In [40]:
```
import pandas
import numpy as np
```

In [41]:
```
ODAQ_results = pandas.read_csv('./ODAQ/ODAQ_listening_test/ODAQ_result
ODAQ_results_BSU1 = pandas.read_csv('./ODAQ_v1_BSU/Cohort_B1_results.c
ODAQ_results_BSU2 = pandas.read_csv('./ODAQ_v1_BSU/Cohort_B2_results.c
```

In [42]:
```
ODAQ_results
```

Out[42]:

	score	method	condition	process	item	subject
0	47.0	LP	LP3.5	LP35	LP_11_guitar	Subject 1: USLA08
1	5.0	LP	LP3.5	LP35	LP_11_guitar	Subject 2: DEID44
2	10.0	LP	LP3.5	LP35	LP_11_guitar	Subject 3: DEID1115
3	20.0	LP	LP3.5	LP35	LP_11_guitar	Subject 4: DEID337
4	30.0	LP	LP3.5	LP35	LP_11_guitar	Subject 5: USLA06
...	...	...	...	...	...	...
6235	100.0	DE	Ref	reference	DE_SitaSings_remix2_LD6	Subject 22: DEID2
6236	100.0	DE	Ref	reference	DE_SitaSings_remix2_LD6	Subject 23: USLA01
6237	100.0	DE	Ref	reference	DE_SitaSings_remix2_LD6	Subject 24: USLA05
6238	100.0	DE	Ref	reference	DE_SitaSings_remix2_LD6	Subject 25: DEID1
6239	100.0	DE	Ref	reference	DE_SitaSings_remix2_LD6	Subject 26: DEID3

6240 rows × 6 columns

In [43]:

```
methods = ODAQ_results['method'].unique()
conditions = ODAQ_results['condition'].unique()
processes = ODAQ_results['process'].unique()
items = ODAQ_results['item'].unique()

print(methods)
print(conditions)
print(processes)
print(items)
```

```
['LP' 'TM' 'UN' 'SH' 'PE' 'DE']
['LP3.5' 'LP7' 'Q1' 'Q2' 'Q3' 'Q4' 'Q5' 'Ref']
['LP35' 'LP70' 'LP50' 'LP90' 'LP105' 'LP120' 'LP150' 'reference' 'TM3k'
 'TM5k' 'TM7k' 'TM9k' 'TM10.5k' 'UN3k' 'UN5k' 'UN7k' 'UN9k' 'UN10.5k'
 'SH70_MS' 'SH50_MS' 'SH30_MS' 'SH20_MS' 'SH10_MS' 'PE_4096_MS_NMR10'
 'PE_2048_MS_NMR10' 'PE_1024_MS_NMR10' 'PE_2048_MS_NMR16'
 'PE_1024_MS_NMR16' 'OpenUnmix_mid' 'TFC_TDF_U_Net_mid' 'Cocktail_mid'
 'DeepFilterNet2_mid' 'PSM_quantize_mask']
['LP_11_guitar' 'LP_23_jazz' 'LP_AmateurOnPurpose'
 'LP_CreatureFromTheBlackjackTable' 'TM_01b_trumpet' 'TM_02_violin'
 'TM_AmateurOnPurpose' 'TM_CreatureFromTheBlackjackTable'
 'UN_20c_accordion' 'UN_21_violin' 'UN_AmateurOnPurpose'
 'UN_CreatureFromTheBlackjackTable' 'SH_04_choral' 'SH_13_glockenspiel'
 'SH_AmateurOnPurpose' 'SH_CreatureFromTheBlackjackTable'
 'PE_27_castanets' 'PE_39_clapping' 'PE_AmateurOnPurpose'
 'PE_CreatureFromTheBlackjackTable' 'DE_CosmosLandromat_remix1_LD6'
 'DE_CosmosLandromat_remix3_LD3' 'DE_ElephantsDream_LD0'
 'DE_female_speech_music_1_LD0' 'DE_female_speech_music_2_LD9'
 'DE_female_speech_music_3_LD3' 'DE_Meridian_remix1_LD3'
 'DE_Meridian_remix2_LD6' 'DE_SitaSings_remix1_LD0'
 'DE_SitaSings_remix2_LD6']
```

