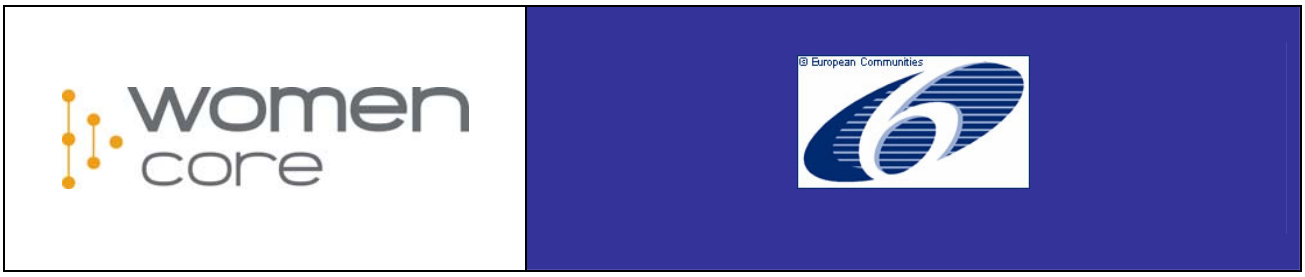

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DELIVERABLE 16 – COLLECTION AND ANALYSIS OF STATISTICAL DATA ON WOMEN'S PARTICIPATION IN CONSTRUCTION RESEARCH

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Abstract:

This report provides the results of Task 2.3 "Collection and analysis of statistical data on women's participation in construction patents" (leader CIFS) in WP2 *Improving the knowledge base of women in construction research: exploiting existing sources* (leader Loughborough University). The report provides an analysis of the share and number of women inventors participating in European patenting within the construction, chemistry, and pharmaceuticals sectors from 1994-2004. The report describes the creation of a first name database consisting of gender-segregated first names of EU25 countries that is used to identify the gender of inventors. It presents the changes in the gender balance in the three sectors, countries and patent classes (IPC classification) over an 11-year period. An analysis of the gender and nationality (country of residence) of research teams is also presented. The report concludes that the female proportion of inventors in the construction sector has grown, although from a very low level.

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INDEX

LIST OF TABLES AND FIGURES

COUNTRY ABBREVIATIONS

AT	Austria
BE	Belgium
CY	Cyprus
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
ES	Spain
FI	Finland
FR	France
GB	Great Britain
GR	Greece
HU	Hungary
IE	Ireland
IT	Italy
LT	Lithuania
LU	Luxembourg
LV	Latvia
MT	Malta
NL	Netherlands
PL	Poland
PT	Portugal
SE	Sweden
SI	Slovenia
SK	Slovakia

1. INTRODUCTION

This report describes the analysis and results of task 2.3 'Collection and analysis of statistical data on women's participation in construction patents'. It accomplishes this by measuring women's participation in different patent categories and the level of women inventors' 'patent production.

Patents, as a science and technology output marker, are important indicators to measure women's participation in construction research. For comparative purposes, the study is extended to the pharmaceutical and chemistry sectors, as earlier studies (see below) have shown that women in these sectors have a higher participation in patenting.

The data investigated in this study is derived from existing statistical sources from the European Patent Organisation (EPO).

1.1. AIMS AND OBJECTIVES

The overall aim of this task is to analyse women researchers' participation in obtaining patents in the construction sector. This is achieved by:

- Analyzing patents by gender, country and industrial sector.
- Identifying specific patterns and conditions relating to women's participation in patents in the construction sector.
- Comparing current conditions in the construction sector with those in the chemistry and pharmaceutical sectors.

As gender is not registered on patent applications, this study has produced gender-segregated data by analysing inventors' first names. For this purpose, a database of European first names has been created.

Data has been analysed, using "participation" as the main indicator – a method of measuring women's level of participation by country, sector and patent class.

1.2. BACKGROUND

The 'Women in Industrial Research' (WIR) study (2003), launched by the European Commission's DG for Research, pointed to the need to improve the quality of statistics on women in industrial research. The study points to a need for more gender segregated statistical

data in a number of key areas regarding science and technology. One of these areas is patents, which is an indicator of science and technology output. Patent applicants, however, do not state their gender in the patent application form. Thus, until recently, no statistical data on the gender balance of patent originators existed.

The study in this task is inspired by the 'Scientific and Technological Performance by Gender – A Feasibility Study on Patents and Bibliometric Indicators' by Fulvio Naldi and Illaria Vannini Parenti (Naldi & Parenti, 2002). This study assessed the feasibility of identifying inventors' gender by means of the inventors' first names. A comprehensive first name database of 5 European languages was created and used to identify the gender of inventors to all patents published by the European Patent Organisation (EPO) in 1998. According to their research, women inventors had the most *patents-equivalent*[1] in the pharmaceuticals and chemistry sectors.

Task 2.3 will investigate and compare women's participation in taking patents in the construction, pharmaceutical and chemistry sectors to expose the gender indicators that are relevant to construction research.

1.3. SCOPE OF WORK

First names from the EU25's 20 official languages have been collected and transliterated into a first name database (FNDB), which consists of more than 46,000 first names. Software has been written in order to select and analyse relevant data. The WOMEN-CORE team obtained PATSTAT data from the European Patent Office. The team analysed the data by gender, country, year of application and industry sector. The team analysed patent data relating to the construction sector by the number of patents, inventors, and by the gender makeup of research teams. The team also analysed and compared changes in women's participation in patents over the 11-year period from 1994-2004 in the three investigated industrial sectors – construction, pharmaceuticals, and chemistry.

[1] *Patents-equivalent* was conceptualised by Naldi & Parenti as a measure of contribution to the origination of patents.

