The TLS206_PERSON Table

Welcome to a comprehensive exploration of one of the key tables in the PATSTAT database: the Person Table (`TLS206_PERSON`). This table is essential for providing detailed information about individuals and organisations involved in patent applications, whether as inventors or applicants. This table includes key data such as `PERSON_ID` (a unique identifier), name, address, country code, and sector classification (e.g., academia, industry).

By linking `TLS206_PERSON` with other tables like `TLS207_PERS_APPLN` , we can enrich patent application data with **personal details**, offering insights into who is involved in innovation, where they are located, and which sectors they represent. This allows for a comprehensive analysis of the global distribution of innovation and the contributions of key players in various industries.

The country code and sector classification fields enable **geographic and sector-based analysis**, helping to identify the origins of innovations and which industries or institutions are most active. For example, understanding the role of academic institutions versus corporate entities in patent filings is valuable for policymakers and businesses.

Furthermore, the table includes **standardised name forms**, such as `DOC_STD_NAME` and `HAN_HARMONIZED` , which resolve ambiguities when there are variations in names across different filings. This helps ensure accurate tracking of contributions across multiple applications.

In conclusion, `TLS206_PERSON` is crucial for understanding the people and organisations driving innovation. By analysing this data, we can identify key contributors, their geographic and sector affiliations, and their roles in the patenting process.

In [1]:
```
from epo.tipdata.patstat import PatstatClient
from epo.tipdata.patstat.database.models import TLS206_PERSON, TL
S207_PERS_APPLN, TLS201_APPLN
from sqlalchemy import func, case, select, and_

# Initialise the PATSTAT client
patstat = PatstatClient(env='TEST')

# Access ORM
db = patstat.orm()
```

Key Fields in the `TLS206_PERSON` Table

PERSON_ID (Primary Key)

In `TLS207_PERS_APPLN` , the `PERSON_ID` is used to connect individuals to their respective roles (inventor or applicant) in patent applications. By joining `TLS206_PERSON` with `TLS207_PERS_APPLN` using `PERSON_ID` as the linking field, we can enrich our analysis by combining patent application data with detailed personal information, such as names, addresses, and sectors. This reliable linking is vital for analysing who drives innovation within the patent landscape.

The `PERSON_ID` serves as the primary key in the `TLS206_PERSON` table, uniquely identifying each individual or organisation involved in patent applications. This unique identifier ensures consistency across different patent records, allowing accurate linking of personal data with corresponding roles in patent filings.

The connection between `TLS201_APPLN` , `TLS207_PERS_APPLN` , and `TLS206_PERSON` is essential for understanding how patent applications link to the individuals or organisations behind them. The `TLS201_APPLN` table contains core information about each patent application, with `APPLN_ID` as the unique identifier for each application. This identifier is then used in `TLS207_PERS_APPLN` , which bridges patent applications with people involved, such as inventors and applicants, through the `PERSON_ID` field.

`TLS207_PERS_APPLN` records the many-to-many relationships between individuals and patent applications, indicating whether a person is an applicant or inventor through the `APPL_SEQ_NR` and `INVT_SEQ_NR` fields. Finally, `TLS206_PERSON` contains detailed personal data, including names, addresses, and country codes, which can be linked to patent applications via `PERSON_ID` . This connection enriches patent data with personal details, facilitating a deeper analysis of who contributes to patent filings and innovation.

By joining these tables, we gain a comprehensive view of patent applications and the people or organisations behind them, along with insights into their roles, locations, and sectors.

In [2]:
```
q = db.query(
    TLS207_PERS_APPLN.appln_id,
    TLS201_APPLN.appln_nr,
    TLS206_PERSON.person_id,
    TLS206_PERSON.person_name
).join(
    TLS207_PERS_APPLN, TLS206_PERSON.person_id == TLS207_PERS_APP
LN.person_id  # Join on person_id
).join(
    TLS201_APPLN, TLS207_PERS_APPLN.appln_id == TLS201_APPLN.appl
n_id  # Join on appln_id
)

res = patstat.df(q)

res
```

Out[2]:

	appln_id	appln_nr	person_id	person_name
0	57025341	2008078434	40585895	LEDERBUCH, PAVEL
1	275544314	55538009	45175768	Urbanowicz, John
2	381603477	201113374528	11243775	Myhrvold, Nathan P.
3	9163373	19494176	20649701	SCHULZE,HORST,DD
4	55068766	3729008	10779314	Robinson, Seth M.
...	...	...	...	...
1325921	52691972	67755903	6552866	Dame, Mark Edward
1325922	49151418	26750488	7243397	Yamada, Toshikazu
1325923	54049442	89886792	10261899	Rathjen, Jr., John C.
1325924	409563943	201320168773	43609631	ZHAO YUANLEI
1325925	323114641	201010171525	18745393	WANG HUA

1325926 rows × 4 columns

This demonstrates how `PERSON_ID` **links** individuals or organisations to specific patent applications through `TLS207_PERS_APPLN` and `TLS201_APPLN`.

Name and Address Delivered by the Offices

The `TLS206_PERSON` table provides **detailed information** about the individuals and organisations involved in patent applications. The fields such as `PERSON_NAME`, `PERSON_NAME_ORIG_LG`, `PERSON_ADDRESS`, and `PERSON_CTRY_CODE` are critical for identifying applicants and inventors, and for analysing geographic and linguistic trends. The DOCDB standardised name system includes a unique identifier (`DOC_STD_NAME_ID`) and a uniform name (`DOC_STD_NAME`) to ensure consistency across records. Similarly, the PATSTAT system features the `PSN_ID` for unique identification and the `PSN_NAME` for **consistent naming**, aiding in data aggregation and analysis. By joining these fields with the `TLS207_PERS_APPLN` table, we can gain deeper insights into the diversity and location of contributors to the patent process.

PERSON_NAME

The name of the person or organisation as delivered by the office.