In [44]:

```python
# Get unique subjects from ODAQ_results
unique_subjects = ODAQ_results['subject'].unique()

print(unique_subjects)

# Dynamically create expert variables
for i, subject in enumerate(unique_subjects, start=1):
    globals()[f"expert{i}"] = ODAQ_results[ODAQ_results['subject'] ==
```

```
['Subject 1: USLA08' 'Subject 2: DEID44' 'Subject 3: DEID1115'
 'Subject 4: DEID337' 'Subject 5: USLA06' 'Subject 6: DEID5'
 'Subject 7: DEID9' 'Subject 8: DEID4' 'Subject 9: USLG04'
 'Subject 10: USLA04' 'Subject 11: USLA07' 'Subject 12: DEID256'
 'Subject 13: DEID6' 'Subject 14: USLG05' 'Subject 15: USLA09'
 'Subject 16: USLG02' 'Subject 17: USLG03' 'Subject 18: DEID7'
 'Subject 19: USLA12' 'Subject 20: DEID10' 'Subject 21: DEID8'
 'Subject 22: DEID2' 'Subject 23: USLA01' 'Subject 24: USLA05'
 'Subject 25: DEID1' 'Subject 26: DEID3']
```

In [45]:

```python
# Initialize score lists dynamically for 26 experts
for i in range(1, 27):  # Assuming 26 experts
    globals()[f"expert{i}_scores"] = []

# Append scores systematically
for item in items:
    for i in range(1, 27):
        expert_df = globals()[f"expert{i}"]  # Access expert data fram
        scores = expert_df[expert_df['item'] == item]['score'].values
        globals()[f"expert{i}_scores"].append(scores)
```

In [46]:

```python
# Function to compute rankings with penalty for ties
```

```python
def competition_ranking(scores):
    """Returns competition-style rankings (ascending order), where tie

    sorted_indices = np.argsort(scores)  # Sort in ascending order
    ranks = np.zeros_like(scores, dtype=int)

    rank = 1  # Start ranking from 1
    for i in range(len(scores)):
        if i > 0 and scores[sorted_indices[i]] == scores[sorted_indice
            ranks[sorted_indices[i]] = ranks[sorted_indices[i - 1]]  #
        else:
            ranks[sorted_indices[i]] = rank  # Assign new rank

        rank += 1  # Increment rank, ensuring skipped positions for ti

    return ranks
```

In [47]:

```python
# Compute rankings systematically for 26 experts
for i in range(1, 27):  # Assuming 26 experts
    expert_scores = globals()[f"expert{i}_scores"]  # Get the score li
    globals()[f"expert{i}_rankings"] = np.array([competition_ranking(r
```

In [48]:

```python
expert1_scores
```

Out[48]:
```
[array([ 47.,  66.,  56.,  76.,  90., 100.,  91.,  94.]),
 array([ 17.,  50.,  35.,  46., 100., 100., 100., 100.]),
 array([ 13.,  43.,  35.,  55.,  53., 100.,  78., 100.]),
 array([ 38.,  60.,  47.,  73.,  83., 100.,  92.,  92.]),
 array([ 22.,  53.,  44.,  60.,  69.,  78., 100.,  82.]),
 array([ 25.,  43.,  13.,  50.,  57.,  63.,  68., 100.]),
 array([ 11.,  38.,  37.,  54.,  71.,  81.,  79., 100.]),
 array([ 18.,  42.,  28.,  39.,  77.,  49.,  72., 100.]),
 array([ 55.,  74.,  40.,  54.,  62.,  74., 100.,  85.]),
 array([ 35.,  68.,  16.,  44.,  52.,  87., 100., 100.]),
 array([ 25.,  42.,  59.,  79.,  75.,  89.,  60., 100.]),
 array([ 16.,  32.,  64.,  85., 100., 100., 100., 100.]),
 array([ 37.,  65.,  12.,  27.,  32.,  32.,  37., 100.]),
 array([ 15.,  66.,  18.,  26.,  40.,  52.,  56., 100.]),
 array([ 37.,  58.,  49.,  69.,  66.,  78.,  87., 100.]),
 array([ 17.,  42.,  11.,  20.,  29.,  43.,  77., 100.]),
 array([ 46.,  72.,  32.,  65.,  37.,  61.,  74., 100.]),
 array([ 45.,  78.,  15.,  29.,  47.,  37.,  49., 100.]),
 array([ 17.,  30.,  63.,  61.,  37.,  78., 100., 100.]),
 array([ 44.,  63.,  67.,  74.,  80.,  83.,  83., 100.]),
 array([ 20.,  36.,  18.,  45.,  55.,  74., 100.,  85.]),
 array([ 26.,  51.,  18.,  35.,  59.,  60.,  82., 100.]),
 array([ 13.,  63.,  43.,  62.,  59.,  60.,  75., 100.]),
 array([ 22.,  52.,  28.,  38.,  28.,  32.,  85., 100.]),
 array([ 17.,  40.,  29.,  76.,  51.,  75., 100., 100.]),
 array([ 14.,  45.,  25.,  48.,  62.,  56.,  82., 100.]),
 array([ 59.,  84.,  48.,  62.,  67.,  80.,  87., 100.]),
 array([ 32.,  81.,  33.,  42.,  53.,  74.,  75., 100.]),
 array([ 34.,  54.,  37.,  61.,  69.,  79.,  90., 100.]),
 array([ 21.,  64.,  29.,  44.,  60.,  74.,  65., 100.])]
```

