Next, we were able to address the second consideration of when is a plant likely to close by utilizing a statistical analysis modeling technique known as Cox-Proportional Hazards we were able to address when a plant is most likely to close over time. Cox-Proportional Hazards is used in the healthcare industry to predict the probability of a patient surviving to the next day or dying. We were then able to manipulate the model structure into a new model focused on predicting when a plant will close based on several factors to include the geographical location of the plant, industry specialization, etc. The model for plant behavior, however, assumes that all plants at some point will close and was unchangeable due to the data provided by DCMA for only those plants that have closed. Last, linear regression modeling was performed on the data provided by DCMA to predict how long a plant that closes will remain closed for. The model focused on plants that have already closed and evaluated the predicted length of closure based on several characteristics of the individual plants rather than suppliers as a whole. The integration of the outputs for each model is still underway in order to create a streamlined capability for the DoD to quickly assess a supplier's risk for closure. However, the development of a method to identify stronger suppliers will be beneficial within other industries, allowing a means to not only measure but compare the risk associated with choosing various suppliers for the Department of Defense.

Keywords**:** Lean Six Sigma, Cox-Proportional Hazard Model, Linear Regression, Department of Defense, Aerospace Industry, Risk Assessment