Thorben Pelzer

Chinese Engineers Relational Database (CERD) Design Manual
IMPRINT

This working paper is part of the Working Paper Series of the Collaborative Research Centre (SFB) 1199 "Processes of Spatialization under the Global Condition".

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Abstract

The CERD database is a register of engineers from the Chinese Republican period (1912–1949). The digital analysis of historical registers has led to a prosopographic catalogue of persons, educational institutions, and companies. The data can be put in relation to one another by researchers to answer individual research questions. This paper describes the architecture of the database, explains how it works, and presents ways of analysing the data.
Introduction

The following manual describes the aims, structure, and operation of the Chinese Engineering Relation-al Database (CERD). The database is the quantitative part of the broader collaborative research group “Chinese Engineers and their Spatial Imaginations: Architects of an Interconnected Nation, 1906–1937”, led by Elisabeth Kaske. The subproject is situated within the Collaborative Research Centre (SFB) 1199, which investigates “Processes of Spatialization under the Global Condition”.

The subproject aims to analyse the relationship between infrastructure and the nation-state. It investigates the introduction of the nation-state as a spatial format, the infrastructural formatting of the “Chinese” territory, and the infrastructural dimension of integrating China within a global spatial order. The group will look at three different groups of actors: the Ministry of Communications (jiaotong bu), polytechnic schools and universities, and professional engineering associations. The database serves as an aid for the subproject as a whole and connects the different angles, as it comprises data relevant to all the research questions.

Aim and Scope

The database’s origin and function within the research centre are reflected in its structure: the database revolves around individuals (actors being the research object of the research centre subgroup) as well as locations (spatialities being the research object of the overall research centre).

CERD is not a general-purpose database like the China Biographical Database (CBDB), a vast project that collects a wide range of biographical detail, with a focus on the pre-modern period. In contrast, data collection for CERD is designed with the specific goals of the research project in mind. Therefore, the database features a deliberately limited amount of defined entities.

The database serves as a tool of quantitative exploration and as a support for qualitative studies. This primarily relates to two questions within the spatialization research complex. The first is that of mobilities and the second is that of networks. Through the uncovering of mobilities, such as the extent of foreign tertiary education or the flows of internal workplace migration, data analysis indicates potentials of spatial literacy as well as provides a ground to observe spatial formatting as a performance of movement in space. Meanwhile, individual and organizational networks unearthed through the dataset give insight into the human capital and social connectedness (guanxi) of the engineers, which were prerequisites for their agency as infrastructural entrepreneurs and which may also have worked as influences on the direction of the work they produced. In all aforementioned cases, theories of space are less presupposed into the database design than they are part of the data output and its interpretation.

To this regard, while contrived within a research context of the sociology of space, third parties are invited to analyse the data for their aims as well. To enable data analysis outside the entity spectrum of CERD, the complete or selected data can be exported and integrated into other databases, as described in chapter 4. The data exportability is ensured with related investigations such as the “Elites, Networks and Power” research project in mind.

1 The author of this manual is also a researcher within the group. Chen Hailian is co-opted to the SFB research group, and funded through her BMBF project “Die Wegbereiter von Chinas Aufstieg zur Technologiemacht: Technische Bildungseinrich- tungen und ihre Studierende im Zeitalter des Globalen Wandels, 1860–1911” [The pioneers of China’s rise to technological power: Technical educational institutions and their students in the age of global transformation, 1860–1911]. The following diligent student assistants pioneered our data input: Oliver Dieckmann, William Chin Fung Ng, and Felix Opper.


Sources

The data mining process can be divided into three phases according to the priority in the project and the effort required to collect the data from the sources. Where automatized digitalization is possible in an efficient manner, the sources have been scanned using optical character recognition (Tesseract OCR) and the results checked twice before finally being entered into the system. Minor sources of smaller scope are instead collected manually (see below).

Phase 1 – Gongchengren minglu

The first set of data being inputted is the Gongchengren minglu, a 1941 directory of engineers published by the National Resources Commission (Guojia ziyuan weiyuanhui, NRC). With approximately 13,000 entries, this directory is the largest of its kind. As the directory only concerns engineers, and as it was published four years after the end of the researched period, a manual sorting of the data is not necessary. The bullet point style of entries further eases the flow of data mining (see figure 1).

Phase 2 – Further directories

In the second phase, the data will be supplemented using further directories available. In contrast to the Gongchengren minglu, these directories are not exclusively listing engineers, but they include many of them. These sources include Who's who indices that list influential individuals and historical directories of students. Secondary literature further complements the results, listing students, technocrats, or influential individuals in general.