In [49]:
```
expert1_rankings
```

Out[49]:
```
array([[1, 3, 2, 4, 5, 8, 6, 7],
       [1, 4, 2, 3, 5, 5, 5, 5],
       [1, 3, 2, 5, 4, 7, 6, 7],
       [1, 3, 2, 4, 5, 8, 6, 6],
       [1, 3, 2, 4, 5, 6, 8, 7],
       [2, 3, 1, 4, 5, 6, 7, 8],
       [1, 3, 2, 4, 5, 7, 6, 8],
       [1, 4, 2, 3, 7, 5, 6, 8],
       [3, 5, 1, 2, 4, 5, 8, 7],
       [2, 5, 1, 3, 4, 6, 7, 7],
       [1, 2, 3, 6, 5, 7, 4, 8],
       [1, 2, 3, 4, 5, 5, 5, 5],
       [5, 7, 1, 2, 3, 3, 5, 8],
       [1, 7, 2, 3, 4, 5, 6, 8],
       [1, 3, 2, 5, 4, 6, 7, 8],
       [2, 5, 1, 3, 4, 6, 7, 8],
       [3, 6, 1, 5, 2, 4, 7, 8],
       [4, 7, 1, 2, 5, 3, 6, 8],
       [1, 2, 5, 4, 3, 6, 7, 7],
       [1, 2, 3, 4, 5, 6, 6, 8],
       [2, 3, 1, 4, 5, 6, 8, 7],
       [2, 4, 1, 3, 5, 6, 7, 8],
       [1, 6, 2, 5, 3, 4, 7, 8],
       [1, 6, 2, 5, 2, 4, 7, 8],
       [1, 3, 2, 6, 4, 5, 7, 7],
       [1, 3, 2, 4, 6, 5, 7, 8],
       [2, 6, 1, 3, 4, 5, 7, 8],
       [1, 7, 2, 3, 4, 5, 6, 8],
       [1, 3, 2, 4, 5, 6, 7, 8],
       [1, 5, 2, 3, 4, 7, 6, 8]])
```

In [51]:
```python
# Perfect ranking
perfect_ranking = np.array([1, 2, 3, 4, 5, 6, 7, 8])
```

In [52]:
```python
# Define a distance function (Euclidean distance)
def compute_distance(vec1, vec2):
    return np.linalg.norm(vec1 - vec2)  # Euclidean distance
```

For $\mathbf{v}_1 = [v_{1,1}, v_{1,2}, \ldots, v_{1,n}]$ and $\mathbf{v}_2 = [v_{2,1}, v_{2,2}, \ldots, v_{2,n}]$, with $n = 8$, we compute the euclidean distance between them as follows:

$$d(\mathbf{v}_1, \mathbf{v}_2) = \sqrt{\sum_{i=1}^{n} (v_{1,i} - v_{2,i})^2}$$

In [53]:
```python
# Initialize a 26x30 matrix to store distances
distance_matrix = np.zeros((26, 30))

# Compute distances systematically
for i in range(1, 27):  # 26 experts
```

```
    expert_rankings = globals()[f"expert{i}_rankings"]  # Get expert r

    for j in range(30):  # 30 ranking vectors per expert
        distance_matrix[i-1, j] = compute_distance(expert_rankings[j],

distance_matrix_df = pandas.DataFrame(distance_matrix, columns=items)
```

