In [13]:

```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.preprocessing import LabelEncoder
from sklearn.preprocessing import OneHotEncoder
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.cluster import KMeans
from sklearn import decomposition
from wordcloud import WordCloud, STOPWORDS
from sklearn.metrics import davies_bouldin_score
from sklearn import metrics
from scipy.spatial.distance import cdist
from sklearn.cluster import DBSCAN
from sklearn.model_selection import train_test_split

df =pd.read_csv('C:/Users/KARTDH/Desktop/DAW/Cluster POC/FailedSearch.csv')

df.describe()
```

Out[13]:

	ClickDepth	Pagenumber	PageClick	Final_Success	Query_Cnt	ResultClick_Cn
count	56977.000000	56977.000000	56977.000000	56977.0	56977.000000	56977.00000
mean	5.218176	1.676712	16.776436	0.0	1.340085	6.28472
std	4.196961	2.010455	32.323095	0.0	1.516311	4.18182
min	0.000000	0.000000	0.000000	0.0	0.000000	1.00000
25%	2.000000	1.000000	2.000000	0.0	0.000000	4.00000
50%	4.000000	1.000000	6.000000	0.0	1.000000	5.00000
75%	8.000000	2.000000	22.000000	0.0	2.000000	7.00000
max	23.000000	72.000000	1077.000000	0.0	28.000000	98.00000

In [14]:
```
df.head(10)
```

Out[14]:

	Region	Org	Profession	Query_Text	ClickDepth	Pagenumber	PageClick	Final_Su
0	Asia	Experiences - Devices	Engineering	Azureslam	2	1	2	
1	Asia	Experiences - Devices	Engineering	AzureSlam kusto	9	1	9	
2	Asia	Experiences - Devices	Engineering	AzureSlam kusto access	0	1	0	
3	Asia	Experiences - Devices	Engineering	banned api	2	2	22	
4	Asia	Experiences - Devices	Engineering	benefit azure subscription	1	1	1	
5	Asia	Experiences - Devices	Engineering	benevity	1	1	1	
6	Asia	Experiences - Devices	Engineering	best practices online service	1	1	1	
7	Asia	Experiences - Devices	Engineering	beyond compare	1	1	1	
8	Asia	Experiences - Devices	Engineering	beyond compare key	2	1	2	
9	Asia	Experiences - Devices	Engineering	BigFunnel Session	2	1	2	

In [ ]:
```
# This is for replacing the outlier with their Median values
#numeric_df=df1[['Final_Success','PageClick','NPaginations','Query_Cnt','Resu

Cdmedian = int(df['PageClick'].median())
qcmedian = int(df['Query_Cnt'].median())
rcmedian = int(df['ResultClick_Cnt'].median())
ncmedian = int(df['Navigation_Cnt'].median())
df['PageClick'] = np.where(df['PageClick'] > 8, Cdmedian, df['PageClick'])
df['Query_Cnt'] = np.where(df['Query_Cnt'] > 2, qcmedian, df['Query_Cnt'])
df['ResultClick_Cnt'] = np.where(df['ResultClick_Cnt'] > 4, rcmedian, df['Res
df['Navigation_Cnt'] = np.where(df['Navigation_Cnt'] > 1, ncmedian, df['Navig
```

In [47]:
```
#Loading only 30000 records for training
df1=df[0:30000]
df1=df1.drop(["ClickDepth","Pagenumber","Final_Success"],axis = 1)
```

In [49]:

```
df1.describe()
```

Out[49]:

	PageClick	Query_Cnt	ResultClick_Cnt	Navigation_Cnt
count	30000.000000	30000.000000	30000.000000	30000.000000
mean	4.345633	0.861833	4.443533	0.030767
std	2.409598	0.697204	1.012544	0.172688
min	0.000000	0.000000	1.000000	0.000000
25%	2.000000	0.000000	4.000000	0.000000
50%	6.000000	1.000000	5.000000	0.000000
75%	6.000000	1.000000	5.000000	0.000000
max	8.000000	2.000000	5.000000	1.000000