In [3]:
```
q = db.query(
    TLS207_PERS_APPLN.appln_id,
    TLS201_APPLN.appln_nr,
    TLS206_PERSON.person_id,
    TLS206_PERSON.person_name
).join(
    TLS207_PERS_APPLN, TLS206_PERSON.person_id == TLS207_PERS_APP
LN.person_id
).join(
    TLS201_APPLN, TLS207_PERS_APPLN.appln_id == TLS201_APPLN.appl
n_id
).filter(
    TLS206_PERSON.person_name != None          # Filter out rows
where person_name is None
).order_by(
    TLS206_PERSON.person_name
)

res = patstat.df(q)

res
```

Out[3]:

	appln_id	appln_nr	person_id	person_name
0	23871673	0100005	29372236	&CCARON
1	487421422	201710680800	58089751	&quotGUANGZHOU POWER SUPPLY CO., LTD.&quot
2	478302400	201620941863	58137100	'AGTS (Shanghai) Transmission Technology Co., ...
3	47539282	10394336	23321210	'ARTHEL' (SOCIETE D'EXPLOITATION DES BREVETS J...
4	545369628	4927994	80710576	'AZOVSTAL' METALLURGICAL INTEGRATED WORKS
...	...	...	...	...
1325856	412467118	201280012045	63097179	ＴＨＫ株式会社
1325857	341730629	2011129277	63097179	ＴＨＫ株式会社
1325858	540303313	2019084361	63097179	ＴＨＫ株式会社
1325859	7486359	96192305	85428825	��ǿ�ά��
1325860	7625387	98126977	84638761	��ά��

1325861 rows × 4 columns

Connections between individuals and patent applications can be seen, shedding light on the collaborative nature of innovation. Repeating application numbers in the results indicate multiple contributors to the same application, reflecting the teamwork often involved in the patenting process.

PERSON_NAME_ORIG_LG

The name in its original language (could include non-Latin characters).

In [4]:
```
q = db.query(
    TLS207_PERS_APPLN.appln_id,
    TLS201_APPLN.appln_nr,
    TLS206_PERSON.person_id,
    TLS206_PERSON.person_name,
    TLS206_PERSON.person_name_orig_lg
).join(
    TLS207_PERS_APPLN, TLS206_PERSON.person_id == TLS207_PERS_APP
LN.person_id  # Join to look at precisely one person
).join(
    TLS201_APPLN, TLS207_PERS_APPLN.appln_id == TLS201_APPLN.appl
n_id
).filter(
    TLS206_PERSON.person_name != TLS206_PERSON.person_name_orig_l
g  # Filter for names different from original language
).order_by(
    TLS206_PERSON.person_name  # Order by person name
)

res = patstat.df(q)

res
```

Out[4]:

	appln_id	appln_nr	person_id	person_name	person_name_orig_lg
0	487421422	201710680800	58089751	&quotGUANGZHOU POWER SUPPLY CO., LTD.&quot	广州供电局有限公司
1	478302400	201620941863	58137100	'AGTS (Shanghai) Transmission Technology Co., ...	捷颂（上海）传动科技有限公司
2	545369628	4927994	80710576	'AZOVSTAL' METALLURGICAL INTEGRATED WORKS	МЕТАЛУРГІЙНИЙ КОМБІНАТ 'АЗОВСТАЛЬ'
3	478072824	201510686160	59279255	'CEPRI Saipu Examination and Authentification ...	中电赛普检验认证（北京）有限公司
4	478080860	201510706131	59279255	'CEPRI Saipu Examination and Authentification ...	中电赛普检验认证（北京）有限公司
...	...	...	...	...	...
636816	578238616	202163	69642344	ČESKÉ VYSOKÉ UČENÍ TECHNICKÉ V PRAZE	ÄŚeskĂ© vysokĂ© uÄŤenĂ technickĂ© v Praze
636817	9052443	2006123	63723275	ČVUT V PRAZE - FAKULTA STROJNÍ	ÄŚVUT v Praze - Fakulta strojnĂ
636818	472822792	2015690	67903495	ČVUT V PRAZE, FAKULTA STROJNÍ	ÄŚVUT v Praze, Fakulta strojnĂ
636819	512443702	201935850	88302151	Červenka, Vratislav	ÄŚervenka, Vratislav
636820	501263822	201834939	68496577	ŠAMAJ PAVOL	Ĺ amaj Pavol

636821 rows × 5 columns

This is particularly useful for names that are written in non-Latin scripts or alphabets (.g., Cyrillic for Russian, Kanji or Hiragana for Japanese, Arabic...).

DOCDB Standardised Name

The **DOCDB standardised name** refers to a standardised version of the applicant or inventor's name. This **standardisation** is performed by the European Patent Office (EPO) to ensure consistency in naming across different patent applications and documents, especially since names can vary due to differences in language, formatting, or abbreviations.

- `DOC_STD_NAME_ID` : This is the unique identifier for the DOCDB standardised name. It helps differentiate between different standard names in the database.
- `DOC_STD_NAME` : This is the actual standardised name of the person or organisation. It provides a uniform version of the name as recorded in the DOCDB (EPO's worldwide patent database). For example, an organisation might be listed under multiple variations of its name in different countries, but the `DOC_STD_NAME` field would unify these under one consistent name.

PATSTAT Standardised Name

The PATSTAT standardised name refers to another method of standardising names for applicants and inventors to ensure **consistency** and facilitate easier data analysis. This standardisation may differ from the DOCDB standardisation. Here’s a breakdown of the relevant fields related to the PATSTAT standardised name:

- `PSN_ID` : This is the unique identifier for the **PATSTAT standardised name**. It allows users to reference specific standardised names within the database, ensuring that each entry can be uniquely identified.
- `PSN_NAME` : This is the **standardised name** of the person or organisation as recognised in the PATSTAT database. It provides a consistent version of the name, which is particularly useful for aggregating data and performing analyses where variations in naming might otherwise complicate results.
- `PSN_LEVEL` : The `PSN_LEVEL` field serves as an indicator of the effort invested in assigning a standardised psn_name to the corresponding individual name. The levels are defined as follows:
  - **Level 1**: This indicates that only an automated script has been applied to correct the syntax and clean up the name. This process typically involves basic formatting adjustments.
  - **Level 2**: This level signifies that human involvement was part of the assignment process for the `PSN_NAME` . The specifics of this process can be found in the separate methodology documentation.
  - **Level 0**: This level indicates that the person records have not undergone significant processing, except for minor adjustments such as capitalising the name and possibly removing extra spaces and punctuation.

The primary purpose of the `PSN_LEVEL` is to provide a quality assessment of the `PSN_NAME` . It does not serve any analytical purpose regarding patent data.

