Visual Analysis of Key Phrase Frequencies over the Years

In [1]:

```python
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

Importing CSV Files

In [2]:

```python
df_total = pd.read_csv("data/total_phrase_frequencies.csv")
df_yearly = pd.read_csv("data/yearly_phrase_frequencies.csv")
```

In [3]:

```python
df_total.head()
```

Out[3]:

	Phrase	Total Frequency
0	training	396
1	administrative capacities	207
2	public administration reform	112
3	human resource(s)	87
4	civil servants	58

In [4]:

```python
df_yearly.head()
```

Out[4]:

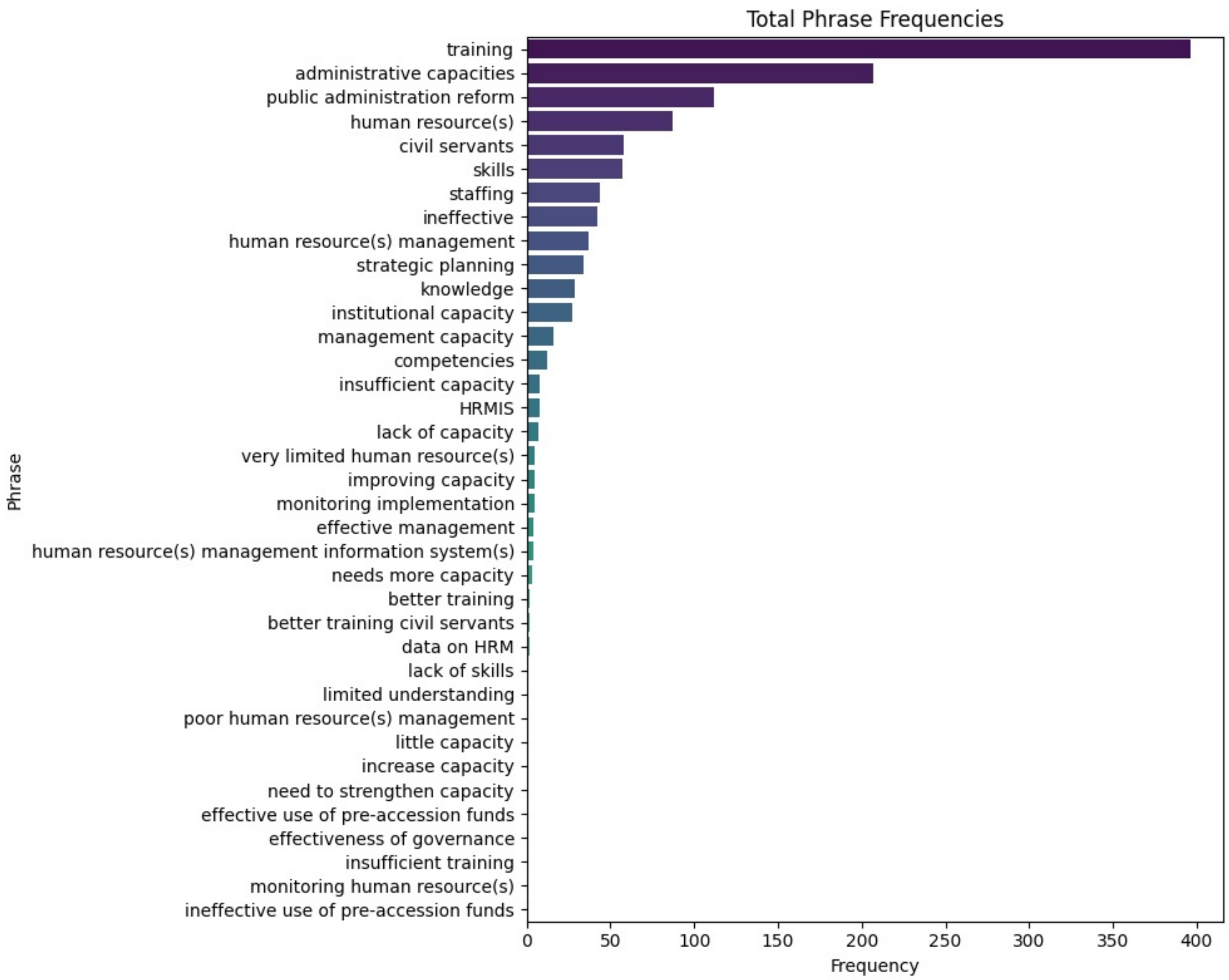
	Phrase	2005	2014	2015	2016	2018	2019	2020	2021	2022	2023	2024
0	human resource(s)	4	8	4	6	5	16	7	8	9	13	7
1	human resource(s) management	0	3	3	3	1	5	4	4	3	7	4
2	poor human resource(s) management	0	0	0	0	0	0	0	0	0	1	0
3	monitoring human resource(s)	0	0	0	0	0	0	0	0	0	0	0
4	very limited human resource(s)	0	0	0	0	0	1	1	1	1	1	0

Bar Chart

Horizontal Bar Chart

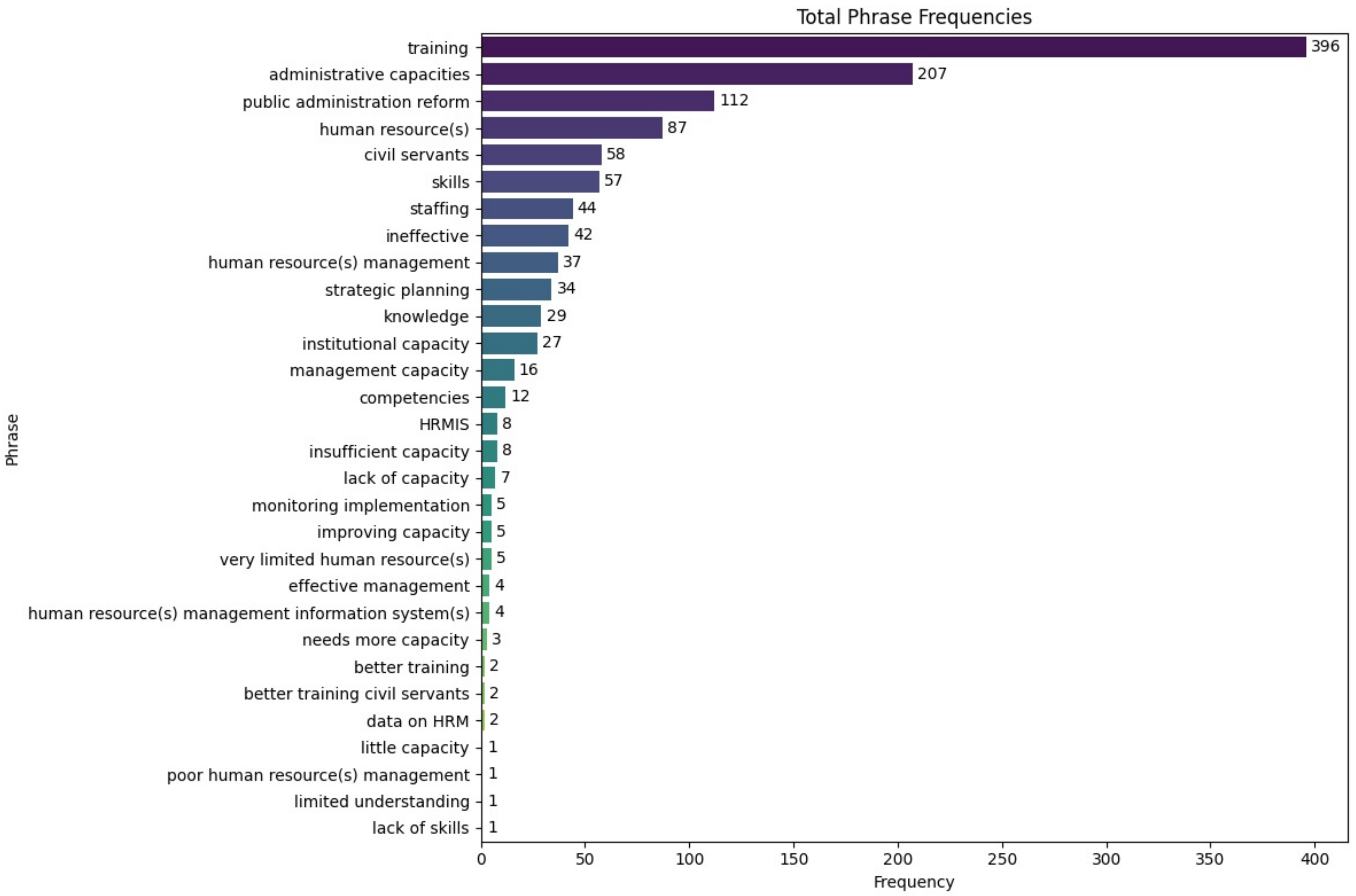
In [5]:

```python
plt.figure(figsize=(10, 8))
sns.barplot(
    data=df_total.sort_values(by="Total Frequency", ascending=False),
    x="Total Frequency",
    y="Phrase",
    hue="Phrase",
    legend=False,
    palette="viridis"
)
plt.title("Total Phrase Frequencies")
plt.xlabel("Frequency")
plt.ylabel("Phrase")
plt.tight_layout()
plt.show()
```



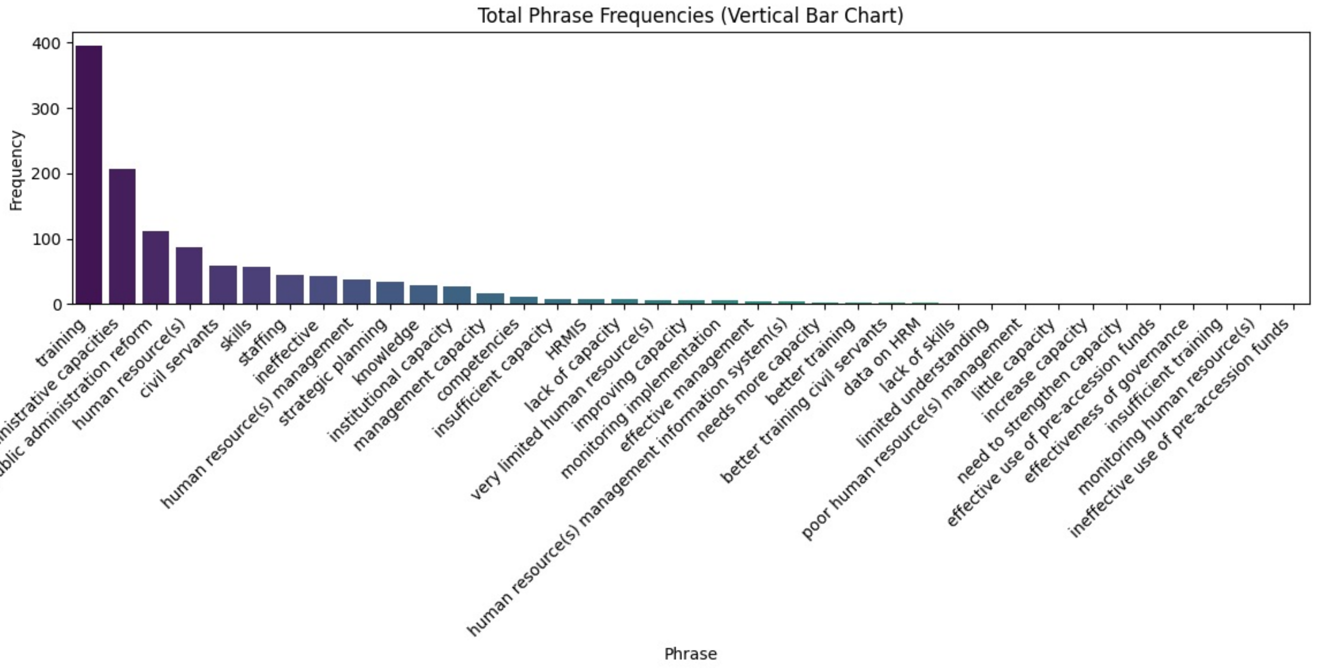
In [18]:

```
plt.figure(figsize=(12, 8))

df_filtered_total = df_total[df_total["Total Frequency"] > 0].sort_values(by="Total Frequency", ascending=False

ax = sns.barplot(
    data=df_filtered_total,
    x="Total Frequency",
    y="Phrase",
    hue="Phrase",
    legend=False,
    palette="viridis"
)

plt.title("Total Phrase Frequencies")
plt.xlabel("Frequency")
plt.ylabel("Phrase")

# Add labels next to bars
for container in ax.containers:
    ax.bar_label(container, fmt="%d", label_type="edge", padding=3)

plt.tight_layout()
plt.show()
```



Vertical Bar Chart

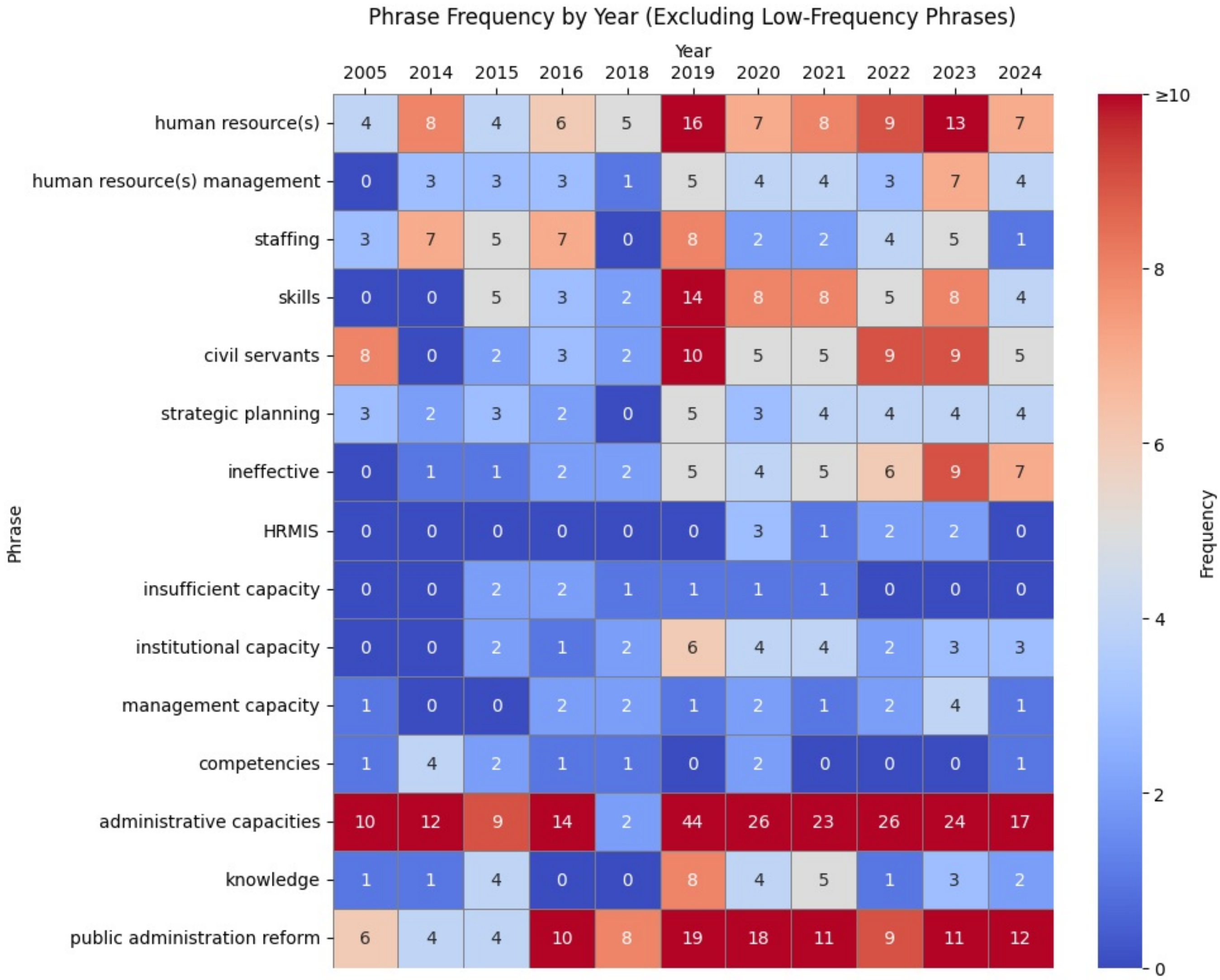
```
In [6]: plt.figure(figsize=(12, 6))
        sns.barplot(
            data=df_total.sort_values(by="Total Frequency", ascending=False),
            x="Phrase",
            y="Total Frequency",
            hue="Phrase",
            legend=False,
            palette="viridis"
        )
        plt.title("Total Phrase Frequencies (Vertical Bar Chart)")
        plt.xlabel("Phrase")
        plt.ylabel("Frequency")
        plt.xticks(rotation=45, ha="right")
        plt.tight_layout()
        plt.show()
```



Heatmap

In [7]:

```
filtered_phrases = df_total[df_total["Total Frequency"] > 7]["Phrase"] # 8 or more occurences
filtered_phrases = filtered_phrases[filtered_phrases.str.lower() != "training"]
df_filtered = df_yearly[df_yearly["Phrase"].isin(filtered_phrases)]
df_heatmap = df_filtered.set_index("Phrase")

plt.figure(figsize=(10, 8))
ax = sns.heatmap(
    df_heatmap,
    cmap="coolwarm",
    linewidths=0.5,
    linecolor='gray',
    annot=True,
    fmt="d",
    cbar_kws={"label": "Frequency"},
    vmin=0,
    vmax=10
)

colorbar = ax.collections[0].colorbar
ticks = colorbar.get_ticks()
tick_labels = [str(int(t)) for t in ticks]
tick_labels[-1] = "≥" + tick_labels[-1]
colorbar.set_ticks(ticks)
colorbar.set_ticklabels(tick_labels)

ax.xaxis.tick_top()
ax.xaxis.set_label_position('top')
plt.title("Phrase Frequency by Year (Excluding Low-Frequency Phrases)", pad=40)
plt.xlabel("Year")
plt.ylabel("Phrase")
plt.tight_layout()
plt.show()
```

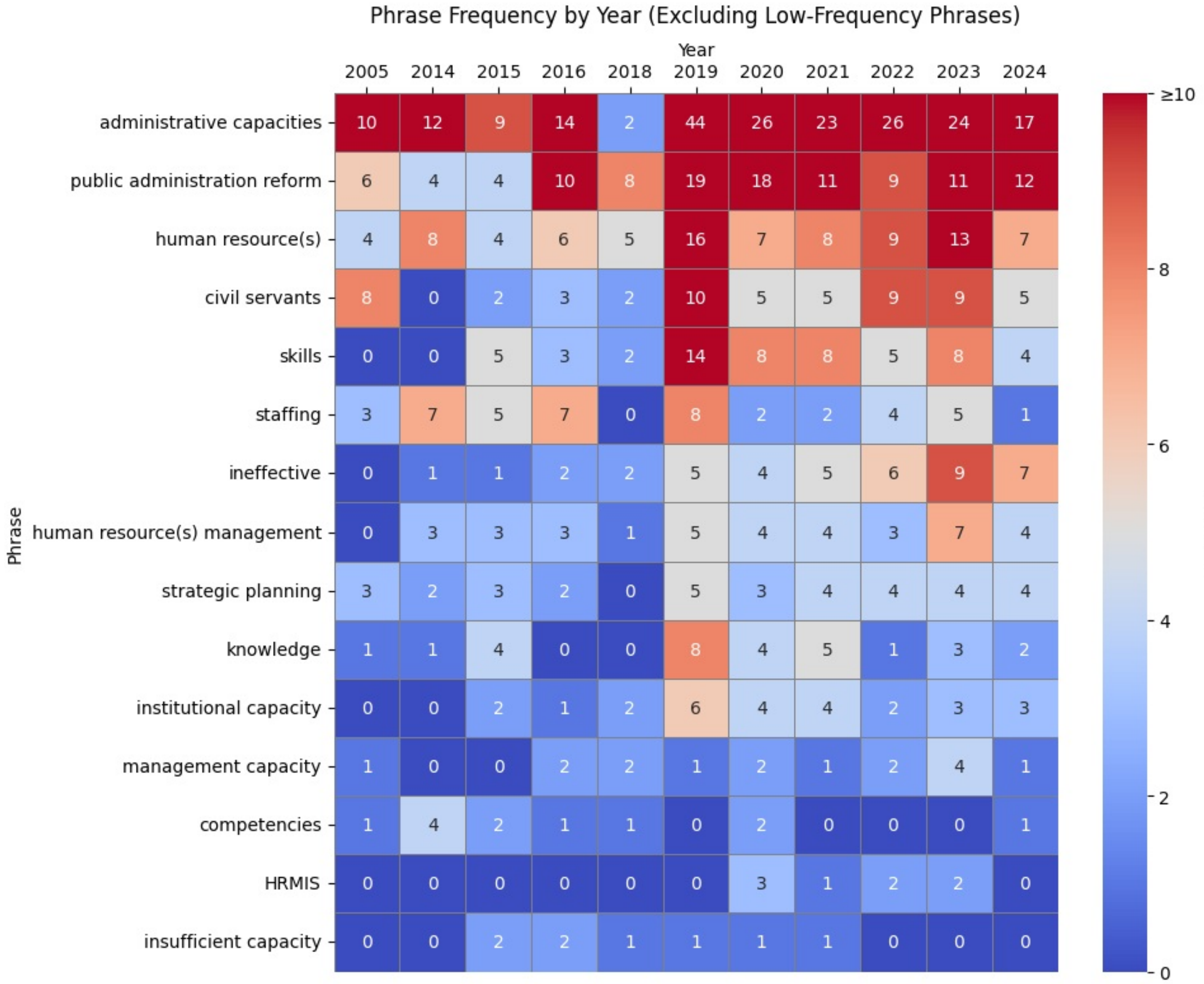


Heatmap Sorted

In [8]:

```
filtered_phrases = df_total[df_total["Total Frequency"] > 7]["Phrase"]
filtered_phrases = filtered_phrases[filtered_phrases.str.lower() != "training"]
df_filtered = df_yearly[df_yearly["Phrase"].isin(filtered_phrases)]
```

```python
df_heatmap = df_filtered.set_index("Phrase")

df_heatmap = df_heatmap.loc[df_heatmap.sum(axis=1).sort_values(ascending=False).index]  # sort rows by total fr

plt.figure(figsize=(10, 8))
ax = sns.heatmap(
    df_heatmap,
    cmap="coolwarm",
    linewidths=0.5,
    linecolor='gray',
    annot=True,
    fmt="d",
    cbar_kws={"label": "Frequency"},
    vmin=0,
    vmax=10
)

colorbar = ax.collections[0].colorbar
ticks = colorbar.get_ticks()
tick_labels = [str(int(t)) for t in ticks]
tick_labels[-1] = "≥" + tick_labels[-1]
colorbar.set_ticks(ticks)
colorbar.set_ticklabels(tick_labels)

ax.xaxis.tick_top()
ax.xaxis.set_label_position('top')
plt.title("Phrase Frequency by Year (Excluding Low-Frequency Phrases)", pad=40)
plt.xlabel("Year")
plt.ylabel("Phrase")
plt.tight_layout()
plt.show()
```



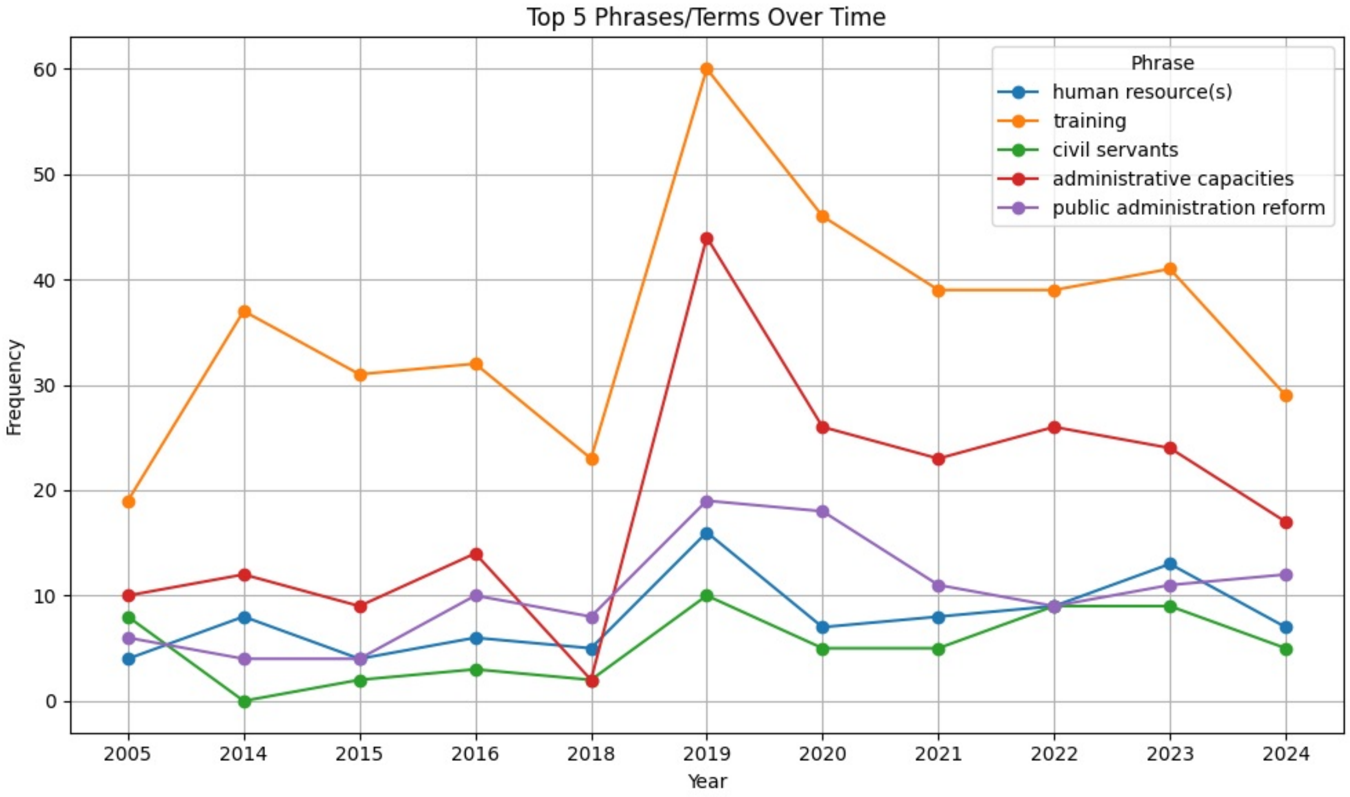
Phrase	2005	2014	2015	2016	2018	2019	2020	2021	2022	2023	2024
administrative capacities	10	12	9	14	2	44	26	23	26	24	17
public administration reform	6	4	4	10	8	19	18	11	9	11	12
human resource(s)	4	8	4	6	5	16	7	8	9	13	7
civil servants	8	0	2	3	2	10	5	5	9	9	5
skills	0	0	5	3	2	14	8	8	5	8	4
staffing	3	7	5	7	0	8	2	2	4	5	1
ineffective	0	1	1	2	2	5	4	5	6	9	7
human resource(s) management	0	3	3	3	1	5	4	4	3	7	4
strategic planning	3	2	3	2	0	5	3	4	4	4	4
knowledge	1	1	4	0	0	8	4	5	1	3	2
institutional capacity	0	0	2	1	2	6	4	4	2	3	3
management capacity	1	0	0	2	2	1	2	1	2	4	1
competencies	1	4	2	1	1	0	2	0	0	0	1
HRMIS	0	0	0	0	0	0	3	1	2	2	0
insufficient capacity	0	0	2	2	1	1	1	1	0	0	0

Line Chart with Top 5 Phrases

In [9]:

```python
top_5_phrases = df_total.sort_values(by="Total Frequency", ascending=False).head(5)["Phrase"]
df_top5 = df_yearly[df_yearly["Phrase"].isin(top_5_phrases)].set_index("Phrase").T
df_top5.index.name = "Year"
df_top5 = df_top5.reset_index()
```

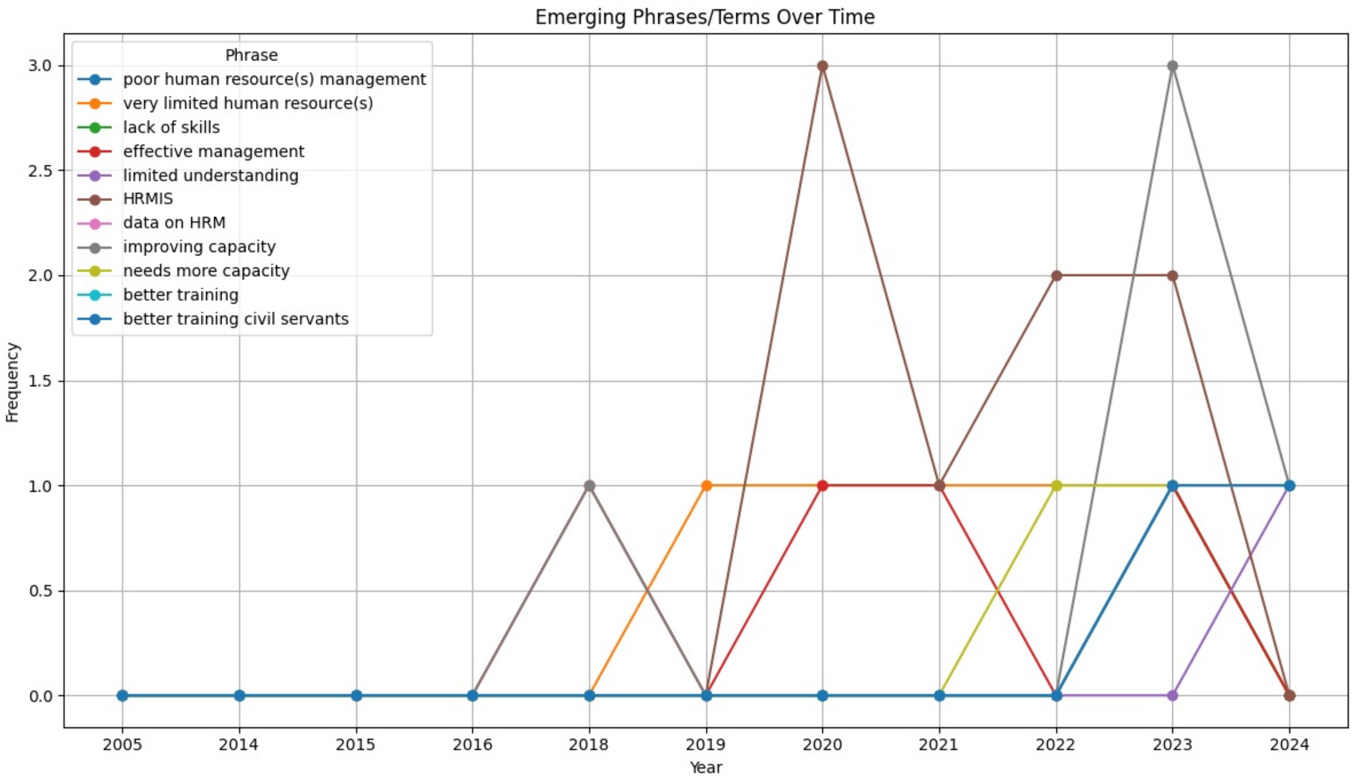
```python
plt.figure(figsize=(10, 6))
for phrase in df_top5.columns[1:]:
    plt.plot(df_top5["Year"], df_top5[phrase], marker='o', label=phrase)