Phase 3 – Various archival sources

The data mining of the last phase is expected to be the least efficient. The sources consist of local gazetteers (difang zhi), member lists of professional engineering associations, and other scattered archival materials. As these sources have no consistent structure, they need to be worked through on

---

6 We thank Elisabeth Koll for providing us with a copy of the Gongchengren minglu.
a page-by-page basis, and as they are often of badly preserved condition and have a poor print quality, the information is faster inserted by hand than through OCR.

Structure

The database centres on biographical entries, the so-called person records (see figure 2). Each person record can have an unlimited amount of child records. These detail the person’s career path, either in the form of an educational record or an occupational record. These child records use their own predefined tables, but they cannot exist without referring to a person as their parent record. They describe an individual’s temporarily limited education or employment, not the place or location where this education or employment took place.

The educational and occupational child records refer to places where the person studied or worked. These are typically schools or companies. What differentiates these places from the child records is that each such institution exists as a stand-alone record within the system, without a unique parent record. In this way, many different persons’ careers can refer to the same institutional record. Instead of using a person record as the start of an enquiry, researchers can also start by browsing a school’s or a company’s record and from there track which individuals were associated with that institution.

Apart from the child records, the three table types – person, educational institution, and employer – all refer to a location record. For the individual, this is their birthplace, while in the other cases, this is place where the described entry – the headquarters or a subbranch – was located. There is only one location record type, regardless of whether the reference originates from a person, a school, or an employer. The location records are also self-referential, as every Chinese location that is not a province is itself referring to a provincial record (which is also a record that uses the location table).

Apart from (1) entries that are unique to one record [such as a person’s name or the name of a company] and (2) entries that refer to other tables [such as a person’s birthplace entry referring to a specific location table], the third entry type is the reference to a dictionary. Within the context of CERD, dictionaries are lists of precompiled vocabularies that have no additional information assigned to them. They are used to avoid ambivalence, differences in spelling, etc. of word entries (varchar). These are, for example, lists of company types to tag employers and lists of administrative division types to tag locations. These vocabulary lists can organically grow as the data input advances. However, the vo-
cabularies themselves are incapable of receiving additional information (i.e. additional columns), which differentiates the dictionaries from full-fledged record tables.

Both the six record table types (see figure 2) and the vocabulary list entries have unique IDs automatically assigned to them. These IDs can be used for queries (see chapter 3). In the case of the tables, the IDs are listed in the operator columns below. In the case of the vocabulary lists, as these dynamically grow, the design manual refrains from listing them with their corresponding IDs, although these can be discovered by the tech-savvy using the “defterms” table of the offline SQL export (see chapter 4.2).

Primary Record: The Person Table

Person tables are the primary record type of the database. They only include the most basic information about an individual – their name(s), lifespan, place of birth, gender, as well as a list of memberships in various organizations (see below). The details of their career are instead given in child records that are linked to the primary record (see chapter 2.2).

While the online interface prioritizes the *Hanyu pinyin* transcription of a name, this romanization system was not developed until the 1950s. Instead, when engineers adopted an international spelling of their name, they chose their own means of transcription. They sometimes transcribed their names according to the postal romanization system, but they often took many liberties. In CERD, this kind of spelling is referred to as a person’s “conventional” name. In the case that sources list further names for a person, for example a courtesy name (zi) or additional conventional names, these are included as “alternate names”.