In [5]:
```
q = db.query(
    TLS207_PERS_APPLN.appln_id,
    TLS201_APPLN.appln_nr,
    TLS206_PERSON.person_id,
    TLS206_PERSON.person_name,
    TLS206_PERSON.person_name_orig_lg,
    TLS206_PERSON.doc_std_name_id,
    TLS206_PERSON.doc_std_name,
    TLS206_PERSON.psn_id,
    TLS206_PERSON.psn_name,
    TLS206_PERSON.psn_level
).join(
    TLS207_PERS_APPLN, TLS206_PERSON.person_id == TLS207_PERS_APP
LN.person_id
).join(
    TLS201_APPLN, TLS207_PERS_APPLN.appln_id == TLS201_APPLN.appl
n_id
).order_by(
    TLS206_PERSON.person_id
)

res = patstat.df(q)

res
```

Out[5]:

	appln_id	appln_nr	person_id	person_name	person_name_orig_lg	doc
0	17342174	98917166	1	Nokia Corporation	Nokia Corporation	
1	16049957	03732975	21	Koninklijke Philips Electronics N.V.	Koninklijke Philips Electronics N.V.	
2	16227388	05703021	21	Koninklijke Philips Electronics N.V.	Koninklijke Philips Electronics N.V.	
3	17095752	95108893	57	BAYER AG	BAYER AG	
4	17304418	98116160	62	HONDA GIKEN KOGYO KABUSHIKI KAISHA	HONDA GIKEN KOGYO KABUSHIKI KAISHA	
...	...	...	...	...	...	
1325921	588188432	2023061690	92514654	MAR, David Buck	MAR, David Buck	
1325922	602198027	2022012606	92514744	MIGNACCA Richard	MIGNACCA Richard	
1325923	600772140	2023019662	92514772	MOHAMMAD, Mostak	MOHAMMAD, Mostak	
1325924	604333655	2022048468	92515469	VADIPOUR, Morteza	VADIPOUR, Morteza	
1325925	596392943	2023071045	92515497	VENKATARAMANA, Raju Dommaraju	VENKATARAMANA, Raju Dommaraju	

1325926 rows × 10 columns

PERSON_ADDRESS

The address of the person or organisation.

In [6]:
```
q = db.query(
    TLS207_PERS_APPLN.appln_id,
    TLS201_APPLN.appln_nr,
    TLS201_APPLN.appln_auth,
    TLS206_PERSON.person_id,
    TLS206_PERSON.person_name,
    TLS206_PERSON.person_address
).join(
    TLS207_PERS_APPLN, TLS206_PERSON.person_id == TLS207_PERS_APP
LN.person_id
).join(
    TLS201_APPLN, TLS207_PERS_APPLN.appln_id == TLS201_APPLN.appl
n_id
).filter(
    TLS206_PERSON.person_address == None  # Filter rows where per
son_address is None
).order_by(
    TLS206_PERSON.person_id
)


res = patstat.df(q)

res
```

Out[6]:

	appln_id	appln_nr	appln_auth	person_id	person_name	person_a
0	17095752	95108893	EP	57	BAYER AG	
1	17410318	99402921	EP	80	L'OREAL	
2	55537	07013724	EP	220	SIEMENS AKTIENGESELLSCHAFT	
3	16233784	05716935	EP	220	SIEMENS AKTIENGESELLSCHAFT	
4	16383817	07012714	EP	220	SIEMENS AKTIENGESELLSCHAFT	
...	...	...	...	...	...	
1247674	588188432	2023061690	WO	92514654	MAR, David Buck	
1247675	602198027	2022012606	MX	92514744	MIGNACCA Richard	
1247676	600772140	2023019662	WO	92514772	MOHAMMAD, Mostak	
1247677	604333655	2022048468	WO	92515469	VADIPOUR, Morteza	
1247678	596392943	2023071045	WO	92515497	VENKATARAMANA, Raju Dommaraju	

1247679 rows × 6 columns

It can be observed that many individuals, either as applicants or inventors, do not have a specified address. Therefore, it would be beneficial to conduct a query that counts the number of individuals **lacking** an address, categorised by application authority. This analysis is particularly relevant, as there may be other fields that could also be missing, and considering these gaps in data could provide a more comprehensive understanding of the information quality associated with patent filings. Additionally, for conducting in-depth analysis, it is useful to retrieve data regarding the origin of the individuals involved in the applications and their engagement with the invention.

It may be interesting to explore how these missing addresses are distributed **across different application authorities**, given that these data points are closely tied to the bureaucratic process. Understanding the distribution of missing addresses could reveal insights into potential inefficiencies or gaps in the data collection practices of specific authorities as well as regulatory compliance.

In [7]:
```
application_authority_counts_query = db.query(
    TLS201_APPLN.appln_auth,
    func.count(func.distinct(TLS206_PERSON.person_id)).label('num_missing_addresses')  # Count distinct person_id with None address
).join(
    TLS207_PERS_APPLN, TLS206_PERSON.person_id == TLS207_PERS_APPLN.person_id
).join(
    TLS201_APPLN, TLS207_PERS_APPLN.appln_id == TLS201_APPLN.appln_id
).filter(
    TLS206_PERSON.person_address == None  # Filter for records with None addresses
).group_by(
    TLS201_APPLN.appln_auth  # Group by application authority
).order_by(
    func.count(func.distinct(TLS206_PERSON.person_id)).desc()
)

application_authority_counts_res = patstat.df(application_authority_counts_query)

application_authority_counts_res
```

Out[7]:

	appln_auth	num_missing_addresses
0	CN	316363
1	US	134153
2	WO	44678
3	EP	35678
4	JP	28169
...	...	...
75	KZ	4
76	SM	3
77	YU	2
78	NI	2
79	IS	1

80 rows × 2 columns

The results of this query reveal which application authorities are most deficient in providing the addresses of individuals and entities.

It would be interesting to analyse how much these missing data affect the **overall records** of each application authority. If there is an application authority with numerous missing data, it may not be significant if the total number of applications they handle is large, especially when considering the registered individuals in that authority. To understand this, we can compare the total number of individuals managed by each application authority with the number of missing data.

We have already examined the number of missing data points per application authority, and now we will run a similar query that looks at the total persons' records. These results will then be used as subqueries for a main query that calculates the percentage of missing data for each application authority.