1.4. ACCREDITATIONS

Thanks to Mrs. Sysse Engberg for her helpful assistance in identifying the gender of Greek first names and transcribing the names' lists. Mrs. Sysse Engberg is a lecturer of Modern Greek at the University of Copenhagen.

The research team is also grateful for Mrs. Ieva Pigozne's, Latvian Institute in Riga, assistance in collecting Latvian names.

Also, thanks to Mrs. Mehrak Maleki, construction expert and senior examiner at the Danish Trademark and Patent Office (Patent- og Varemærkestyrelsen) for her helpful advice and suggestions for defining the group of IPC codes relevant for the construction sector.

1.5. STRUCTURE OF THE REPORT

The report consists of four chapters, including this one.

Chapter two describes the methodology and nature of data sources utilized in this study. The chapter also describes the criteria used to collect first names, the creation and quality assessment process for the FNDB, and a brief description of the software used for data analysis. Furthermore, the report provides a detailed description of our approaches to analysing patent data.

Chapter three presents the analysis and the ensuing results from the patent and inventor data. The first subsection analyses the construction sector alone. The second subsection compares the construction sector to both the chemistry and pharmaceutical sectors.

Chapter four provides the conclusions and recommendations based on this study's results.

2. METHODOLOGY

This chapter describes the methodology and tools employed in the study's research design. First, a description of the creation of the First Name Database (FNDB) is provided. Second, this chapter describes the process by which the WOMEN-CORE team created the FNDB, since our approach differed from the methodology used in Naldi and Parenti's feasibility study (Naldi & Parenti 2002). This description is followed by a presentation of the FNDB's identification rate of inventors' gender and its reliability as a gender identification tool. Third, this chapter provides an introduction to the patent classification system and the PATSTAT data material, focusing on how these influenced the methodology employed in task 2.3.

2.1. THE FIRST NAME DATA BASE

The FNDB is a comprehensive collection of European first names, divided by country and gender. It is derived from sources such as websites, language experts and literature (mostly encyclopaedias and dictionaries).

The FNDB contains 46,619 names from all EU25 countries. 25,135 are identified as female; 21,107 are male names. 377 are identified as 'double-gendered', i.e. the name can be applied to both genders.

The FNDB was created primarily from sources found on the Internet that were considered valid and associated names with gender. The team consulted external experts and native speakers to verify some of the more ambiguous names.

The FNDB was inspired by 'A Feasibility Study on Patent and Bibliometric Indicators', which collected and gender differentiated first names in 5 countries[2] (Naldi & Parenti 2004). As task 2.3 covers the entire EU25, in contrast to just 5 countries covered in the Feasibility Study, the research design diverges from that of the Feasibility Study (Naldi & Parenti 2004).

Naldi & Parenti collected first names from dictionaries, encyclopaedias and other literature, as well as from Internet websites and files (Naldi & Parenti 2002:13). The names were differentiated by gender, often with the assistance of one or more native speakers of the languages included in the study. The fact that data was derived from paper sources meant that Naldi & Parenti inputted the data in their first name database manually (ibid: 14). For task 2.3, the WOMEN-CORE research team found this methodology too time-consuming to manually

[2] The countries included in the study were: Germany, Spain, France, UK and Sweden-

input names from EU25 countries. The research team concentrated its search to electronic sources where first names were already assigned with gender instead.

2.1.1. Sources and quality assessment

The research team used Internet websites as their primary source for the FNDB. A great deal of care should be taken when using Internet sites, as there are scientific dangers involved. Some Internet sites are user-edited, which implies that the contents are not or minimally reviewed. Other sites are controlled and edited by the author, but do not provide references and sources. Hence, it can be difficult to establish if Internet websites are reliable sources of information.

Below are 2 categories of sources with comments regarding their quality:

Dictionaries/encyclopedias: Are sources that are safe to use and contain only minor glitches if any at all. Usually these are in the form of books, containing articles that have been written by academically educated people, usually with some connection to universities. The category "Dictionaries" also contains encyclopedias, which come in the form of studies of names and naming traditions in a certain culture, region, or country. Usually, they make use of both contemporary and historical sources. Historically based sources provide valuable information about first name traditions in a certain area, but such studies have a tendency to focus on national borders, omitting new traditions and tendencies in giving first names, such as those coming from immigrants. Modern encyclopedias also have user-generated content.

Internet web pages: For the purpose of this task, searching for names on the Internet proved the most cost effective method to obtain data. There are many websites about names on the Internet, although the quality and quantity of sources regarding first names vary from country to country. Obviously, the major European languages (e.g. French, German and English) have more sources than marginal ones, which are spoken by relatively fewer people (e.g. Finnish, Maltese, Latvian, Lithuanian). The quality of available sources has more significance for our research than the quantity of available sources. Our research has prioritized data from official listings of the most common names – such as those provided by government agencies responsible for collecting statistical data (Slovenia, UK, Spain, Czech Republic, Sweden, etc.) – or more extensive lists of "authorized" names. Authorized names are those that are published by relevant authorities in countries with restrictive naming laws (e.g. Denmark, Portugal, and Estonia). Where these types of sources did not exist, the team derived data from naming days'

calendars (Latvia) and non-officially sanctioned Internet sites, such as Behind the Name[3] and Wikipedia[4]. Below is a table showing the various sources used in the research process for the FNDB.

Table 1. Source types and quality assessment.

Source quality	Source types
Good	Dictionaries and encyclopedias, list of approved first names published by governmental organizations, internet files published by universities and/or governmental organizations, experts such as university professors, 'natives'.
Medium	Internet sites with content edited by internal structures/editors Wikipedia
Poor	Internet sites where content is added by user

Source: CIFS.

A complete list of the sources is provided in Annex 1.

[3] Behind the Name (www.behindthename.com) is a collection of names of most of the world's languages. The site cites references.