<table>
<thead>
<tr>
<th>Description</th>
<th>Type</th>
<th>Value</th>
<th>Priority</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>integer</td>
<td>unique</td>
<td>automatic</td>
<td></td>
</tr>
<tr>
<td>Sources</td>
<td>dictionary → sources</td>
<td>multi</td>
<td>required</td>
<td>f.996</td>
</tr>
<tr>
<td>Family name, <em>Hanyu pinyin</em></td>
<td>varchar</td>
<td>single</td>
<td>required</td>
<td>f.1</td>
</tr>
<tr>
<td>Given name, <em>Hanyu pinyin</em></td>
<td>varchar</td>
<td>single</td>
<td>recommended</td>
<td>f.18</td>
</tr>
<tr>
<td>Chinese characters</td>
<td>varchar</td>
<td>single</td>
<td>recommended</td>
<td>f.993</td>
</tr>
<tr>
<td>Family name, conventional</td>
<td>varchar</td>
<td>single</td>
<td>optional</td>
<td>f.994</td>
</tr>
<tr>
<td>Given name, conventional</td>
<td>varchar</td>
<td>single</td>
<td>optional</td>
<td>f.995</td>
</tr>
<tr>
<td>Alternate names</td>
<td>varchar</td>
<td>multi</td>
<td>optional</td>
<td>f.132</td>
</tr>
<tr>
<td>Gender</td>
<td>dictionary → genders</td>
<td>single</td>
<td>optional</td>
<td>f.20</td>
</tr>
<tr>
<td>Birth date</td>
<td>integer</td>
<td>single</td>
<td>recommended</td>
<td>f.936</td>
</tr>
<tr>
<td>Place of birth</td>
<td>record → location</td>
<td>single</td>
<td>recommended</td>
<td>f.134</td>
</tr>
<tr>
<td>Death date</td>
<td>integer</td>
<td>single</td>
<td>recommended</td>
<td>f.937</td>
</tr>
<tr>
<td>Secondary &amp; preparatory</td>
<td>child → education</td>
<td>multi</td>
<td>optional</td>
<td>f.939</td>
</tr>
<tr>
<td>Tertiary education</td>
<td>child → education</td>
<td>multi</td>
<td>recommended</td>
<td>f.940</td>
</tr>
<tr>
<td>Occupations</td>
<td>child → occupation</td>
<td>multi</td>
<td>recommended</td>
<td>f.942</td>
</tr>
</tbody>
</table>
Clubs

The database knows two forms of membership: the membership in professional engineering organizations and the membership in clubs. The latter pertains to all forms of membership not included in the former and that are not a form of paid regular labour. This includes membership in student and alumni organizations, fraternities, and non-political service organizations.

Genders

The system knows the genders female, male, other, and unknown. In the case where historical dictionaries distinctively mark women, all other individuals are assumed male.

Sources

The system does not allow for the creation of a new primary record without the reference to a proper source. Source fields are multi-value entries so that existing records can at any time be supplemented with additional information gathered from a variety of sources.

Professional associations

The organization of engineers in professional associations is one of the primary research interests of the research project. The list includes any organization that defines its common membership through the occupation of engineering or its subdisciplines. Some of the associations can be suborganizations or regional branches of others, but an engineer is only linked to the branch or level of an organization as is recorded in the documented biographical information and historical membership lists.

Relationship types

Professional relations are an outcome of data analysis and must not be added manually. The relationship entry is reserved for family relations (child, parent, or sibling) and mentorships (student or teacher). As relationships must be linked to existing person records, only relations to engineers are part of the database.

Child records

CERD features two child record tables, which are similar in form and function. They detail the education(s) and occupation(s) of a person. Theoretically, child records have their own ID and can be accessed and displayed on their own. However, they cannot be created without an existing parent record attached to them, which differentiates them from the secondary records [see chapter 2.3].
Education

Each person can have an unlimited amount of education records assigned to them. While the education record can be assigned to a person record as either (a) secondary and preparatory, or (b) a tertiary form of education, both entries use the same child record mask.

<table>
<thead>
<tr>
<th>Description</th>
<th>Type</th>
<th>Value</th>
<th>Priority</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>integer</td>
<td>unique</td>
<td>automatic</td>
<td></td>
</tr>
<tr>
<td>Parent record</td>
<td>record → person</td>
<td>single</td>
<td>required</td>
<td></td>
</tr>
<tr>
<td>Educational机构</td>
<td>record → educational institution</td>
<td>single</td>
<td>recommended</td>
<td></td>
</tr>
<tr>
<td>Fields/majors</td>
<td>dictionary → fields/majors</td>
<td>multi</td>
<td>required</td>
<td></td>
</tr>
<tr>
<td>Degree</td>
<td>dictionary → degrees</td>
<td>multi</td>
<td>recommended</td>
<td></td>
</tr>
<tr>
<td>Start date</td>
<td>integer</td>
<td>single</td>
<td>optional</td>
<td></td>
</tr>
<tr>
<td>Graduation date</td>
<td>integer</td>
<td>single</td>
<td>recommended</td>
<td></td>
</tr>
<tr>
<td>Funding</td>
<td>dictionary → funding</td>
<td>single</td>
<td>optional</td>
<td></td>
</tr>
</tbody>
</table>

Degrees

For the case that the source specifies the degree awarded, this list includes titles from different academic cultures, such as bachelor, master, doctor, diploma, and juren.