In [8]:
```
application_authority_tot_query = db.query(
    TLS201_APPLN.appln_auth,
    func.count(func.distinct(TLS206_PERSON.person_id)).label('tot
al_persons')  # Count distinct person_id with None address
).join(
    TLS207_PERS_APPLN, TLS206_PERSON.person_id == TLS207_PERS_APP
LN.person_id
).join(
    TLS201_APPLN, TLS207_PERS_APPLN.appln_id == TLS201_APPLN.appl
n_id
).group_by(
    TLS201_APPLN.appln_auth
).order_by(
    func.count(func.distinct(TLS206_PERSON.person_id)).desc()
)

application_authority_tot_res = patstat.df(application_authority_
tot_query)

application_authority_tot_res
```

Out[8]:

	appln_auth	total_persons
0	CN	316366
1	US	153063
2	WO	45034
3	EP	40326
4	JP	28169
...	...	...
75	EE	4
76	SM	3
77	YU	2
78	NI	2
79	IS	1

80 rows × 2 columns

In [9]:
```
application_authority_counts_query_sub = application_authority_co
unts_query.subquery()
application_authority_tot_query_sub = application_authority_tot_q
uery.subquery()
```

In [10]:
```
combined_query = db.query(
    application_authority_tot_query_sub.c.appln_auth,
    application_authority_counts_query_sub.c.num_missing_addresse
s,
    application_authority_tot_query_sub.c.total_persons,
    (application_authority_counts_query_sub.c.num_missing_address
es / application_authority_tot_query_sub.c.total_persons * 100).l
abel('percentage_none_address')  # Calculate percentage of None a
ddresses
).outerjoin(  # Left outer join ensures all application authoriti
es are included
    application_authority_counts_query_sub,
    application_authority_counts_query_sub.c.appln_auth == applic
ation_authority_tot_query_sub.c.appln_auth
).order_by((application_authority_counts_query_sub.c.num_missing_
addresses / application_authority_tot_query_sub.c.total_persons *
100).desc()
).limit(10)   # Select top 10

combined_res = patstat.df(combined_query)
combined_res['percentage_none_address'] = combined_res['percentag
e_none_address'].astype(int)

combined_res
```

Out[10]:

	appln_auth	num_missing_addresses	total_persons	percentage_none_address
0	EA	277	277	100
1	KR	17438	17438	100
2	AU	3951	3951	100
3	UA	272	272	100
4	ES	5645	5645	100
5	TW	3172	3172	100
6	NO	361	361	100
7	LU	230	230	100
8	FR	3298	3298	100
9	JP	28169	28169	100

The **percentage** for certain key application authorities is quite high, meaning that this data cannot be reliably used if these application authorities are taken into account.

PERSON_CTRY_CODE

The country code of the person or organisation.

Since missing data has been identified, it is worth conducting a similar analysis focusing on the person's country code. However, we might expect these data to be more readily available compared to personal addresses.

In [11]:
```
q = db.query(
    TLS207_PERS_APPLN.appln_id,
    TLS201_APPLN.appln_nr,
    TLS201_APPLN.appln_auth,
    TLS206_PERSON.person_id,
    TLS206_PERSON.person_name,
    TLS206_PERSON.person_address,
    TLS206_PERSON.person_ctry_code
).join(
    TLS207_PERS_APPLN, TLS206_PERSON.person_id == TLS207_PERS_APP
LN.person_id
).join(
    TLS201_APPLN, TLS207_PERS_APPLN.appln_id == TLS201_APPLN.appl
n_id
).order_by(
    TLS206_PERSON.person_name
)

res = patstat.df(q)

res
```

Out[11]:

	appln_id	appln_nr	appln_auth	person_id	person_name	person_address
0	7486359	96192305	CN	263	None	None
1	7486359	96192305	CN	263	None	None
2	7486359	96192305	CN	263	None	None
3	7486359	96192305	CN	263	None	None
4	7486359	96192305	CN	263	None	None
...	...	...	...	...	...	...
1325921	412467118	201280012045	CN	63097179	ＴＨＫ株式会社	None
1325922	341730629	2011129277	JP	63097179	ＴＨＫ株式会社	None
1325923	540303313	2019084361	JP	63097179	ＴＨＫ株式会社	None
1325924	7486359	96192305	CN	85428825	��ǿ�ά��	None
1325925	7625387	98126977	CN	84638761	��ά��	None

1325926 rows × 7 columns

Similarly, there are many missing values in the person country code.

In [12]:
```
application_authority_country_counts_missing_query = db.query(
    TLS201_APPLN.appln_auth,  # Application authority
    func.count(func.distinct(TLS206_PERSON.person_id)).label('num_missing_country_codes')  # Count distinct person_id with empty country codes
).join(
    TLS207_PERS_APPLN, TLS206_PERSON.person_id == TLS207_PERS_APPLN.person_id
).join(
    TLS201_APPLN, TLS207_PERS_APPLN.appln_id == TLS201_APPLN.appln_id
).filter(
    TLS206_PERSON.person_ctry_code == '  '  # Filter for records with missing country codes (empty spaces)
).group_by(
    TLS201_APPLN.appln_auth
).order_by(
    func.count(func.distinct(TLS206_PERSON.person_id)).desc()
)

application_authority_country_counts_res = patstat.df(application_authority_country_counts_missing_query)

application_authority_country_counts_res
```

Out[12]:

	appln_auth	num_missing_country_codes
0	CN	306948
1	JP	28136
2	US	7931
3	KR	4869
4	ES	4139
5	AU	3041
6	GB	1735
7	DE	1514
8	WO	965
9	RU	766
10	FR	700
11	MX	646
12	IT	430
13	NZ	289
14	SU	252
15	ZA	180

16	HK	120
17	CA	114
18	FI	108
19	MA	108
20	BR	101
21	NL	90
22	IL	88
23	UA	78
24	SE	73
25	CH	34
26	DD	27
27	AT	26
28	BE	23
29	SG	16
30	AP	14
31	NO	11
32	DK	10
33	BG	10
34	GR	9
35	CL	8
36	IE	7
37	SA	6
38	GE	6
39	HU	6
40	TW	5
41	KZ	4
42	EG	4
43	IN	3
44	PL	3
45	SK	2
46	EA	2
47	EC	1
48	GT	1

49	TR	1
50	EP	1
51	CY	1
52	AR	1

In light of these two fields, we can compare the absence of addresses with that of country codes present in each application authority.