One Hot Encoding

In [50]:

```
# generate binary values for categorical fileds using get_dummies
dum_df = pd.get_dummies(df1,columns=["Region","Org","Profession"] )
dum_df.info()
#dum_df
dum_df.head(5)
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 30000 entries, 0 to 29999
Data columns (total 44 columns):
 #   Column                                           Non-Null Count  Dtype
---  ------                                           --------------  -----
 0   Query_Text                                       30000 non-null  objec
t
 1   PageClick                                        30000 non-null  int64
 2   Query_Cnt                                        30000 non-null  int64
 3   ResultClick_Cnt                                  30000 non-null  int64
 4   Navigation_Cnt                                   30000 non-null  int64
 5   Region_Americas                                  30000 non-null  uint8
 6   Region_Asia                                      30000 non-null  uint8
 7   Region_EMEA                                      30000 non-null  uint8
 8   Region_Puget Sound                               30000 non-null  uint8
 9   Org_AI _ Research Group                          30000 non-null  uint8
 10  Org_Business Development Group                   30000 non-null  uint8
 11  Org_Cloud - AI                                   30000 non-null  uint8
 12  Org_Core Services Engineering _ Ops              30000 non-null  uint8
 13  Org_Corp Other                                   30000 non-null  uint8
 14  Org_Corporate_ External _ Legal Affairs          30000 non-null  uint8
 15  Org_Experiences - Devices                        30000 non-null  uint8
 16  Org_Finance Group                                30000 non-null  uint8
 17  Org_Gaming                                       30000 non-null  uint8
 18  Org_Global Sales and Marketing Ops               30000 non-null  uint8
 19  Org_HR Group                                     30000 non-null  uint8
 20  Org_Marketing and Consumer Business              30000 non-null  uint8
 21  Org_Worldwide Commercial Business                30000 non-null  uint8
 22  Profession_Business Development - Strategy       30000 non-null  uint8
 23  Profession_Business Programs - Operations        30000 non-null  uint8
 24  Profession_Customer Success                      30000 non-null  uint8
 25  Profession_Data Center                           30000 non-null  uint8
 26  Profession_Engineering                           30000 non-null  uint8
 27  Profession_Evangelism                            30000 non-null  uint8
 28  Profession_Field Business Leadership             30000 non-null  uint8
 29  Profession_Finance                               30000 non-null  uint8
 30  Profession_Hardware Engineering                  30000 non-null  uint8
 31  Profession_Hardware Manufacturing Engineering    30000 non-null  uint8
 32  Profession_Human Resources                       30000 non-null  uint8
 33  Profession_IT Operations                         30000 non-null  uint8
 34  Profession_Inside Sales and Solutions            30000 non-null  uint8
 35  Profession_Legal - Corporate Affairs             30000 non-null  uint8
 36  Profession_Marketing                             30000 non-null  uint8
 37  Profession_Research                              30000 non-null  uint8
 38  Profession_Retail                                30000 non-null  uint8
 39  Profession_Sales                                 30000 non-null  uint8
 40  Profession_Services                              30000 non-null  uint8
 41  Profession_Supply Chain - Operations Management  30000 non-null  uint8
 42  Profession_Technical Sales                       30000 non-null  uint8
 43  Profession_Unassigned                            30000 non-null  uint8
```

```
dtypes: int64(4), object(1), uint8(39)
memory usage: 2.3+ MB
```

Out[50]:

	Query_Text	PageClick	Query_Cnt	ResultClick_Cnt	Navigation_Cnt	Region_Americas	R
0	Azureslam	2	2	5	0	0	
1	AzureSlam kusto	6	1	5	0	0	
2	AzureSlam kusto access	0	1	5	0	0	
3	banned api	6	0	5	0	0	
4	benefit azure subscription	1	1	4	0	0	

5 rows × 44 columns

```
In [51]: dum_df.shape

Out[51]: (30000, 44)
```

Word2Vec

```
In [52]: def extract(lst):
             res=[]
             for i in lst :
                 s=i.split(', ')
                 res.append(s)
             return (res)
```

```
In [53]: #Building Word2Vec Model Using Query Text
         import gensim
         from gensim.models import Word2Vec
         from nltk.corpus import stopwords

         sentences =extract(df1['Query_Text'].str.lower())
         #print(type(sentences))
         #print(sentences)

         w2v_model = Word2Vec(sentences, window=2 ,min_count=1,sg=0)
```

```
In [54]: print(len(sentences))
         sentences[0:10]

         30000

Out[54]: [['azureslam'],
          ['azureslam  kusto'],
          ['azureslam  kusto access'],
          ['banned api'],
          ['benefit azure subscription'],
          ['benevity'],
          ['best practices online service'],
          ['beyond compare'],
          ['beyond compare key'],
          ['bigfunnel session']]
```

In [55]:

```
#calculate average word2vec for each words in QueryText.
sentvectors = [];
for sent in sentences:
    sent_vec = np.zeros(100)
    cnt_words =0;
    for word in sent:
        try:
            vec = w2v_model.wv[word]
            sent_vec += vec
            cnt_words += 1
        except:
            pass
    sent_vec /= cnt_words
    sentvectors.append(sent_vec)
```

In [56]:

```
#combining the AvgWord2Vec for each QueryText with df1 where it has other fea
new_df = pd.concat([dum_df,pd.DataFrame(sentvectors)],axis=1)
```

In [57]:

```
#Dropping the Query Text Filed as we got Avgword2Vec for each Query Text
new_df=new_df.drop(["Query_Text"],axis = 1)
```