Fields/majors

The fields of study include general studies such as “engineering” and “sciences” but also more specialized majors such as chemical, hydraulic, and mechanical engineering. The database also includes entry options for fields only partly related to engineering – for example, administration – and options for degrees completely unrelated to engineering – for example, political sciences – so that a complete educational biography can be inputted, including double degrees and studies pursued before the commencement of an engineering career.

Funding

This entity is aimed at distinguishing between private and government students, especially for the case of studies overseas and the enrolment in preparatory schools. The most prominent subcategory of government-funded students were those funded through the US Indemnity Scholarship Fund.

Occupation

Each person can have an unlimited amount of occupations assigned to them. Occupations are compensated forms of regular labour, which differentiates them from memberships in associations and service organizations.
<table>
<thead>
<tr>
<th>Description</th>
<th>Type</th>
<th>Value</th>
<th>Priority</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>integer</td>
<td>unique</td>
<td>automatic</td>
<td></td>
</tr>
<tr>
<td>Parent record</td>
<td>record → person</td>
<td>single</td>
<td>required</td>
<td>f:247</td>
</tr>
<tr>
<td>Employer</td>
<td>record → employer</td>
<td>single</td>
<td>required</td>
<td>f:21</td>
</tr>
<tr>
<td>Original occupational description</td>
<td>varchar</td>
<td>multi</td>
<td>recommended</td>
<td>f:983</td>
</tr>
<tr>
<td>Start date</td>
<td>integer</td>
<td>single</td>
<td>recommended</td>
<td>f:10</td>
</tr>
<tr>
<td>End date</td>
<td>integer</td>
<td>single</td>
<td>recommended</td>
<td>f:11</td>
</tr>
</tbody>
</table>

**Secondary Records**

The following three record types exist independent of the person record table. The first two – the employer and the educational institution records – are referred to by a person’s child records. The third one, the location record, is referred to by both the person record and by all secondary records.

**Employer**

The employer record provides basic information about a place of work, which can be referred to by the occupation child record. The employer record must not be confused with the dictionary for professional associations or the one for fraternities and non-political service organizations, which are used in the case of uncompensated memberships (see chapter 2.1).

<table>
<thead>
<tr>
<th>Description</th>
<th>Type</th>
<th>Value</th>
<th>Priority</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>integer</td>
<td>unique</td>
<td>automatic</td>
<td></td>
</tr>
<tr>
<td>Name of employer</td>
<td>varchar</td>
<td>single</td>
<td>required</td>
<td>f:1</td>
</tr>
<tr>
<td>Short name/acronym</td>
<td>varchar</td>
<td>single</td>
<td>optional</td>
<td>f:2</td>
</tr>
<tr>
<td>Organization type</td>
<td>dictionary → organization types</td>
<td>multi</td>
<td>recommended</td>
<td>f:22</td>
</tr>
<tr>
<td>Location</td>
<td>record → location</td>
<td>single</td>
<td>recommended</td>
<td>f:134</td>
</tr>
<tr>
<td>Mother organization</td>
<td>record → employer</td>
<td>single</td>
<td>optional</td>
<td>f:1003</td>
</tr>
</tbody>
</table>

**Organization types**

This list defines organization records as public or privately operated. It can further specify them as belonging to a branch such as railroads or government offices.

Mother organization
In cases where a subbranch of an organization is of considerable size, occupied with extraordinary tasks, or located at a different place, these branches are created as their own entries and are hierarchically linked to their mother organization.

**Educational institution**

The educational institution record template is the shortest within CERD. It only gives the name of the institution and links it with a location record.

<table>
<thead>
<tr>
<th>Description</th>
<th>Type</th>
<th>Value</th>
<th>Priority</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>integer</td>
<td>unique</td>
<td>automatic</td>
<td></td>
</tr>
<tr>
<td>Name of institution</td>
<td>varchar</td>
<td>single</td>
<td>required</td>
<td>f:1</td>
</tr>
<tr>
<td>Place</td>
<td>record → location</td>
<td>single</td>
<td>recommended</td>
<td>f:238</td>
</tr>
</tbody>
</table>

**Location**

The person, employer, and educational institution records, as well as the location record itself, can refer to this entity. For practical reasons, CERD only uses points (longitude and latitude) to refer to geographical locations. For larger geographical entities such as provinces and states, the political centre – e.g. the provincial or state capital – is used. Depending on the situation, users may want to replace these geospatial coordinates with vector shapefiles when creating their own graphical presentations.