[4] Wikipedia (www.wikipedia.org.) is a user-edited encyclopedia. The reliability of this source is thus not guaranteed. A recent study that compared Wikipedia with the Encyclopaedia Britannica, conducted by American scientists for the renowned science magazine *Nature,* concluded that Wikipedia was comparatively quite reliable. In compared articles, Wikipedia had a mistake ratio that was only a few percent higher than those in the Encyclopedia Britannica (*Nature* 438, 2005). With careful reviewing of its articles and its external references, we consider Wikipedia to be a medium-reliable source of knowledge and have, thus, used this source as a supplement to more acknowledged sources (scientific scripts, encyclopaedias, etc.).

2.1.2. Creation of the FNDB: From sources to database

European first names appear to be very similar in many countries. Spelling often deviates, as European languages include different letters and characters in their alphabets (ñ, ü, â, è, é, ł, œ, etc.). In order to simplify the processing of collected names in the FNDB, all variations of the same name (names that have identical spelling but have different special characters and accents) were standardized by transliteration to ASCII characters (ä to ae, ø to oe, ñ to n, ß to ss, etc.). After transliteration, duplicates were excluded. Names that can be used as both female *and* male names were removed from these categories and added to the 'Unknown sex' category. The research team developed special software for this process. Figure 2 (below) provides an overview of the capacity of the FNDB.

Table 2. Sex differentiated first names by language.

Language	Countries	Male	Female	Unknown sex	Total
CZ	CZ	1,482	2,047	6	3,535
DK	DK	5,240	7,406	196	12,842
DE	DE AT	398	448	4	850
EL	GR CY	348	222	0	570
UK	UK IE	1,979	1,991	138	4,108
ES	ES	245	317	0	562
EE	EE	621	676	0	1,297
FI	FI	291	262	0	553
FR	FR BE LU	4,722	5,338	10	10,070
HR	HR	169	152	0	321
IT	IT	673	857	3	1,533
LT	LT	38	39	0	77
LV	LV	1,867	2,605	2	4,474
MT	MT	84	68	7	159
NL	NL BE LU	305	334	7	646
PL	PL	137	147	0	284
PT	PT	549	495	2	1,046
SK	SK	191	196	1	388
SI	SL	991	987	1	1,979
SE	SE	777	548	0	1,325
-	EU25	21,107	25,135	377	46,619

Source: CIFS.

Table 2 shows significant variability in the number of names collected, which is a result of differences in the quantity and quality of available sources. The EU25 has 20 official languages, but many more are spoken in Europe. These unofficial languages also have an influence on naming practices in EU25 countries[5]. Hence, the team's research focused on sources that reflect actual naming practices (e.g. the most popular names) among the 20 official languages. The level of heterogeneity in first name traditions and practices differs widely from one language to another, as will be presented below.

The process of identifying the gender of inventors occurred in two steps. First, all inventors with a specific country code were compared to the first names collected in their country of origin. The inventors that were not identified in the first step were then compared to the total collection of first names from EU25 countries.

The chart below (Figure 3) presents the FNDB's gender identification success rate.

[5] http://ec.europa.eu/public_opinion/archives/ebs/ebs_243_sum_en.pdf (January 30, 2008)

Table 3. Identification rate by country when identifying gender of inventors by FNDB.

Country	All patentees	Gender identified	Gender identified (%)
AT	30,949	23,616	76.3%
BE	41,038	29,319	71.4%
CY	304	99	32.6%
CZ	9,455	7,483	79.1%
DE	506,902	413,808	81.6%
DK	31,499	23,895	75.9%
EE	1,755	910	51.9%
ES	39,445	29,503	74.8%
FI	34,051	21,105	62.0%
FR	165,812	117,401	70.8%
GB	187,656	143,390	76.4%
GR	1,610	1,102	68.4%
HU	18,247	14,113	77.3%
IE	7,594	4,499	59.2%
IT	71,394	53,299	74.7%
LT	877	428	48.8%
LU	2,267	1,148	50.6%
LV	1,091	979	89.7%
MT	55	15	27.3%
NL	74,377	48,726	65.5%
PL	23,357	18,792	80.5%
PT	2,339	1,588	67.9%
SE	45,014	32,848	73.0%
SI	3,164	2,400	75.9%
SK	2,764	2,272	82.2%
Total EU25	1,303,016	992,738	76.2%

Source: CIFS.

The FNDB's overall gender identification rate is 76.2%. The best results were achieved for Latvia (LV – 89.7%), Slovakia (SK – 82.2%), Germany (DE – 81.6%) and Poland (PL – 80,5%). The FNDB had the lowest gender identification rate in Malta (MT) with 27.3% and Cyprus (CY) with 32.6%. In 17 out of 25 countries, the FNDB was able to differentiate more than two thirds of inventors by sex.

An interesting finding is that there is no evident relation between the number of first names and the resulting gender differentiation rate. For Malta, the research team collected 159 gender

specific first names, which were used to identify 55 inventors' gender. The team, however, only achieved an identification rate of 27.3%, whereas for Germany, 850 gender specific first names identified more than 400,000 inventors. This points to high levels of heterogeneity in naming practices and to the obvious conclusion that quality of available sources, not the quantity of gender specific names, provides a better result.

2.2. THE PATENT DATABASE

The European Patent Organisation (EPO) has published 'the EPO Worldwide Patent Statistical Database' – also known as 'PATSTAT' – biannually since March 2006. This database contains data on granted patents from all over the world, with information extracted from the EPO's master bibliographical database 'DocDB' and other sources. Every patent is registered, including all changes and developments that occur during its lifetime as a legal document (application date, priority date, relation to other patents, etc.). An edition of PATSTAT can be considered a 'snapshot' of the database at a given moment, and the status of a single patent may change from one edition of PATSTAT to the next.