In [54]:
```
distance_matrix_df
```

Out[54]:

	LP_11_guitar	LP_23_jazz	LP_AmateurOnPurpose	LP_CreatureFromTheBlack
0	2.828427	4.472136	2.645751	
1	2.645751	1.414214	1.414214	
2	3.162278	2.449490	2.000000	
3	3.162278	1.732051	4.000000	
4	3.316625	2.645751	1.000000	
5	1.732051	1.732051	2.645751	
6	1.414214	2.000000	2.000000	
7	1.414214	1.414214	2.828427	
8	4.898979	2.828427	1.414214	
9	1.732051	3.872983	1.414214	
10	1.414214	2.236068	2.000000	
11	3.316625	3.162278	3.464102	
12	2.000000	2.000000	1.414214	
13	3.000000	5.000000	3.605551	
14	2.828427	2.828427	2.449490	
15	5.656854	2.645751	3.605551	
16	2.236068	2.236068	1.732051	
17	1.414214	3.162278	1.000000	
18	1.414214	3.000000	4.358899	
19	2.000000	2.000000	1.732051	
20	2.000000	2.828427	2.000000	
21	4.000000	3.316625	2.828427	
22	1.732051	2.828427	1.414214	
23	1.414214	3.464102	2.645751	
24	2.645751	4.000000	2.645751	
25	4.358899	3.316625	3.464102	

26 rows × 30 columns

In [55]:

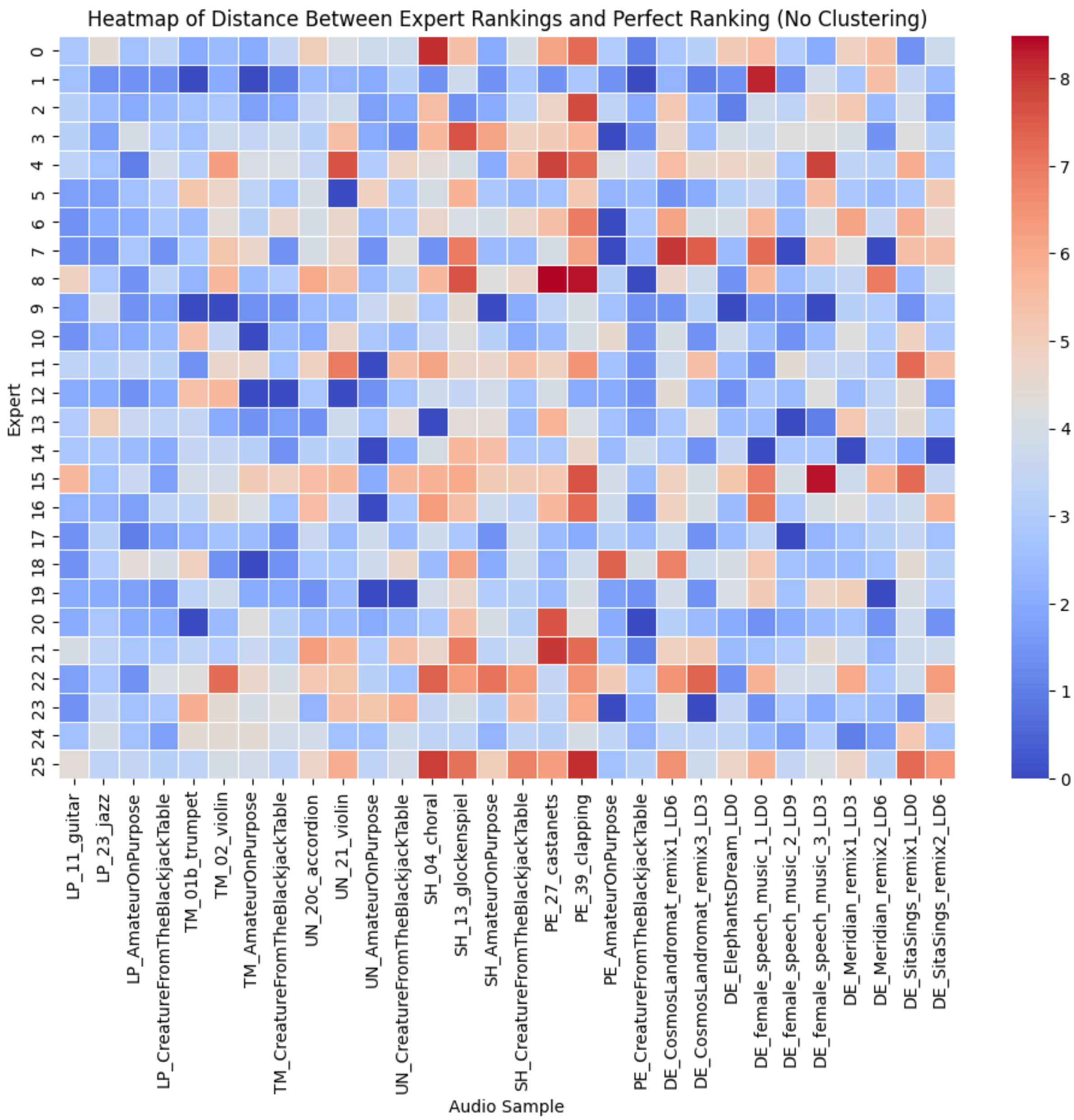
```
import matplotlib.pyplot as plt
import seaborn as sns
```

```
import numpy as np
import pandas as pd


# Create a heatmap
plt.figure(figsize=(12, 8))
sns.heatmap(distance_matrix_df, cmap="coolwarm", annot=False, linewidt

# Labels and title
plt.xlabel("Audio Sample")
plt.ylabel("Expert")
plt.title("Heatmap of Distance Between Expert Rankings and Perfect Ran

# Show the plot
plt.show()
```



