**Appendix E**

K-Means is an unsupervised Machine Learning technique, that falls within the category of clustering algorithms. Nowadays, thanks to its efficiency and easiness of implementation, K-Means has become one of the most popular clustering techniques in several fields (Huang et al., 2021), among which operations management (Brusco et al., 2017). K-Means divides *n* observations into *k* clusters. K-Means is an iterative algorithm, characterized by three main steps: I) select *k* centroids, II) associate each observation to the nearest centroid, and III) re-calculate centroids and re-assign the observations to the nearest centroid until there is no further change or a tolerance value is reached (Ghazal et al., 2021). The number of clusters (*k*) is defined by the user, and it could be selected through a tuning process based on a reference parameter such as the silhouette. The silhouette measures how similar a given observation is to other observations falling in the same cluster. High silhouette value means that the observation is well related to the associated cluster. The silhouette can be estimated for all the observations, and the mean silhouette is an indicator of the clustering goodness.

In this work, the observations are the mean relevance and coefficient of variation associated with each challenge. Using K-Means and considering a number of clusters between 2 and 6, the highest silhouette value of 0.7601 is estimated for three clusters (see Figure E1). Therefore, three is chosen as the number of clusters for the analysis.



**Figure E1**: Silhouette Value of K-Means arising from a number of clusters between 2 and 6

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