<table>
<thead>
<tr>
<th>Description</th>
<th>Type</th>
<th>Value</th>
<th>Priority</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>integer</td>
<td>unique</td>
<td>automatic</td>
<td></td>
</tr>
<tr>
<td>Place type</td>
<td>dictionary → place types</td>
<td>single</td>
<td>recommended</td>
<td>f:113</td>
</tr>
<tr>
<td>Place name</td>
<td>varchar</td>
<td>single</td>
<td>required</td>
<td>f:1</td>
</tr>
<tr>
<td>Province</td>
<td>record → location</td>
<td>single</td>
<td>recommended</td>
<td>f:1002</td>
</tr>
<tr>
<td>Country</td>
<td>dictionary → countries</td>
<td>multi</td>
<td>recommended</td>
<td>f:26</td>
</tr>
<tr>
<td>Location</td>
<td>geospatial coordinates</td>
<td>single</td>
<td>recommended</td>
<td>f:28_lat and f:28_long</td>
</tr>
</tbody>
</table>

**Countries**

A list of (contemporary) countries to give a rough idea of national belonging of the locations; locations can be part of multiple countries for cases such as Republican-era Mongolia. The country entity does not aim to reconstruct the frequently changing political belonging of territories to the various Chinese and foreign political entities.
**Place types**

Location records have a place type assigned to them. The vocabulary list includes the administrative divisions of the Beiyang Republic (counties, towns, circuits, provinces, areas, regions, prefectures, special administrative regions, and commercial regions) and additionally has an entry for foreign independent countries and for US states. The status of a place may have changed through time, as did the structure of administrative divisions, so this entry can only give a basic idea of hierarchy in relation to other locations.

**Online Access**

The dataset can be accessed using Heurist, a web database interface that provides both a backend and a frontend for relational research data in the humanities. The CERD web frontend is kindly hosted by the University of Sydney and can be accessed through the following link:

https://heuristplus.sydney.edu.au/heurist/?db=tp86k_sfbdem&website#

The same website is accessible using this shortened URL:

https://tinyurl.com/cerd-leipzig

The online database can be cited, for example, as the following:


URLs for individual records can be created using the “cite as HTML” command within Heurist and can be cited as in the following example:


The Heurist interface can be used to query the database (see figure 3). There are mainly two reasons to do this. The first is historical lookups, for example to find all engineers that worked at a specific company or to find out the educational biography of a person of interest. The other usage case would be to select a limited dataset for further external analysis. For example, a query could select all people born in Hunan in order to export this specific set of data for visualization.

Below, the operators and symbols used for these queries are described, before exemplary queries are presented in order to give a clearer impression of the required syntax.

---


13 A thorough list of contributors is available on the database website. As the list of individuals involved, especially of the assistants inputting data, is constantly growing, it is not feasible to include a complete list of editors in print.
Operators and Symbols

The t-operator ("table") limits queries to specific record tables using their corresponding record ID:

<table>
<thead>
<tr>
<th>Record table</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employer</td>
<td>t:4</td>
</tr>
<tr>
<td>Location</td>
<td>t:12</td>
</tr>
<tr>
<td>Person</td>
<td>t:10</td>
</tr>
<tr>
<td>Educational institution</td>
<td>t:57</td>
</tr>
<tr>
<td>Occupation</td>
<td>t:61</td>
</tr>
<tr>
<td>Tertiary education</td>
<td>t:58</td>
</tr>
<tr>
<td>Secondary or preparatory education</td>
<td>t:56</td>
</tr>
</tbody>
</table>

Each field of a table can be addressed using the f-operator ("field") and the corresponding field ID as listed in chapter 2 of this manual.
Tables and fields can be limited using the following symbols:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>:</td>
<td>includes</td>
</tr>
<tr>
<td>=</td>
<td>is exactly</td>
</tr>
<tr>
<td>&gt;</td>
<td>greater than (integer)</td>
</tr>
<tr>
<td>&lt;</td>
<td>lesser than (integer)</td>
</tr>
<tr>
<td>OR</td>
<td>include either</td>
</tr>
<tr>
<td>-</td>
<td>omit</td>
</tr>
</tbody>
</table>

The online database distinguishes between simplified and traditional Chinese characters and only uses the latter. Using simplified characters in the search will not yield correct results.