In its 2006-edition, the PATSTAT database (released 25 April 2007) contained about 60 million patent applications from more than 31 million inventors. From these, a subset of patents was selected according to the following criteria:

Table 4. Subset size and selection criteria.

Selection Criteria:	Individual persons in the sample:
Date of application within interval 1994-2004. **Patents with IPC codes defined as construction, chemistry or pharmaceuticals.**	**5,447,461**
Patentees registered by address in EU25[6].	**1,303,016**
Sex differentiated by the FNDB and identified as female or male.	**1,044,522**
Registered in the applications as inventors (Applicants that are not registered as inventors are left out. Applicants can be individual persons or a company or institution.)	**961,078**

Source: CIFS.

The final subset contains 931,740 applications relating to at least one of 961,078 inventors.

The research team classified those patents that related to construction, chemistry or pharmaceutical sectors according to the IPC-ISIC concordance table (Verspagen *et al.*) that established the relations between patent classification (IPC[7]) codes and industrial sectors. The pharmaceutical and chemistry sectors were well defined in the concordance table in terms of relevant patent classes. The research team extended the list of construction relevant patent

[6] The quality of patent application data fields could be improved: the 1.3 million inventors registered with a EU25 country code should be compared to more than 1.6 million inventors whose country code is unknown (see appendix 2). Thus, the number of inventors in Europe is possibly higher than the available data allows us to determine.

[7] International Patent Classification, which is the system employed by the European Patent Office (EPO).

classes suggested by the concordance table in order to fit the broad definition of construction employed in WOMEN-CORE. For this task, the research team consulted a professional expert in construction patents at the Danish Patent and Trademark Organisation.

The IPC-ISIC concordance table often times makes it difficult to assign a particular patent to a single industrial sector. In the IPC-ISIC concordance table, one patent class may be registered in several industrial sectors. Furthermore, the IPC classification system consists of categories that are not mutually exclusive. IPC categories are defined by different parameters such as the character of the invention, the material from which it is created, or the purpose or function of the invention. It follows that one invention can be assigned to more than one patent class. Similarly, one patent class may be identified as relevant in more than one of the sectors studied here, since chemistry and pharmaceuticals are in some cases very closely related. For example, much innovation in the pharmaceutical industry is the product of chemical research. Furthermore, chemistry researchers may invent some inventions that are especially relevant in the construction sector – as is the case in the cement industry.

2.3. MEASURING PARTICIPATION: PATENTS AND INVENTOR RELATIONS

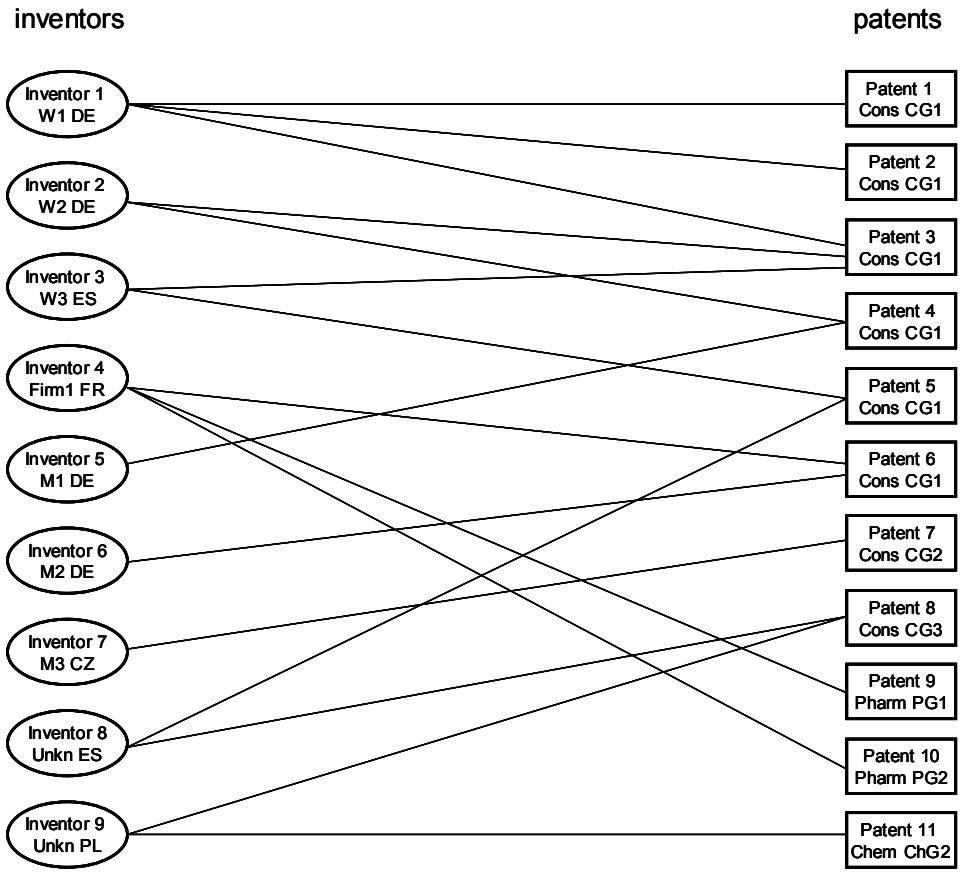
The analysis of patent data focuses on measuring women's ***participation*** in construction, chemistry and pharmaceutical sectors. Participation is defined as an indicator that counts the number of patents with at least one inventor of a given gender and country (Naldi & Parenti 2002, p 26).

Using the participation indicator, we focus on 'women's share of patents' – a measure of the proportion of patents, in which women participated in origination. In order to understand participation as a measure, it must be noted that the sum of relations between patents and inventors exceeds the *real* number of actual patents and inventors.