In [13]:
```
country_code_count_query = db.query(
    TLS201_APPLN.appln_auth,
    func.count(func.distinct(TLS206_PERSON.person_id)).label('total_persons')  # Count distinct person_id with missing country code
).join(
    TLS207_PERS_APPLN, TLS206_PERSON.person_id == TLS207_PERS_APPLN.person_id
).join(
    TLS201_APPLN, TLS207_PERS_APPLN.appln_id == TLS201_APPLN.appln_id
).group_by(
    TLS201_APPLN.appln_auth
).order_by(
    func.count(func.distinct(TLS206_PERSON.person_id)).desc()
)

country_code_count_res = patstat.df(country_code_count_query)

country_code_count_res
```

Out[13]:

	appln_auth	total_persons
0	CN	316366
1	US	153063
2	WO	45034
3	EP	40326
4	JP	28169
...	...	...
75	EE	4
76	SM	3
77	YU	2
78	NI	2
79	IS	1

80 rows × 2 columns

In [14]:
```
country_code_count_query_sub = country_code_count_query.subquery()
application_authority_country_counts_query_sub = application_authority_country_counts_missing_query.subquery()
```

In [15]:
```
combined_country_code_query = db.query(
    country_code_count_query_sub.c.appln_auth,
    application_authority_country_counts_query_sub.c.num_missing_
country_codes,
    (application_authority_country_counts_query_sub.c.num_missing
_country_codes / country_code_count_query_sub.c.total_persons * 1
00).label('percentage_missing_country_codes')
).outerjoin(
    application_authority_country_counts_query_sub,
    application_authority_country_counts_query_sub.c.appln_auth =
= country_code_count_query_sub.c.appln_auth
).order_by(
    (application_authority_country_counts_query_sub.c.num_missing
_country_codes / country_code_count_query_sub.c.total_persons * 1
00).desc()
).limit(10)   # Select top 10

combined_country_code_res = patstat.df(combined_country_code_quer
y)

combined_country_code_res['num_missing_country_codes'] = combined
_country_code_res['num_missing_country_codes'].fillna(0).astype(i
nt) # necessary for the outerjoin
combined_country_code_res['percentage_missing_country_codes'] = c
ombined_country_code_res['percentage_missing_country_codes'].fill
na(0).astype(int)

combined_country_code_res
```

Out[15]:

	appln_auth	num_missing_country_codes	percentage_missing_country_codes
0	KZ	4	100
1	JP	28136	99
2	CN	306948	97
3	NZ	289	96
4	HK	120	81
5	AU	3041	76
6	ES	4139	73
7	IT	430	69
8	IE	7	63
9	EG	4	57

Incomplete country codes can complicate analyses related to the geographical distribution of patent applicants or inventors, making it harder to assess contributions from different countries. Identifying where these data gaps exist is useful for addressing potential inconsistencies.

Analysis of Missing Data in Name and Address Fields

The missing data related to individuals makes it particularly relevant to examine other categories, especially those that may be significant for future analyses.

In [16]:
```
# Query for missing names
missing_names_query = db.query(
    TLS206_PERSON.person_id
).filter(TLS206_PERSON.person_name == None)

missing_names_res = patstat.df(missing_names_query)

# Query for missing addresses
missing_addresses_query = db.query(
    TLS206_PERSON.person_id
).filter(TLS206_PERSON.person_address == None)

missing_addresses_res = patstat.df(missing_addresses_query)

#Query for missing country codes
missing_country_query = db.query(
    TLS206_PERSON.person_id
).filter(TLS206_PERSON.person_ctry_code == '  ')

missing_country_res = patstat.df(missing_country_query)
```

The purpose of these queries is to identify and gather the `PERSON_IDs` of individuals who are missing certain key attributes, which can help assess the completeness of the dataset and potentially inform data quality improvement efforts.

After executing these queries, one might consider analysing the intersections of these missing attributes to uncover patterns, such as whether certain application authorities are more likely to have missing data, or if specific types of entities (individuals vs. corporations) show more incomplete records. This analysis could inform targeted efforts to improve data completeness and reliability.

In [17]:
```
import pandas as pd

# Find person_ids that are missing names and addresses
missing_names_addresses = pd.merge(missing_names_res, missing_addresses_res, on='person_id', how='inner', suffixes=('_name', '_address'))

# Find person_ids that are missing names and country codes
missing_names_country = pd.merge(missing_names_res, missing_country_res, on='person_id', how='inner', suffixes=('_name', '_country'))

# Find person_ids that are missing addresses and country codes
missing_addresses_country = pd.merge(missing_addresses_res, missing_country_res, on='person_id', how='inner', suffixes=('_address', '_country'))

# Find person_ids that are missing names, addresses, and country codes
missing_all = pd.merge(missing_names_res, missing_addresses_res, on='person_id', how='inner')
missing_all = pd.merge(missing_all, missing_country_res, on='person_id', how='inner')
```

In [18]:
```
missing_names_addresses
```

Out[18]:

```
   person_id
0        263
1    5312968
```

In [19]:
```
missing_names_country
```

Out[19]:

```
   person_id
0        263
```

In [20]:
```
missing_addresses_country
```

Out[20]:

```
        person_id
     0    9839689
     1   12483949
     2   12513413
     3   12483843
     4   12755317
   ...        ...
361066   77925860
361067   78230492
361068   60912992
361069   72570112
361070   77533140

361071 rows × 1 columns
```

In [21]:
```
missing_all
```

Out[21]:

```
   person_id
0        263
```

By creating these intersections, the analysis identifies individuals with multiple missing data points, which may indicate systematic issues in data collection

Possible Preliminary Analysis considering Persons' Data

Count by Country

By counting the number of unique applicants and inventors associated with each country code, which represents the country of the person, whether physical individuals or legal entities, the query offers insights into which countries are leading in terms of innovation and patent activity. This analysis can help identify global trends in patent filings and highlight countries that are emerging as key innovation hubs.

In [22]:
```
applicants_query = db.query(
    TLS206_PERSON.person_ctry_code,
    func.count(func.distinct(TLS206_PERSON.person_id)).label('num
_applicants')
).join(
    TLS207_PERS_APPLN, TLS206_PERSON.person_id == TLS207_PERS_APP
LN.person_id
).filter(
    TLS207_PERS_APPLN.applt_seq_nr != 0  # Filter for applicants
).group_by(
    TLS206_PERSON.person_ctry_code
).order_by(
    func.count(func.distinct(TLS206_PERSON.person_id)).desc()
)

applicants_res = patstat.df(applicants_query)
```

In [23]:
```
inventors_query = db.query(
    TLS206_PERSON.person_ctry_code,
    func.count(func.distinct(TLS206_PERSON.person_id)).label('num
_inventors')
).join(
    TLS207_PERS_APPLN, TLS206_PERSON.person_id == TLS207_PERS_APP
LN.person_id
).filter(
    TLS207_PERS_APPLN.invt_seq_nr != 0  # Filter for inventors
).group_by(
    TLS206_PERSON.person_ctry_code
).order_by(
    func.count(func.distinct(TLS206_PERSON.person_id)).desc()
)

inventors_res = patstat.df(inventors_query)
```