In [58]:

```
new_df.shape
```

Out[58]:

```
(30000, 143)
```

PCA

In [59]:

```
#Column Standarization for PCA and T-SNE
from sklearn.preprocessing import StandardScaler
standardized_data = StandardScaler().fit_transform(new_df)
print(standardized_data.shape)
```

```
(30000, 143)
```

In [60]:

```
print(standardized_data)
```

```
[[-0.97347028  1.63250112  0.54958189 ...  0.34005771  1.32923632
  -0.47671902]
 [ 0.68658505  0.19817593  0.54958189 ... -0.14871362  1.06625183
  -1.10781865]
 [-1.80349794  0.19817593  0.54958189 ... -0.74471756 -1.22103301
   0.88949001]
 ...
 [-1.38848411  0.19817593 -0.43804581 ...  1.14642494 -1.58055764
  -0.22797785]
 [ 0.68658505 -1.23614926  0.54958189 ...  1.09292517  0.41292533
   0.37134233]
 [-1.38848411  0.19817593  0.54958189 ...  1.67360322 -0.92690247
  -0.20144233]]
```

In [61]:

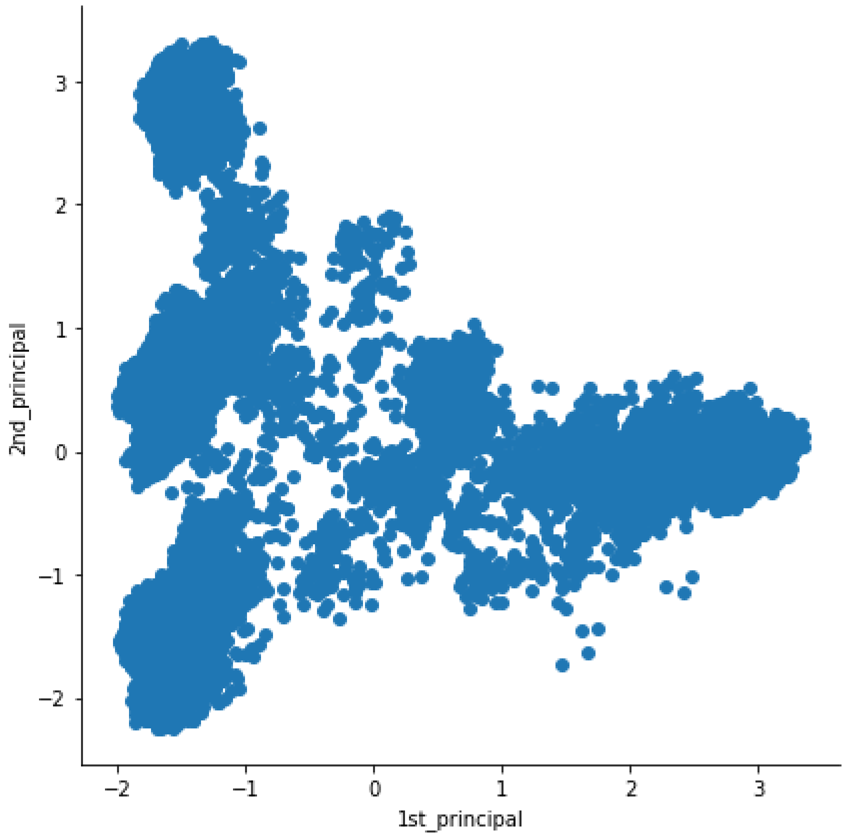
```
# initializing the pca
from sklearn import decomposition
pca = decomposition.PCA()

# configuring the parameteres
# the number of components = 2
pca.n_components = 2
pca_data = pca.fit_transform(standardized_data)

# pca_reduced will contain the 2-d projects of simple data
print("shape of pca_reduced.shape = ", pca_data.shape)
```

```
shape of pca_reduced.shape =  (30000, 2)
```

In [62]:

```
#attaching the label for each 2-d data point
#pca_data = np.vstack((pca_data.T)).T

# creating a new data fram which help us in ploting the result data
pca_df = pd.DataFrame(data=pca_data, columns=("1st_principal", "2nd_principal
sns.FacetGrid(pca_df, size=6).map(plt.scatter, '1st_principal', '2nd_principa
plt.show()
```

```
C:\Anaconda3\lib\site-packages\seaborn\axisgrid.py:243: UserWarning: The `s
ize` parameter has been renamed to `height`; please update your code.
  warnings.warn(msg, UserWarning)
```