Patent and inventor data are structured as a complex web of relations between patents and inventors. The relationship between inventors and patents is a many-to-many relation, which is much more complicated to describe than one-to-one relations. Data is analysed according to several dimensions: country, gender, sector, patent class, and year of application for a patent. Since inventors and patents may relate to each other in several different ways, measuring participation in some instances implies a double counting of the same person and patent.

This is illustrated by the example in figure 1 and explained below.

Figure 1: A web of inventors and patents.



Source: CIFS.

Some patents in the figure can easily be classified according to gender and country of origin of the inventor. In other cases, the picture is murkier:

- The sole inventor of ”Patent 1” is a female inventor from Germany (coded ”W” and ”DE” respectively). The same applies to ”Patent 2”.
- ”Patent 3” is invented solely by female inventors – but they are from two different countries, Germany and Spain (DE and ES). This means that we can count this as a patent, invented by women, in both Germany and Spain – the patent is counted twice when we classify data according to country and gender of inventors.
- ”Patent 4” is invented by two inventors, both from Germany – but one is a man, another a woman. We count this patent twice when we classify patents according to gender of inventors.

- ”Patent 5” is invented by two inventors in Spain, one of which is a woman – but the other is of unknown gender. As we have left out the ‘Unknown gender’ category, we only count this patent once: as originated by a female inventor.

Some inventors have made inventions in what are defined analytically as different sectors – e.g., ”Inventor 9” of unknown gender, from Poland, has invented patents in both construction and chemistry sectors, something that does in fact occur in the dataset. Furthermore, there are a number of patent classes within the broad and rather loosely defined field of construction patents that could easily be defined as belonging to another industrial sector. It is also not uncommon for an inventor to have patents within several patent classes and industrial sectors.

In the real world, the patent relationship web is more complicated than in the figure above, which does not take into account the time dimension (an inventor may apply for a new patent several times over the course his/her career). Also, this model does not account for the inventors outside EU25, who originate patents in cooperation with an inventor(s) in EU25.

When we look at patents from Germany, we obviously include patents where all inventors are from Germany, but we also include those patents that German inventors originated with inventors from elsewhere. That is, in the figure above, “Patent 3” is counted both as 1 patent in Germany and as 1 patent in Spain. When classifying in this way, the sum of the numbers of patents from all 25 countries becomes larger than the total number of patents since some patents are included in more than one country.

Similarly, if a research group consisting of 1 woman and 4 men originated a patent, it is included in both the “women-invented patents” and as “men-invented patents” categories. The sum of the numbers of patents from men and women thus becomes larger than the total number of patents – since some patents are included in more than one gender category.

2.3.1. Two approaches: inventors or patents

The WOMEN-CORE team has worked with two different approaches to handling data in this report, analysing both inventor-based and patent-based data. When employing these two approaches, our research provides a more nuanced view of the relation between inventor and patent. This allows us to see inventor-patent relations as both a one-to-one and a many-to-one relationship.

Inventor data analysis: This approach makes use of inventor data only. In this approach, the same person can be found in the data more than once. If a person has invented (or participated in inventing) two products within *different* patent classes and we look at data drawn from the

database for different patent classes, then this person will be represented in each patent class. Or, if an inventor applies for patents several times during her career, she counts as one inventor in every year she applies. Thus, the sum of numbers of inventors proliferates with every level of detail we add to the analysis[8] and comparative analysis can only be done between data on equal level of detail. The figures we get from this analytic approach are indicators of participation, i.e. women's participation, Germany's participation, etc. by year, sector, or patent class.

In the inventor-based approach, we see each inventor-patent-relation as a separate case. Hence, we have no way of ascertaining the development of collaboration between inventors, including the possible trends in collaboration between men and women, and, in general, whether there is any gender bias in the formation of research teams. Therefore, we work with a second approach in the section on inventor groups.

Patent data analysis: Section 3.1.4 provides an analysis based on patent data. In this approach, we take patents as the point of departure, and we employ a different dataset that includes the unidentified inventors as well. Using this approach, an inventor can still be in more than one team, since one inventor may participate in the origination of several patents. We look at the relationships between a patent and its team of inventors. The gender composition of inventor groups cannot always be defined or is mixed (if we could identify the gender of all inventors, there would be mixed-gender groups, all female groups and all male groups. In fact, there are combinations with inventors of non-identifiable gender as well). The advantage of working in this way, however, is that we may be able to identify patterns of gender bias in the composition of research teams (e.g. are teams randomly forming, or are there preferences for single sex research teams?).[9]

[8] For instance the sum of inventors by gender + country does not equal the sum of inventors by gender + country + year of application.

[9] Please note that the analysis is only a partial analysis of gender bias in relation to team structure; we can analyse in relation to the overall population of construction inventors we find in the EPO data base, but there is no way to see whether the contributions of some people (men or women) were simply left out in patent applications.

3. ANALYSIS AND RESULTS

This chapter is structured as to first provide a detailed analysis of the general state of patents and inventors in the construction sector. The construction industry will then be compared to the chemistry and pharmaceutical sectors by way of selected analytical parameters/indicators.

3.1. CONSTRUCTION SECTOR

Patent data from the construction sector has been analysed thoroughly as this sector is the focus of WOMEN-CORE. The analysis of this sector is covered over four subchapters. In the first subchapter, patent data is analysed by the inventors' country of residence to depict the geographical dispersion of inventors. In the second, the Women-Core team analyses the internal distribution of construction sector patents and inventors. Data is further subdivided according to patent classes to indicate horizontal gender segregation in construction patenting. The Women-Core team presents the changes and growth rates of patent origination in the construction sector over a period of 11 years (1994-2004) in the third subchapter, which shows an increasing proportion of female inventors. Finally, an analysis of the composition of research teams/units that originate patents in construction is provided, as a complementary analytical perspective, which serves to nuance the analysis of gender segregation in construction patenting by describing the cooperation patterns among men and women patent originators.