In [24]:
```
merged_df = pd.merge(applicants_res, inventors_res, on='person_ct
ry_code', how='outer')

merged_df.fillna(0, inplace=True)


merged_df['num_applicants'] = merged_df['num_applicants'].astype(
int)
merged_df['num_inventors'] = merged_df['num_inventors'].astype(in
t)

merged_df_sorted = merged_df.sort_values(by='num_applicants', asc
ending=False)


merged_df_sorted
```

Out[24]:

	person_ctry_code	num_applicants	num_inventors
0		76952	299458
155	US	39524	74943
43	DE	11620	28849
82	JP	9094	23269
33	CN	7110	21444
...	...	...	...
68	IB	0	1
121	PR	0	2
38	CV	0	1
141	SZ	0	2
159	VC	0	1

168 rows × 3 columns

Top Applicants or Inventors by their Country

In [25]:
```
applicant_query = db.query(
    TLS206_PERSON.person_id,
    TLS206_PERSON.person_name,
    TLS206_PERSON.person_ctry_code,
    func.count(TLS207_PERS_APPLN.appln_id).label('num_application
s_as_applicant')
).join(
    TLS207_PERS_APPLN, TLS206_PERSON.person_id == TLS207_PERS_APP
LN.person_id
).filter(
    TLS207_PERS_APPLN.applt_seq_nr != 0
).group_by(
    TLS206_PERSON.person_id,
    TLS206_PERSON.person_name,
    TLS206_PERSON.person_ctry_code
)

applicant_res = patstat.df(applicant_query)
```

In [26]:
```
inventor_query = db.query(
    TLS206_PERSON.person_id,
    func.count(TLS207_PERS_APPLN.appln_id).label('num_application
s_as_inventor')
).join(
    TLS207_PERS_APPLN, TLS206_PERSON.person_id == TLS207_PERS_APP
LN.person_id
).filter(
    TLS207_PERS_APPLN.invt_seq_nr != 0
).group_by(
    TLS206_PERSON.person_id
)

inventor_res = patstat.df(inventor_query)
```

In [27]:
```
merged_applicant_inventor_df = pd.merge(applicant_res, inventor_r
es, on='person_id', how='outer')
```

In [28]:
```
merged_applicant_inventor_df.fillna(0, inplace=True)

merged_applicant_inventor_df['num_applications_as_applicant'] = m
erged_applicant_inventor_df['num_applications_as_applicant'].asty
pe(int)
merged_applicant_inventor_df['num_applications_as_inventor'] = me
rged_applicant_inventor_df['num_applications_as_inventor'].astyp
e(int)

merged_applicant_inventor_df[['person_name', 'person_ctry_code',
'num_applications_as_applicant', 'num_applications_as_invento
r']].sort_values(by='num_applications_as_applicant', ascending=Fa
lse)
```

Out[28]:

	person_name	person_ctry_code	num_applications_as_applicant	num_applications
11457	General Electric Company	US	2886	
218425	WOBBEN PROPERTIES GMBH	DE	2272	
18266	Vestas Wind Systems A/S	DK	2194	
376912	STATE GRID CORPORATION OF CHINA		2047	
193182	STATE GRID CORPORATION OF CHINA		1304	
...	...	...	...	
283307	0	0	0	
283306	0	0	0	
283305	0	0	0	
283304	0	0	0	
283330	0	0	0	

646342 rows × 4 columns

This query is particularly useful for identifying the **most active contributors** to patent filings, whether they are individual inventors or organisations. By ranking people based on the number of applications they have been involved with as an applicant, it highlights key players in the innovation ecosystem. The result will show which individuals or organisations are leading in terms of patent filings, possibly indicating their level of innovation and influence in certain fields. It could be also interesting to order by inventors instead of applicants.

In [29]:
```
merged_applicant_inventor_df[['person_name', 'person_ctry_code',
'num_applications_as_applicant', 'num_applications_as_invento
r']].sort_values(by='num_applications_as_inventor', ascending=Fal
se)
```

Out[29]:

	person_name	person_ctry_code	num_applications_as_applicant	num_applicati
377053	0	0	0	
379577	WANG LEI		9	
464444	ZHANG LEI		3	
477727	WANG WEI		14	
354581	LI PENG		1	
...	...	...	...	
532749	HANGZHOU YOUXIANG TOYS CO., LTD.		1	
532760	HUIZHONGXIANG ENVIRONMENTAL TECHNOLOGY CO., LTD.		7	
532716	JINAN TONGBEI LIGHTING CO., LTD.		2	
532719	HAIYAN SANWAN PLASTIC INDUSTRY CO., LTD.		1	
532678	BAODING RUNHENG XINGYUAN ELECTRIC CO., LTD.		1	

646342 rows × 4 columns

By separating the counts of applications where a person is an applicant versus an inventor, it becomes clear whether the person is more involved in owning the rights to the patents (as an applicant) or in creating the inventions (as an inventor).

Person Classification: Level and Sector

PSN_SECTOR

`PSN_SECTOR` : This refers to the sector in which the entity operates (e.g., academia, industry, public sector). This information can be valuable for understanding the context of patents, such as identifying trends in innovation across different sectors or comparing contributions to patenting from various fields.

To explore the field `PSN_SECTOR` , you can start by querying data from these fields in the `TLS206_PERSON` table. These fields provide insights into the classification of patent applicants and inventors by type and sector, which can be useful in several types of analyses.