In [63]:

```
pca_df.head(5)
```

Out[63]:

```
   1st_principal  2nd_principal
0       0.583424       0.496217
1       0.453279       0.423880
2       0.627452       0.524307
3       0.498005       0.676544
4       0.613907       0.563310
```

t-SNE using Scikit-Learn

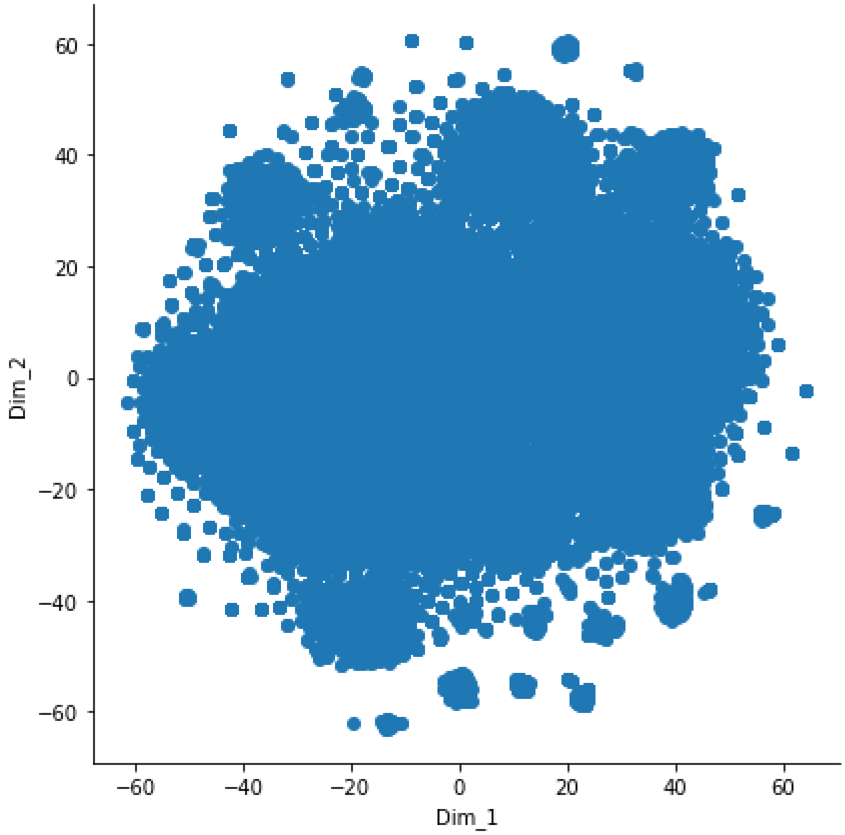
In [64]:

```
from sklearn.manifold import TSNE

data_1000 = standardized_data[0:30000,:]
```

In [65]:

```
# TSNE


model = TSNE(n_components=2, random_state=0)
# configuring the parameteres
# the number of components = 2
# default perplexity = 30
# default learning rate = 200
# default Maximum number of iterations for the optimization = 1000

tsne_data = model.fit_transform(data_1000)

# creating a new data frame which help us in ploting the result data
tsne_data = np.vstack((tsne_data.T)).T
tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2"))

# Ploting the result of tsne
sns.FacetGrid(tsne_df, size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_legend(
plt.show()
```

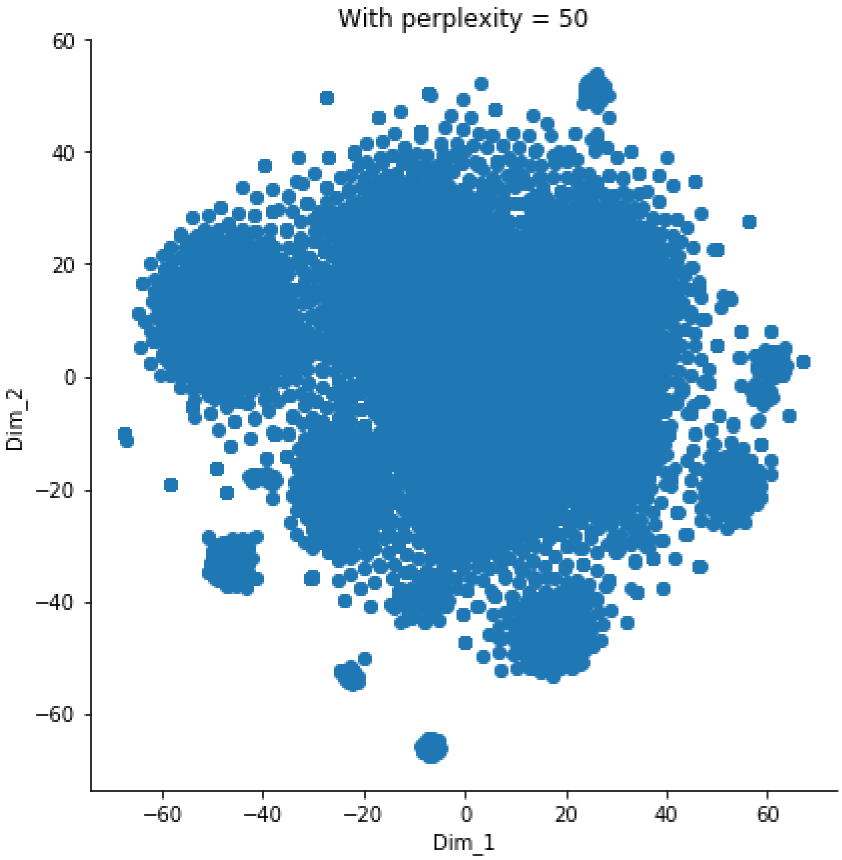
```
C:\Anaconda3\lib\site-packages\seaborn\axisgrid.py:243: UserWarning: The `s
ize` parameter has been renamed to `height`; please update your code.
  warnings.warn(msg, UserWarning)
```