3.1.1. Patents and Inventors by Country

There are great differences in the number of inventors and construction patents originated in each of the EU25 countries. As shown in table 5, the majority of construction inventors and patents are concentrated in very few countries. The most productive country by all measures is Germany, which contributes 48.8% of all inventors and 44.57% of patents in construction. As the cumulative percent shows, the top 5 countries (Germany, United Kingdom, France, the Netherlands and Italy) together account for more than 75% of inventors and patents. The top 9 countries – which also includes Poland, Spain, Austria and Sweden – represent more than 90% of patents and inventors (90.16%). 12 out of 25 countries each have less than 1% of inventors.

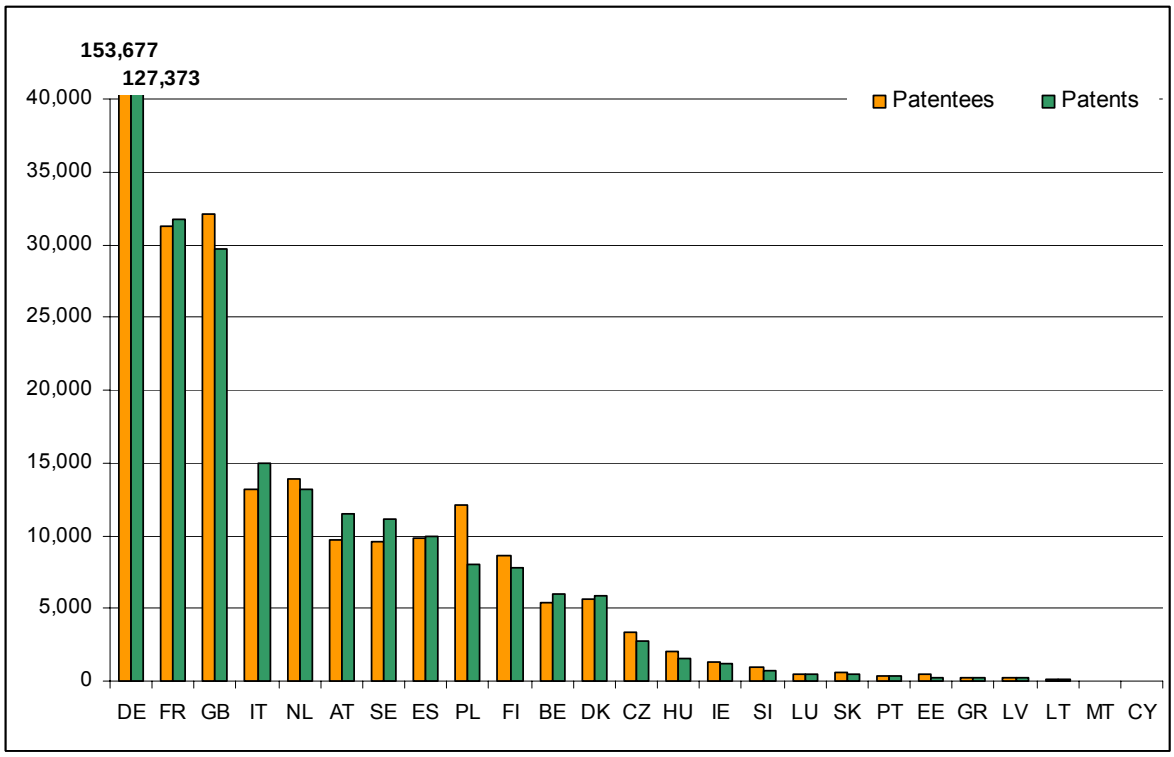
Table 5. EU25 construction sectors' inventors and patents per country in numbers, percent and cumulative percent (countries ordered by share of inventors).

Construction						
Country	Number of inventors	Share of inventors in %	Cumulative %	Number of patents	Share of patents in %	Cumulative %
DE	153,677	48.80%	48.80%	127,373	44.57%	44.57%
GB	32,066	10.18%	58.99%	29,690	10.39%	54.96%
FR	31,307	9.94%	68.93%	31,724	11.10%	66.06%
NL	13,870	4.40%	73.33%	13,215	4.62%	70.69%
IT	13,136	4.17%	77.51%	14,956	5.23%	75.92%
PL	12,044	3.82%	81.33%	8,051	2.82%	78.74%
ES	9,859	3.13%	84.46%	9,950	3.48%	82.22%
AT	9,721	3.09%	87.55%	11,508	4.03%	86.25%
SE	9,614	3.05%	90.60%	11,189	3.92%	90.16%
FI	8,627	2.74%	93.34%	7,780	2.72%	92.89%
DK	5,591	1.78%	95.12%	5,920	2.07%	94.96%
BE	5,348	1.70%	96.82%	5,949	2.08%	97.04%
CZ	3,327	1.06%	97.87%	2,778	0.97%	98.01%
HU	2,022	0.64%	98.52%	1,579	0.55%	98.57%
IE	1,346	0.43%	98.94%	1,212	0.42%	98.99%
SI	935	0.30%	99.24%	744	0.26%	99.25%
SK	571	0.18%	99.42%	442	0.15%	99.40%
LU	432	0.14%	99.56%	475	0.17%	99.57%
EE	428	0.14%	99.69%	273	0.10%	99.67%
PT	357	0.11%	99.81%	354	0.12%	99.79%
LV	243	0.08%	99.88%	181	0.06%	99.85%
GR	216	0.07%	99.95%	271	0.09%	99.95%
LT	113	0.04%	99.99%	106	0.04%	99.99%
CY	20	0.01%	100.00%	20	0.01%	99.99%
MT	14	0.00%	100.00%	22	0.01%	100.00%
EU25	314,884	100.00%		285,762	100.00%	

Source: CIFS.