In [30]:
```python
classification_query = db.query(
    TLS206_PERSON.person_id,
    TLS206_PERSON.person_name,
    TLS206_PERSON.psn_sector
).filter(
    TLS206_PERSON.psn_sector != None  # Filter out records where sector is missing
).order_by(
    TLS206_PERSON.psn_sector
)

classification_res = patstat.df(classification_query)

classification_res
```

Out[30]:

	person_id	person_name	psn_sector
0	5215668	SAAB AB	COMPANY
1	5251106	THOMSON LICENSING	COMPANY
2	5254579	Caterpillar Inc.	COMPANY
3	5227571	Apple Inc.	COMPANY
4	5215651	Robert Bosch GmbH	COMPANY
...	...	...	...
348443	85436873	SONI, HARGOVIND	UNKNOWN
348444	90694156	REINERS, Wolfram Johannes Bernd	UNKNOWN
348445	91851773	LAUBSCHER, Bernard Allen	UNKNOWN
348446	89670828	MTUNGWA, Mandlenkosi	UNKNOWN
348447	90604527	Reiners, Wolfram, Johannes, Bernd	UNKNOWN

348448 rows × 3 columns

In [31]:
```
entity_classification_query = db.query(
    TLS206_PERSON.psn_sector,                          # Entity sector
(e.g., company, academia)
    func.count(TLS206_PERSON.person_id).label('num_entities')
).group_by(
    TLS206_PERSON.psn_sector
).order_by(
    func.count(TLS206_PERSON.person_id).desc()
)

entity_classification_res = patstat.df(entity_classification_quer
y)

entity_classification_res
```

Out[31]:

	psn_sector	num_entities
0	None	297894
1	INDIVIDUAL	200156
2	COMPANY	80905
3	UNKNOWN	59339
4	UNIVERSITY	4693
5	GOV NON-PROFIT	2703
6	GOV NON-PROFIT UNIVERSITY	295
7	COMPANY GOV NON-PROFIT	276
8	COMPANY UNIVERSITY	38
9	HOSPITAL	29
10	COMPANY GOV NON-PROFIT UNIVERSITY	12
11	COMPANY HOSPITAL	2

There are different sectors:

- `None` : This category represents individuals or entities for which no sector information is available. A significant number of entries fall into this category, indicating potential gaps in data collection or categorisation.
- `Individual` : This sector includes individual inventors who are applying for patents. It is a large group, this showing a strong presence of individual inventors in patent applications.
- `Company` : This category comprises corporate entities that are patent applicants. The number of company applications indicates the importance of businesses in driving innovation and securing intellectual property.
- `Unknown` : This sector includes applications where the sector of the applicant is unspecified. This could be due to incomplete data or classification challenges, highlighting the need for improved data accuracy.
- `University` : This sector covers educational institutions that are involved in patenting activities. The presence of universities in patent applications underscores the role of academia in research and innovation.
- `Government Non-Profit` : This category includes government agencies and non-profit organisations that are applying for patents. Their involvement may reflect public sector innovations or research initiatives.
- `Government Non-Profit University` : This sector combines government, non-profit, and university entities. It indicates collaborative efforts among different types of organisations, particularly in research and development.
- `Company Government Non-Profit` : This category represents partnerships or collaborations between corporate entities and government/non-profit organisations, possibly focusing on social impact or public good.
- `Company University` : This sector captures partnerships between companies and universities in patent applications, highlighting collaborative research and technology transfer.
- `Hospital` : This category includes hospitals that apply for patents, often related to medical innovations or healthcare technologies.
- `Company Government Non-Profit University` : This represents a collaborative effort involving companies, government, non-profits, and universities, showcasing extensive partnerships in innovation.
- `Company Hospital` : This sector captures partnerships between companies and hospitals, likely focusing on medical research and technological advancements.

NUTS

NUTS stands for Nomenclature of Territorial Units for Statistics. It is a hierarchical **GEO Code Standard** developed by the European Union (EU) to divide its territory into regions.

Hierarchy

The **NUTS** system is divided into different levels of territorial units, which range from large regions to small localities. The hierarchy is structured in 3 main levels, with population size thresholds for each level defined in the NUTS Regulation:

- **NUTS 1**: Major socio-economic regions (e.g., countries or large regions like Germany's "Länder"). *Population size:* 3 million to 7 million people.
- **NUTS 2**: Basic regions for the application of regional policies (e.g., medium-sized regions like French regions or Spanish autonomous communities). *Population size:* 800,000 to 3 million people.
- **NUTS 3**: Small regions for specific diagnoses (e.g., counties or provinces). *Population size:* 150,000 to 800,000 people.

NUTS_Level

The `nuts_level`:

- **0**: Indicates that the NUTS code identifies a state. **(Not an official NUTS level)**
- **1, 2, 3**: Represent the **official NUTS levels:**
  - **1**: NUTS Level 1
  - **2**: NUTS Level 2
  - **3**: NUTS Level 3
- **4**: Equivalent to NUTS Level 3, but indicates that the NUTS code has been provided by the OECD's REGPAT database. **(Not an official NUTS level)**
- **9**: Indicates that no NUTS code has been assigned. **(Not an official NUTS level)**

In [32]:
```
query_nuts = db.query(
    TLS206_PERSON.nuts,
    TLS206_PERSON.nuts_level
)

results_nuts = patstat.df(query_nuts)

results_nuts
```

Out[32]:

	nuts	nuts_level
0	None	9
1	None	9
2	None	9
3	None	9
4	None	9
...	...	...
646337	None	9
646338	None	9
646339	None	9
646340	None	9
646341	None	9

646342 rows × 2 columns

With the query below , we can find the **exact numbers** for each level.

In [34]:
```
group_q = db.query(
    TLS206_PERSON.nuts_level,
    func.count(TLS206_PERSON.nuts_level).label('distinct_nuts_lev
els'),
).group_by(TLS206_PERSON.nuts_level)


number_distinct_nuts = patstat.df(group_q)

number_distinct_nuts
```

Out[34]:

	nuts_level	distinct_nuts_levels
0	9	548396
1	0	76171
2	3	13448
3	4	8314
4	2	7
5	1	6

Analysis of NUTS with Actual Values

In [36]:
```
grouping = db.query(
    TLS206_PERSON.nuts_level,
    TLS206_PERSON.nuts.label('Nuts Code'),
    func.count(case([(TLS206_PERSON.nuts.isnot(None), 1)], else_=
None)  # only count the nuts if they are not None
    ).label('Number of Nuts'),

).group_by(
    TLS206_PERSON.nuts,
    TLS206_PERSON.nuts_level
).order_by(
    func.count(
        case([(TLS206_PERSON.nuts.isnot(None), 1)], else_=None)
    ).desc()
).limit(10)

notnull_NUTS = patstat.df(grouping)

notnull_NUTS
```

Out[36]:

	nuts_level	Nuts Code	Number of Nuts
0	0	DE	27082
1	0	UK	9232
2	0	FR	8222
3	0	DK	6702
4	0	ES	5077
5	0	NL	3521
6	0	IT	2694
7	0	CH	2353
8	0	NO	2092
9	0	SE	2005

This query is useful for analyzing the geographical distribution of individuals or entities involved in patent applications. By focusing on NUTS codes, one can identify which regions are most frequently represented in the patent data.