**Sample Queries**

A fuzzy search that outputs all entities (person, educations, and occupations) with the names "Wang" and "Jingchun" involved:

```
Wang Jingchun
```

A more eloquent search that only outputs the primary record (the biographical entity) of individuals named Wang Jingchun:

```
t:10 Wang Jingchun
```

These queries are more precise but yield the same results:

```
t:10 f:1:Wang f:18:Jingchun
t:10 f:993:王景春
t:10 f:994=Wang f:995=Ching-chun
```

This query shows all engineers with degrees in civil engineering or hydraulic engineering:

```
t:10 f:940:civil OR f:940:hydraulic
```

To compare, a query that shows only engineers with degrees in both civil engineering and hydraulic engineering:

```
t:10 f:940:civil AND f:940:hydraulic
```

All engineers who studied at a university in Berlin:

```
t:10 f:940:berlin
```
Civil engineering degrees awarded at universities in Shanghai:

土木 f:964:上海

A search for degrees awarded at Tsinghua University that are not electrical engineering:

f:964:清華 -electrical

This query outputs all degrees awarded before 1912:

t:58 f:9<1912

This query outputs all educational institutions in Guangdong:

t:57 f:238:Guangdong

This query displays every employment at companies with *tielu* ("railway") in their name, limited to hiring in the 1920s:

t:61 f:21:鐵路 f:10>1919 f:10<1930

**Exports**

While the online frontend can be used for lookups and basic research, more complex analysis will require the export of selected data. The different means of export are described below. It is strongly suggested to use the export function of Heurist for this, but access to offline backups is also granted to secure long-term preservation of the research data. Following the description of different export methods, some usage examples are presented.

**Heurist Exports**

The backend of Heurist supports the export of queries as comma-separated value (CSV) files. As this is currently not possible through the frontend user interface, the interested researcher will need to either (a) need to inquire for a guest access to the CERD backend or (b) needs to download an offline export and import it into their own Heurist database (see chapter 4.2).

The advantage of using Heurist file exports instead of interpreting the offline backups through other means (see chapter 4.2) is that the files will be easy to read, tables that use data from multiple related record types can be generated easily, and much less computer expertise is necessary in the process.

**Offline Backups**

Bimonthly exports of the data will be made available through a public data repository once the first phase of data input (see chapter 1.2) has been completed. In contrast to the online version, the offline export does not come with an end-user interface. It is distributed as an XML and as a SQL file to be interpreted locally using the desired analysis tools. The export can be cited as:

For most purposes, the XML file will suffice. The XML file follows the Heurist Markup Language (HML) schema, so that it can be imported into other Heurist installations. For other uses, the XML file should first be converted to a CSV, JSON, or Excel file using amply available online convertors. As the table includes the data of all record table types, it must be cleaned manually to only include the types of data required. For instance, deleting all rows but those with the type ID 10 will yield a complete table of all person records (see chapter 3.1).

The second method – using the SQL backup – requires some basic knowledge of SQL. The database file (UTF-8 encoding) can be run on a (virtual) MySQL server in order to export selected data as tables, e.g. in Excel, JSON, or CSV format. The relevant records are in the “records” and “recdetails” tables. The SQL queries will require the same IDs as used for the online queries and as listed in chapter 2.

Usage Examples

After the desired data has been queried and exported, it can be analysed and visualized using tools and libraries such as amCharts, Gephi, RAWGraphs, or Vistorian. The following usage examples are not meant to represent outcomes of the research project. The visualizations are generated using a very early, limited data set that is not a representative account of the prosopography the research eventually aims for. They are included here only as proofs of concept and should not be cited for any research purposes.

The first example (see figure 4) uses data queried for engineers that studied abroad. The visualization traces their career path from their birth province to their educational institution and further to their place of employment. Such visualization can be used to find and display regional preferences to enrol in one or another university or to reveal tendencies for graduates of one university to join the same company.

![Fig. 4. Visualization of career paths from native place to university to workplace using amCharts](image)

Figure 5 uses the same data selection. The visualization was generated with Palladio. It uses the geospatial data of the engineers’ birthplaces and the locations of their educational institutions and connects them accordingly. The marker size is proportional to the occurrence of each birthplace or school.

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The research aspect of mobility can also be analysed when looking at the employments of the engineers and comparing these locations with their native places (see figure 6). Such a visualization can reveal domestic workplace migration among professionals. Apart from the phenomenon of urbanization, it can show old and new core regions of importance to the work of engineering. By querying the data pool for certain dates of employment, such an analysis could further be divided into defined time slices to show core/periphery developments through the decades.

The patent form of visualization for CERD is that of network graphs. Relations between different engineers can be displayed using common memberships in associations, common workplaces, or common alma maters as edges. As the amount of ready data is still small at this stage of the project, no meaningful proof of concept for network visualization can be presented in this working paper. Nonetheless, the analysis of professional networks makes one of the primary potentials of the database in the future.