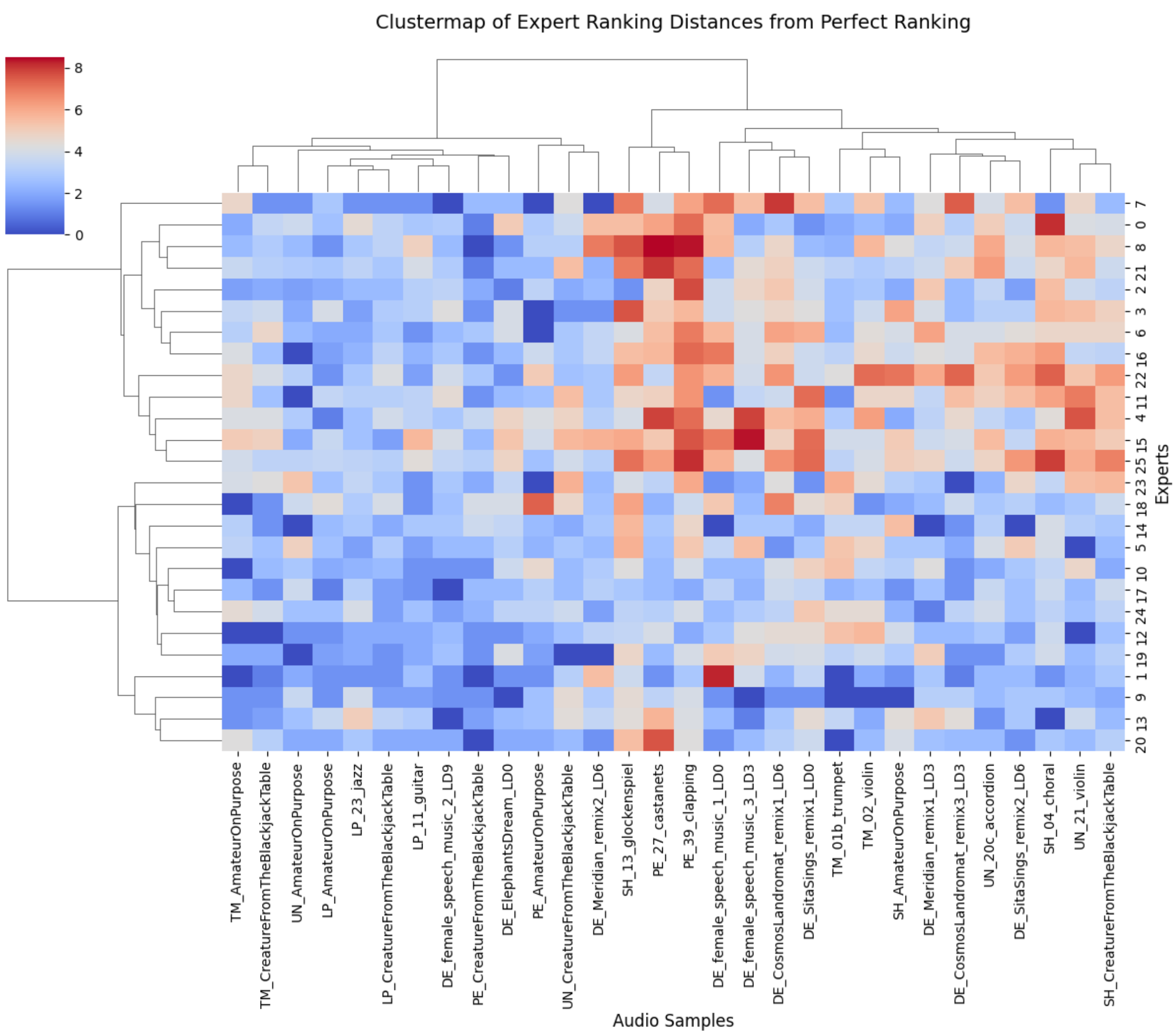
In [56]:
```
from scipy.cluster.hierarchy import linkage, dendrogram
```

```
# Perform hierarchical clustering (using Ward's method)
linkage_matrix = linkage(distance_matrix, method='ward')

# Create a clustermap (heatmap with hierarchical clustering)
clustermap = sns.clustermap(
    distance_matrix_df,
    cmap="coolwarm",
    method="ward",
    figsize=(12, 10),
    xticklabels=True,  # Display column labels (optional)
    yticklabels=True   # Display row labels (optional)
)

# Add axis labels
clustermap.ax_heatmap.set_xlabel("Audio Samples", fontsize=12)
clustermap.ax_heatmap.set_ylabel("Experts", fontsize=12)
clustermap.ax_heatmap.set_title("Clustermap of Expert Ranking Distance

# Show the plot
plt.show()
```