Harmonised Applicant Name (HAN)

- `HAN_NAME` stands for Harmonised Applicant Name (HAN) from OECD. The attribute is populated for all persons. For people whose names haven't been adjusted (like inventors but not applicants), their names are simply copied from the `PERSON_NAME` attribute.

HAN_HARMONISED

- This field indicates the level of harmonisation achieved for the applicant's name, following the OECD's standards:
  - **0**: The original name could not be harmonised, and the name has been replenished.
  - **1**: The name was harmonised but not matched with the ORBIS database.
  - **2**: The name was harmonised and successfully matched with the ORBIS database.

HAN_ID

A unique identifier assigned to each harmonised applicant name (`HAN_NAME`). Multiple rows may have the same HAN_ID, if multiple person names in the person table have been harmonised into a single HAN name. If a name is **not harmonised**, a unique `HAN_ID` is assigned using the `PERSON_ID` with a prefix.

HAN_NAME

This field contains the harmonised names of applicants based on the **OECD HAN project**. It standardises applicant names across different regions to support research and analysis.

The OECD HAN database provides a structured grouping of applicant names for various international patent filings. Updates to the harmonised names occur periodically, with new editions of PATSTAT incorporating the most recent adjustments.

```
In [37]: query_han = db.query(
             TLS206_PERSON.han_id,
             TLS206_PERSON.han_name,
             TLS206_PERSON.han_harmonized,
             TLS206_PERSON.person_id,
             TLS206_PERSON.person_name)

         results_han = patstat.df(query_han)

         results_han
```

Out[37]:

	han_id	han_name	han_harmonized	person_id	person_name
0	104864878	Juhanak, Jiri	0	4864878	Juhanak, Jiri
1	143809040	VERMA, ASHUTOSH SANTRAM	0	43809040	VERMA, ASHUTOSH SANTRAM
2	109839689	Allen, Terry S.	0	9839689	Allen, Terry S.
3	112483949	FERON STEPHANE	0	12483949	FERON STEPHANE
4	112513413	PRIGENT SERGE	0	12513413	PRIGENT SERGE
...	...	...	...	...	...
646337	3527088	STELLENBOSCH UNIVERSITY	2	11769145	Stellenbosch University
646338	2498641	NELSON MANDELA METROPOLITAN UNIVERSITY	1	12655476	NELSON MANDELA METROPOLITAN UNIVERSITY
646339	3527088	STELLENBOSCH UNIVERSITY	2	29602212	STELLENBOSCH UNIVERSITY
646340	3174419	VAAL UNIVERSITY OF TECH	2	41693612	VAAL UNIVERSITY OF TECHNOLOGY
646341	4325195	STELLENBOSSKIJ UNIVERSITET	1	65066365	STELLENBOSSKIJ UNIVERSITET

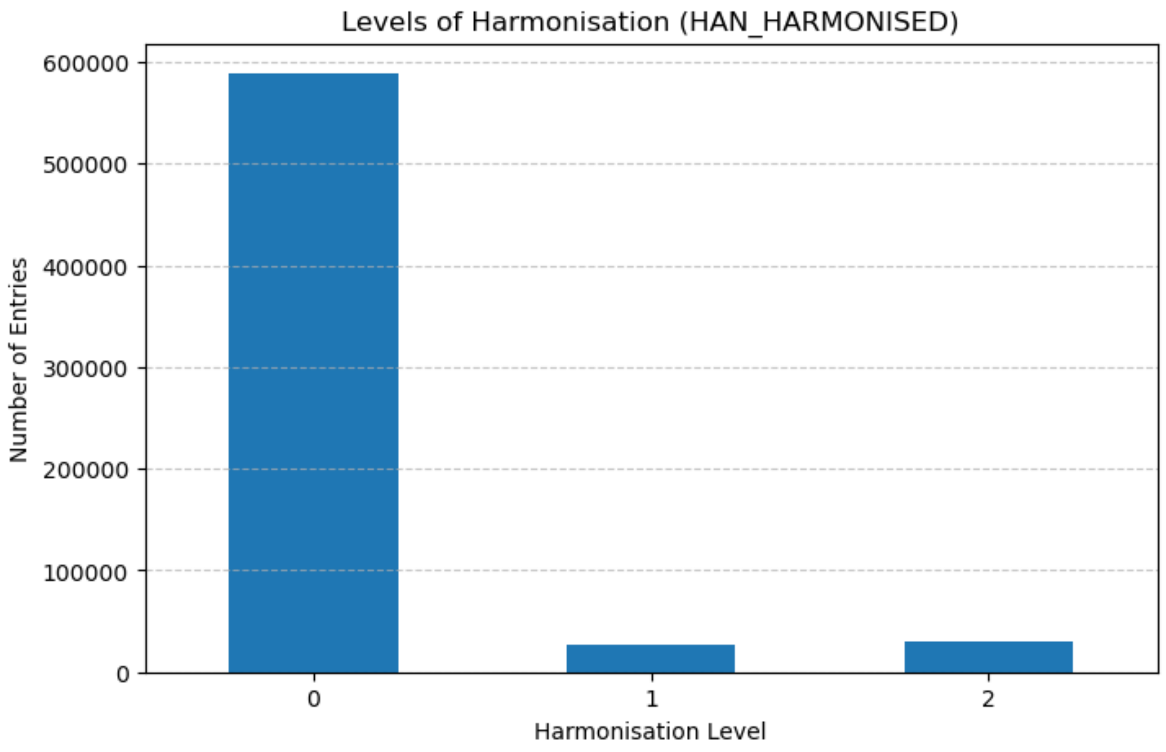
646342 rows × 5 columns

Distribution of the Harmonisation Levels

The distribution of harmonisation levels in the `han_harmonised` column from the `results_han` DataFrame can be visualised.It is visible that the most frequent `han_harmonised level` level is 0, which means that the name could not be harmonised.

In [38]:
```
import matplotlib.pyplot as plt
harmonisation_counts = results_han['han_harmonized'].value_count
s().sort_index()

# Create the bar plot
plt.figure(figsize=(8, 5))
harmonisation_counts.plot(kind='bar')
plt.title('Levels of Harmonisation (HAN_HARMONISED)')
plt.xlabel('Harmonisation Level')
plt.ylabel('Number of Entries')
plt.xticks(rotation=0)
plt.grid(axis='y', linestyle='--', alpha=0.7)
plt.show()
```



Different Name Variations

A filter can be used to focus for example on records where the harmonised name matches "GENERAL ELECT CO." but have a different original name before harmonisation.