In [34]:

```
model = TSNE(n_components=2, random_state=0, perplexity=50)
tsne_data = model.fit_transform(data_1000)

# creating a new data fram which help us in ploting the result data
tsne_data = np.vstack((tsne_data.T)).T
tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2"))

# Ploting the result of tsne
sns.FacetGrid(tsne_df, size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_legend(
plt.title('With perplexity = 50')
plt.show()
```

```
C:\Anaconda3\lib\site-packages\seaborn\axisgrid.py:243: UserWarning: The `s
ize` parameter has been renamed to `height`; please update your code.
  warnings.warn(msg, UserWarning)
```



In [35]:

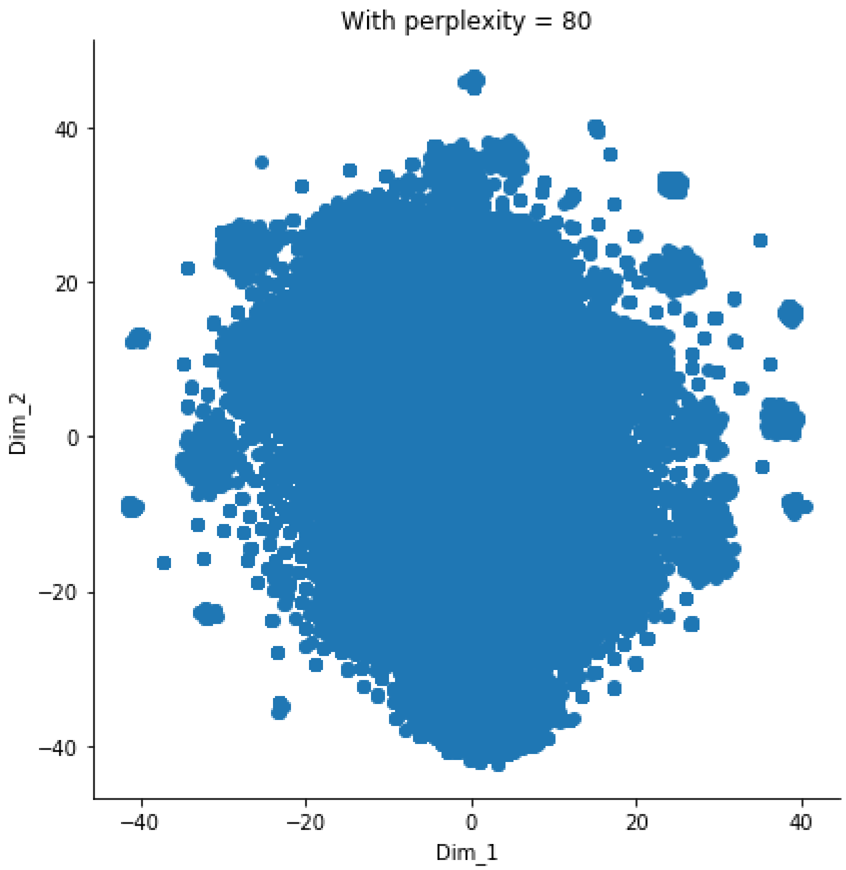
```
model = TSNE(n_components=2, random_state=0, perplexity=80,  n_iter=5000)
tsne_data = model.fit_transform(data_1000)

# creating a new data fram which help us in ploting the result data
tsne_data = np.vstack((tsne_data.T)).T
tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2"))

# Ploting the result of tsne
sns.FacetGrid(tsne_df, size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_legend(
plt.title('With perplexity = 50, n_iter=5000')
plt.show()
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
<ipython-input-35-b795e40bc274> in <module>
      7 
      8 # Ploting the result of tsne
----> 9 sn.FacetGrid(tsne_df, size=6).map(plt.scatter, 'Dim_1', 'Dim_2').ad
d_legend()
     10 plt.title('With perplexity = 50, n_iter=5000')
     11 plt.show()

NameError: name 'sn' is not defined
```

In [152]:

```
model = TSNE(n_components=2, random_state=0, perplexity=80)
tsne_data = model.fit_transform(data_1000)

# creating a new data fram which help us in ploting the result data
tsne_data = np.vstack((tsne_data.T)).T
tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2"))

# Ploting the result of tsne
sns.FacetGrid(tsne_df, size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_legend(
plt.title('With perplexity = 80')
plt.show()
```