The data in the table are presented in a graphic (see figure 2 below).

Figure 2. Construction inventors and patents by country. 1994-2004 total.



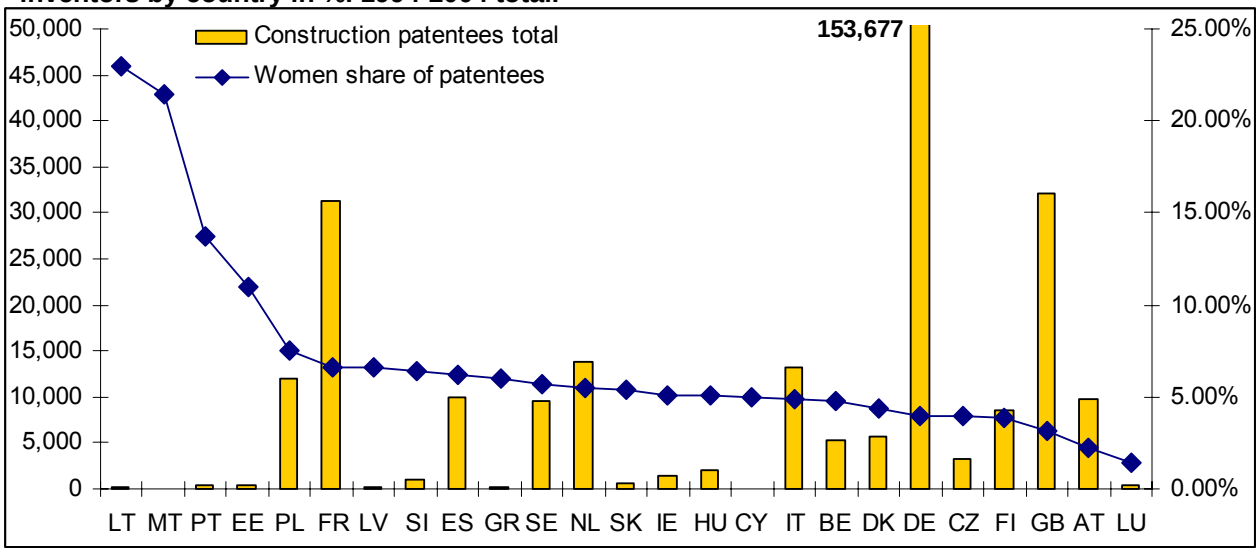
Source: CIFS.

A graphical presentation of the figures on patents and inventors visually stresses the huge differences in the distribution of construction patents and inventors. Germany has 127,373 patents while France, its nearest successor, accounts for 31,724 patents; approximately one fourth of the number of German patents. The fourth country in this sequence - Italy – hosts 14,956 construction patents, i.e. approximately half of the number of patents in France.

3.1.1.1. Women participation

14,309 out of 314,884 construction inventors in the compiled dataset - or 4.54% - are women. In the construction sector, the percentage of female inventors in most countries deviates only slightly from this figure, as seen in the figure 3 (below). Countries with relatively high proportions of women construction inventors have few construction inventors. Thus, Lithuania's relatively large share of women inventors in construction (23.01%) is derived from just 113 inventors. While in Germany, which has more than 150,000 construction inventors, women only constitute 4% of the total number of inventors. However, Poland and France both have large numbers inventors and relatively high proportions of women inventors (7.53% and 6.64%, respectively).

Figure 3. Total number of construction inventors and women's share of construction inventors by country in %. 1994-2004 total.



Source: CIFS.

The figures are presented in Table 6 below.

Table 6. Total number of construction inventors and women's share of inventors by country in %. 1994-2004 total.

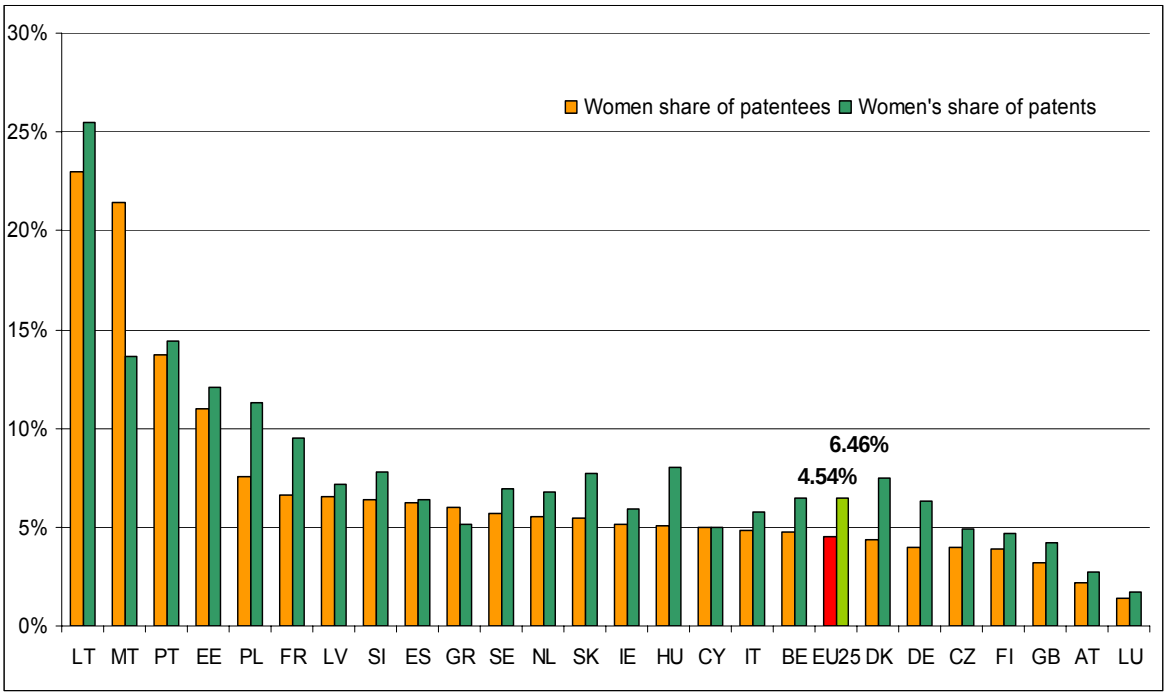
Construction		
Country	Construction patentees total	Women share of patentees
LT	113	23.01%
MT	14	21.43%
PT	357	13.73%
EE	428	10.98%
PL	12,044	7.53%
FR	31,307	6.64%
LV	243	6.58%
SI	935	6.42%
ES	9,859	6.20%
GR	216	6.02%
SE	9,614	5.71%
NL	13,870	5.52%
SK	571	5.43%
IE	1,346	5.13%
HU	2,022	5.04%
CY	20	5.00%
IT	13,136	4.83%
BE	5,348	4.73%
DK	5,591	4.40%
DE	153,677	4.00%
CZ	3,327	3.94%
FI	8,627	3.87%
GB	32,066	3.17%
AT	9,721	2.21%
LU	432	1.39%
EU25	314,884	4.54%