plt.title("Top 5 Phrases/Terms Over Time")
plt.xlabel("Year")
plt.ylabel("Frequency")
plt.legend(title="Phrase", loc="upper right")
plt.grid(True)
plt.tight_layout()
plt.show()
```



Emerging Phrases Line Chart

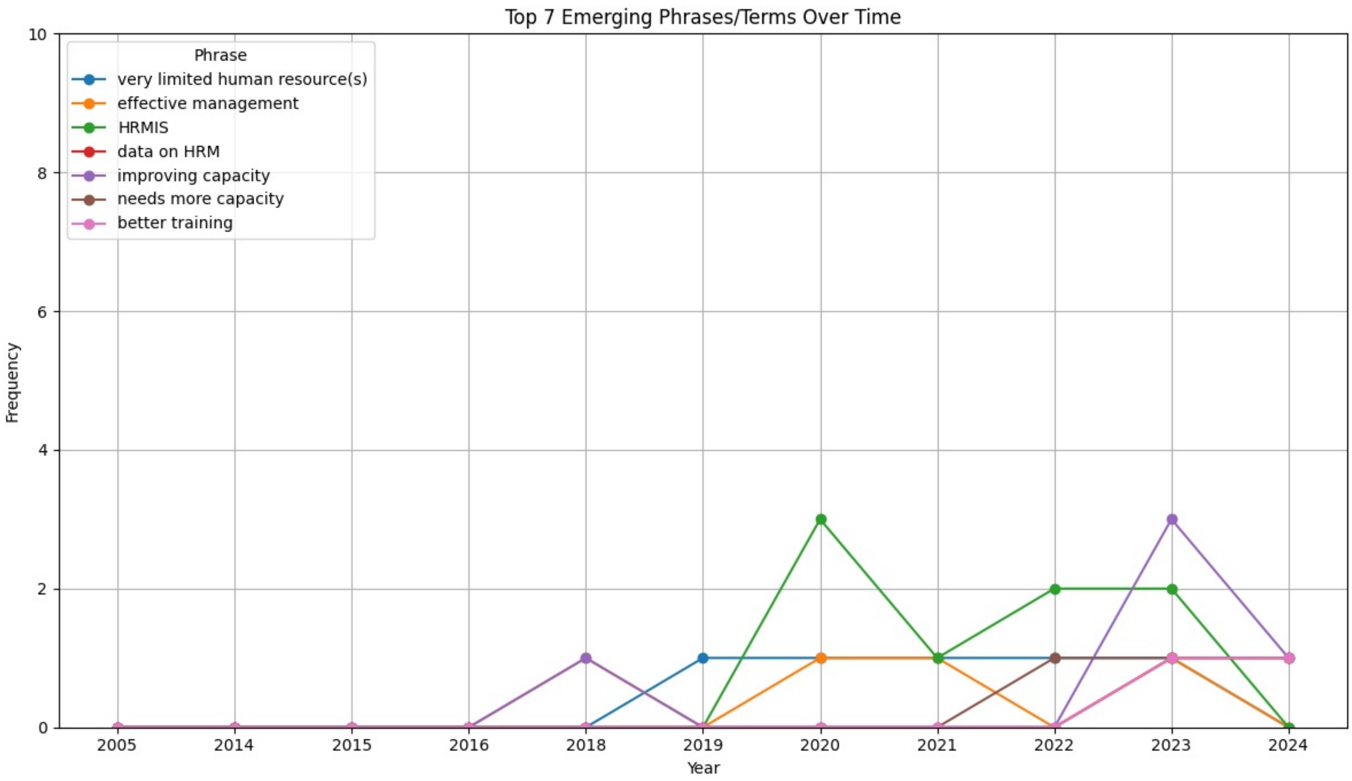
In [10]:

```python
# phrases that were not present in first 4 years but appeared in some of the last 3 years
emerging_phrases = df_yearly[
    (df_yearly[["2005", "2014", "2015", "2016"]].eq(0).sum(axis=1) >= 4) &
    (df_yearly[["2022", "2023", "2024"]].ne(0).any(axis=1))
]["Phrase"]

df_top_emerging = df_yearly[df_yearly["Phrase"].isin(emerging_phrases)].set_index("Phrase").T
df_top_emerging.index.name = "Year"
df_top_emerging = df_top_emerging.reset_index()

plt.figure(figsize=(12, 7))
for phrase in df_top_emerging.columns[1:]:
    plt.plot(df_top_emerging["Year"], df_top_emerging[phrase], marker='o', label=phrase)

plt.title("Emerging Phrases/Terms Over Time")
plt.xlabel("Year")
plt.ylabel("Frequency")
plt.legend(title="Phrase", loc="upper left")
plt.grid(True)
plt.tight_layout()
plt.show()
```



In [16]:

```
# phrases that were not present in first 4 years but appeared in some of the last 3 years
emerging_phrases = df_yearly[
    (df_yearly[["2005", "2014", "2015", "2016"]].eq(0).sum(axis=1) >= 4) &
    (df_yearly[["2022", "2023", "2024"]].ne(0).any(axis=1))
]