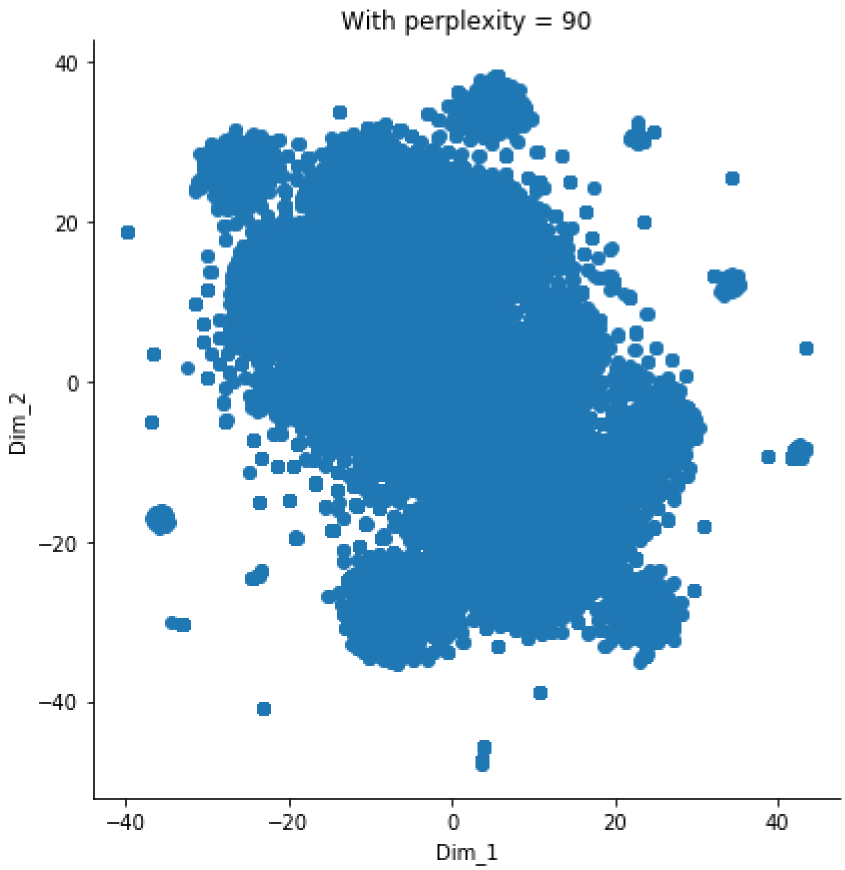
```
C:\Anaconda3\lib\site-packages\seaborn\axisgrid.py:243: UserWarning: The `s
ize` parameter has been renamed to `height`; please update your code.
  warnings.warn(msg, UserWarning)
```



In [66]:

```
model = TSNE(n_components=2, random_state=0, perplexity=100)
tsne_data = model.fit_transform(data_1000)

# creating a new data fram which help us in ploting the result data
tsne_data = np.vstack((tsne_data.T)).T
tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2"))

# Ploting the result of tsne
sns.FacetGrid(tsne_df, size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_legend(
plt.title('With perplexity = 90')
plt.show()
```

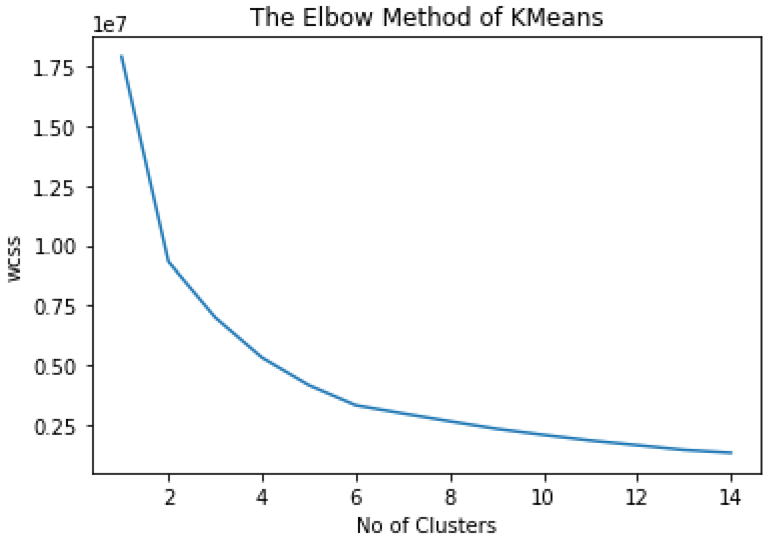
```
C:\Anaconda3\lib\site-packages\seaborn\axisgrid.py:243: UserWarning: The `s
ize` parameter has been renamed to `height`; please update your code.
  warnings.warn(msg, UserWarning)
```