In [57]:
```
# PERFORMANCE-BASED CLUSTERING
```

```
from scipy.cluster.hierarchy import fcluster

# Extract clusters from the linkage matrix
num_clusters = 5  # Choose the number of clusters (you can adjust)
cluster_labels = fcluster(linkage_matrix, num_clusters, criterion='max

# Create a DataFrame mapping experts to their cluster
cluster_df = pd.DataFrame({'Expert': [f"Expert {i}" for i in range(1,
                           'Cluster': cluster_labels})

cluster_df
```

Out[57]:

	Expert	Cluster
0	Expert 1	1
1	Expert 2	5
2	Expert 3	1
3	Expert 4	1
4	Expert 5	2
5	Expert 6	4
6	Expert 7	1
7	Expert 8	3
8	Expert 9	1
9	Expert 10	5
10	Expert 11	4
11	Expert 12	2
12	Expert 13	4
13	Expert 14	5
14	Expert 15	4
15	Expert 16	2
16	Expert 17	1
17	Expert 18	4
18	Expert 19	4
19	Expert 20	4
20	Expert 21	5
21	Expert 22	1
22	Expert 23	2
23	Expert 24	4
24	Expert 25	4
25	Expert 26	2

In [58]:

```
# order cluster_df by Cluster

cluster_df_ordered = cluster_df.sort_values(by='Cluster')

cluster_df_ordered
```

Out[58]:

	Expert	Cluster
0	Expert 1	1
2	Expert 3	1
3	Expert 4	1
21	Expert 22	1
16	Expert 17	1
6	Expert 7	1
8	Expert 9	1
22	Expert 23	2
15	Expert 16	2
11	Expert 12	2
25	Expert 26	2
4	Expert 5	2
7	Expert 8	3
24	Expert 25	4
14	Expert 15	4
5	Expert 6	4
17	Expert 18	4
18	Expert 19	4
19	Expert 20	4
23	Expert 24	4
10	Expert 11	4
12	Expert 13	4
9	Expert 10	5
13	Expert 14	5
20	Expert 21	5
1	Expert 2	5