# ONLY SHOW TOP 7 EMERGING PHRASES
top_7_emerging = emerging_phrases.copy()
top_7_emerging["Total"] = top_7_emerging.iloc[:, 1:].sum(axis=1)
top_7_emerging = top_7_emerging.sort_values(by="Total", ascending=False).head(7)

df_top_emerging = df_yearly[df_yearly["Phrase"].isin(top_7_emerging["Phrase"])].set_index("Phrase").T
df_top_emerging.index.name = "Year"
df_top_emerging = df_top_emerging.reset_index()

plt.figure(figsize=(12, 7))
for phrase in df_top_emerging.columns[1:]:
    plt.plot(df_top_emerging["Year"], df_top_emerging[phrase], marker='o', label=phrase)

plt.title("Top 7 Emerging Phrases/Terms Over Time")
plt.xlabel("Year")
plt.ylabel("Frequency")
plt.legend(title="Phrase", loc="upper left")
plt.grid(True)
plt.ylim(0, 10)
plt.tight_layout()
plt.show()
```



In [12]:

```
df_top_emerging.head(15)
```

Out[12]:

Phrase	Year	very limited human resource(s)	effective management	HRMIS	data on HRM	improving capacity	needs more capacity	better training
0	2005	0	0	0	0	0	0	0
1	2014	0	0	0	0	0	0	0
2	2015	0	0	0	0	0	0	0
3	2016	0	0	0	0	0	0	0
4	2018	0	1	0	0	1	0	0
5	2019	1	0	0	0	0	0	0
6	2020	1	1	3	0	0	0	0
7	2021	1	1	1	0	0	0	0
8	2022	1	0	2	0	0	1	0
9	2023	1	1	2	1	3	1	1
10	2024	0	0	0	1	1	1	1

In [13]:

```
df_top_emerging.columns
```

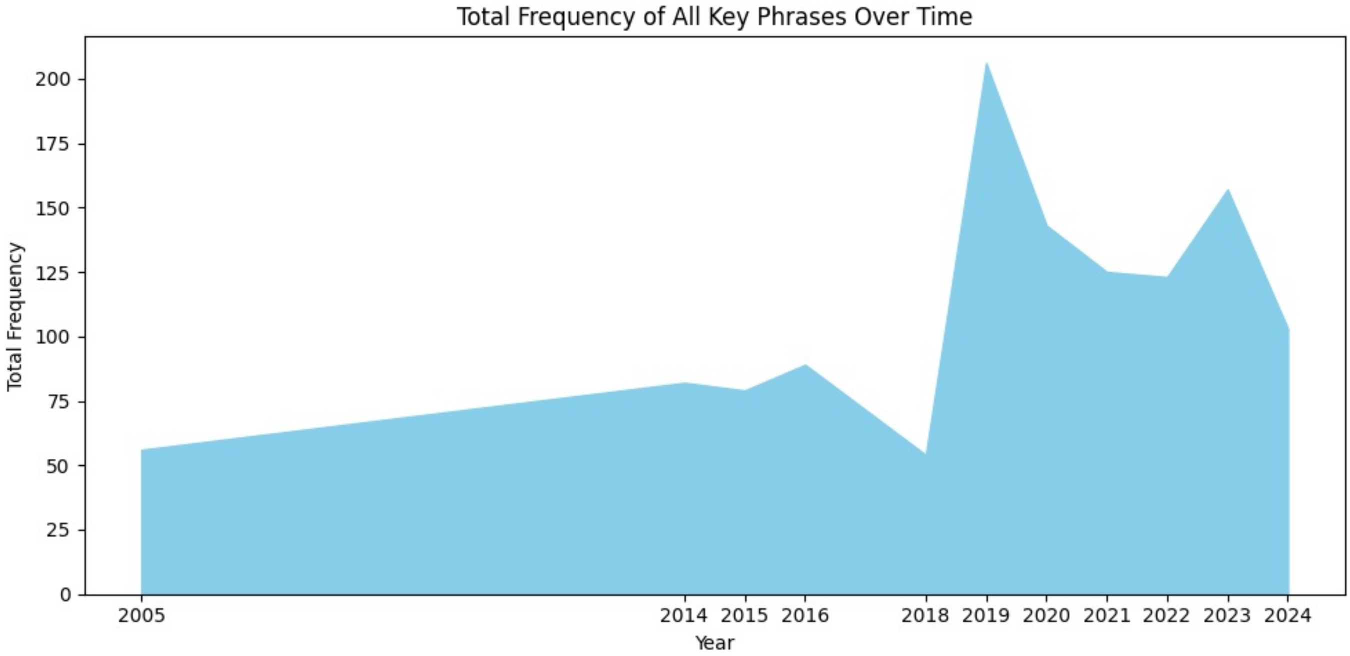
Out[13]:

```
Index(['Year', 'very limited human resource(s)', 'effective management',
       'HRMIS', 'data on HRM', 'improving capacity', 'needs more capacity',
       'better training'],
      dtype='object', name='Phrase')
```

Stacked Area Chart

In [14]:

```
df_area = df_yearly.set_index("Phrase")
df_total_per_year = df_area.sum(axis=0)

years = df_total_per_year.index.astype(int)

plt.figure(figsize=(10, 5))
plt.stackplot(years, df_total_per_year.values, color="skyblue")
plt.xticks(ticks=years, labels=years)
plt.title("Total Frequency of All Key Phrases Over Time")
plt.xlabel("Year")
plt.ylabel("Total Frequency")
plt.tight_layout()
plt.show()
```


Total Frequency of All Key Phrases Over Time
Total Frequency
0
25
50
75
100
125
150
175
200
2005
2014
2015
2016
2018
2019
2020
2021
2022
2023
2024
Year