KMeans

In [67]:

```
wcss=[]
for i in range(1,15):
    kmeans = KMeans(i, init='k-means++',random_state = 0);
    kmeans.fit(tsne_data);
    wcss.append(kmeans.inertia_)
plt.plot(range(1,15),wcss)
plt.title('The Elbow Method of KMeans')
plt.xlabel('No of Clusters')
plt.ylabel('wcss')
plt.show()
```



In [69]:

```
#Kmeans Model Build
n_clusters=6
kmeans = KMeans(n_clusters, init='k-means++',max_iter=100,n_init=1);
labels=kmeans.fit_predict(tsne_data)
print(labels)
```

```
[4 4 4 ... 4 4 4]
```

In [70]:

```
df1['Label']=labels
```

In [71]:

```
df1['Label'].value_counts()
#df1[df1['Label']==2]
```

Out[71]:

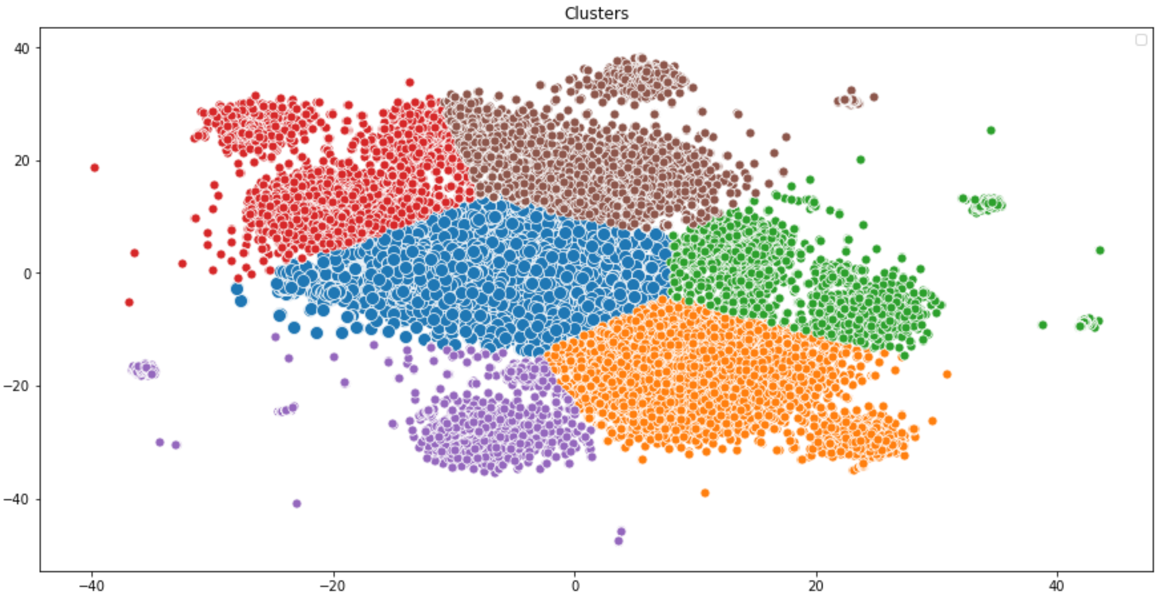
```
1    7115
0    6343
5    5164
3    4732
2    3679
4    2967
Name: Label, dtype: int64
```

```
In [72]:  #Dunn Index
          print(davies_bouldin_score(tsne_data, labels))
```

```
0.8161243402684583
```

```
In [73]:  plt.figure(figsize=(15,7.5))
          sns.scatterplot(tsne_data[labels == 0, 0], tsne_data[labels == 0, 1],s=100)
          sns.scatterplot(tsne_data[labels == 1, 0], tsne_data[labels == 1, 1],s=50)
          sns.scatterplot(tsne_data[labels == 2, 0], tsne_data[labels == 2, 1],s=50)
          sns.scatterplot(tsne_data[labels == 3, 0], tsne_data[labels == 3, 1],s=50)
          sns.scatterplot(tsne_data[labels == 4, 0], tsne_data[labels == 4, 1],s=50)
          sns.scatterplot(tsne_data[labels == 5, 0], tsne_data[labels == 5, 1],s=50)

          plt.title('Clusters')
          plt.legend()
          plt.show()
```