In [59]:

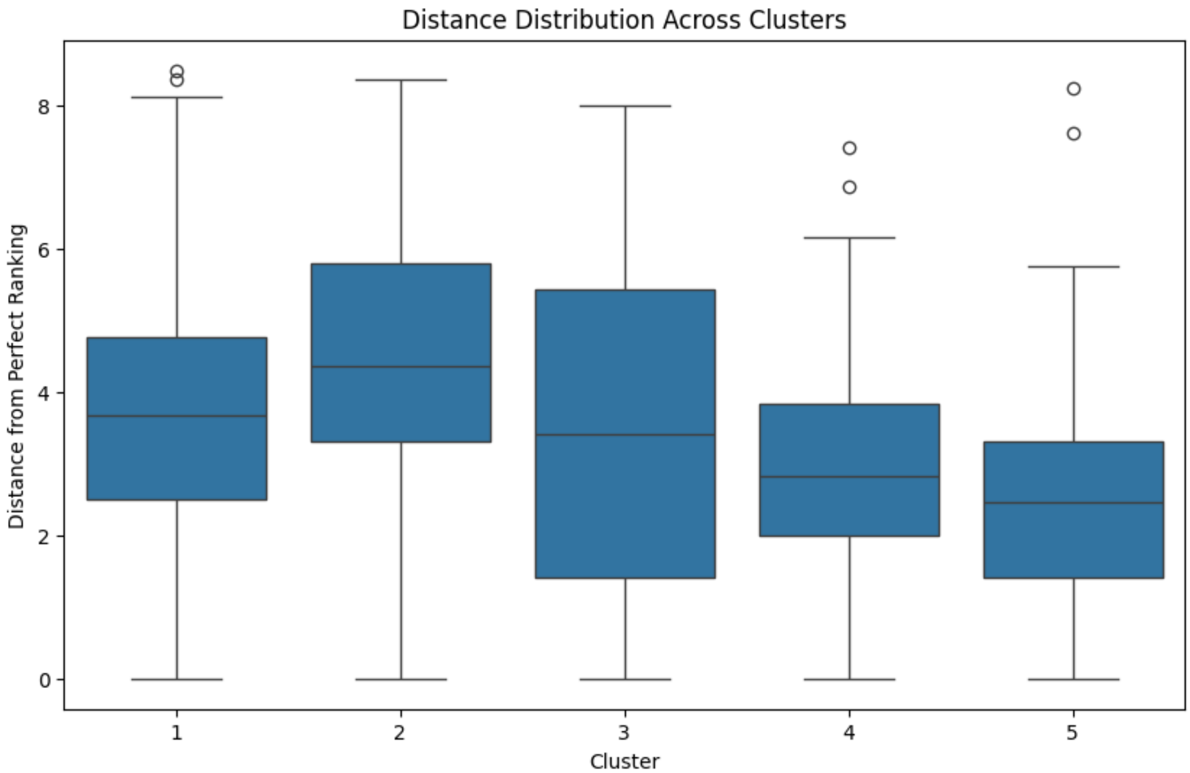
```
import seaborn as sns
import matplotlib.pyplot as plt

# Add cluster labels to the distance matrix
```

```
distance_matrix_df['Cluster'] = cluster_labels

# Melt data for visualization
melted_df = distance_matrix_df.melt(id_vars=['Cluster'], var_name='Ran

# Plot the distribution of distances per cluster
plt.figure(figsize=(10, 6))
sns.boxplot(x='Cluster', y='Distance', data=melted_df)
plt.xlabel("Cluster")
plt.ylabel("Distance from Perfect Ranking")
plt.title("Distance Distribution Across Clusters")
plt.show()
```



In [60]:
```
# Example: Find which experts belong to Cluster 1
cluster_1_experts = cluster_df[cluster_df['Cluster'] == 1]
print(cluster_1_experts)
```

```
       Expert  Cluster
0    Expert 1        1
2    Expert 3        1
3    Expert 4        1
6    Expert 7        1
8    Expert 9        1
16  Expert 17        1
21  Expert 22        1
```