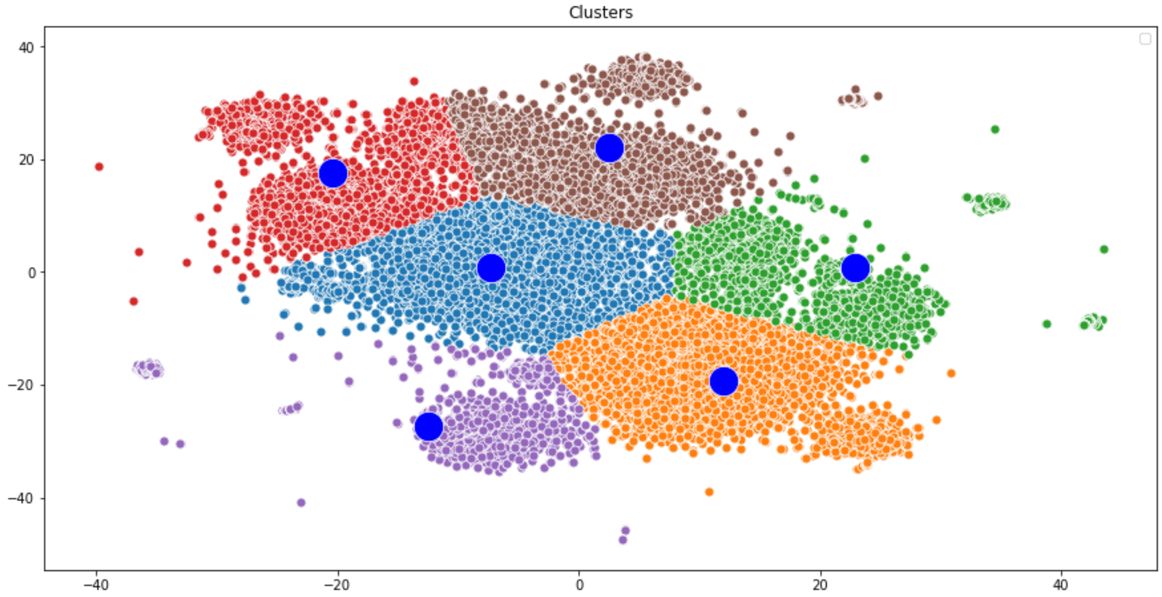
```
No handles with labels found to put in legend.
```



In [74]:

```
plt.figure(figsize=(15,7.5))
sns.scatterplot(tsne_data[labels == 0, 0], tsne_data[labels == 0, 1],s=50)
sns.scatterplot(tsne_data[labels == 1, 0], tsne_data[labels == 1, 1],s=50)
sns.scatterplot(tsne_data[labels == 2, 0], tsne_data[labels == 2, 1],s=50)
sns.scatterplot(tsne_data[labels == 3, 0], tsne_data[labels == 3, 1],s=50)
sns.scatterplot(tsne_data[labels == 4, 0], tsne_data[labels == 4, 1],s=50)
sns.scatterplot(tsne_data[labels == 5, 0], tsne_data[labels == 5, 1],s=50)
sns.scatterplot(kmeans.cluster_centers_[:, 0], kmeans.cluster_centers_[:, 1],
plt.title('Clusters')
plt.legend()
plt.show()
```

```
No handles with labels found to put in legend.
```



In [75]:

```
# Chekcing the Cluster Centers
centers = kmeans.cluster_centers_
centers
```

Out[75]:

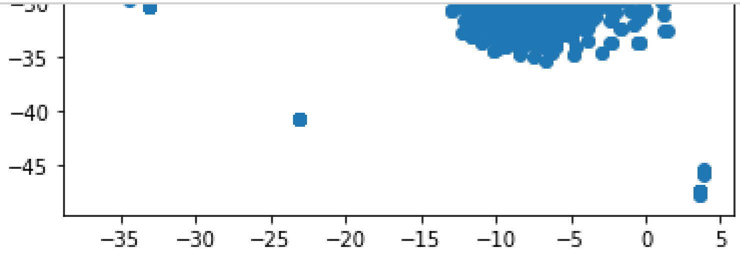
```
array([[ -7.3164907,   0.8667649],
       [ 11.985182 , -19.31039  ],
       [ 22.928114 ,   0.8713355],
       [-20.437199 ,  17.587053 ],
       [-12.436749 , -27.249508 ],
       [  2.521269 ,  22.0606   ]], dtype=float32)
```

In [77]:

```
# Final output
df1.to_csv('C:/Users/KARTDH/Desktop/DAW/Cluster POC/FailedSearchClusterMLOutp
#df1.describe()
```

In [78]:

```
labels = kmeans.labels_
centroids = kmeans.cluster_centers_

for i in range(8):
    # select only data observations with cluster label == i
    ds = tsne_data[np.where(labels==i)]
    # plot the data observations
    plt.plot(ds[:,0],ds[:,1],'o')
    # plot the centroids
    lines = plt.plot(centroids[i,0],centroids[i,1],'kx')
    # make the centroid x's bigger
    plt.setp(lines,ms=15.0)
    plt.setp(lines,mew=2.0)
    plt.show()

result = zip(tsne_data , kmeans.labels_)

sortedR = sorted(result, key=lambda x: x[1])
sortedR
```


−30
−35
−40
−45
−35
−30
−25
−20
−15
−10
−5
0
5