Source: CIFS.

As mentioned in the methodology chapter, this study measures participation as 'patent relations' and not patents as units. In this regard, 'women patents' are defined as patents related to women; i.e. patents originated in whole or in part by women.

Women's share of construction patents is higher than the share of women inventors. This may be explained by the fact that a patent may have many registered inventors. For example, if 'patent X' has 8 inventors, 7 of which are male, while 1 is female, we have 1 'male-related' patent' and 1 'female-related' patent.

Figure 4. Women's share of construction inventors and patents* by country in %. 1994-



Source: CIFS.

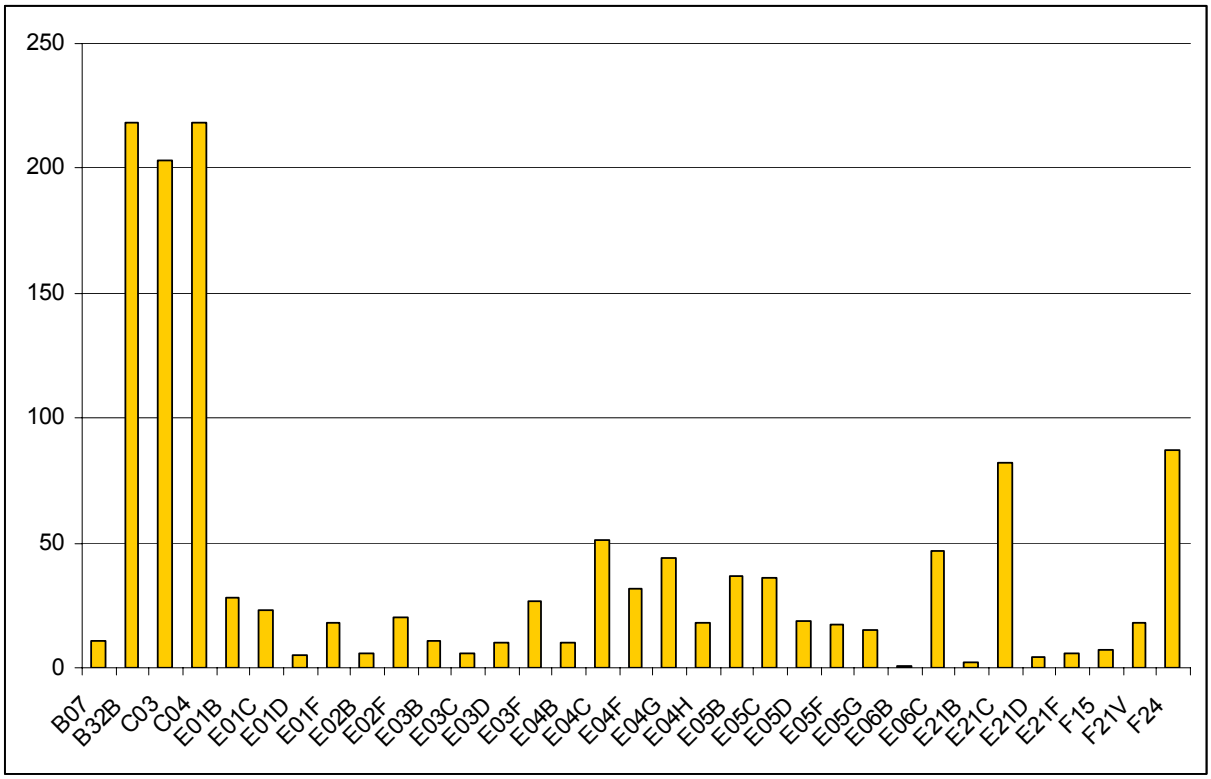
*** Share of patents related to women (women involved in origination).**

4.54% of construction inventors in EU25 are women and 6.46% of all construction patents have been originated in part by women. Generally, the countries with relatively large numbers of inventors have a small proportion of female inventors.

3.1.2. Patents and Inventors by Patent Classes in Construction

An analysis of the distribution of inventors – especially female inventors – by patent classes is performed in order to produce indicators of the horizontal segregation of inventors in construction patenting. The 33 patent classes identified as relevant to construction research and descriptions of the contents of each patent class are provided in Annex 3.

Figure 5. Number of female construction inventors by patent class (2004).

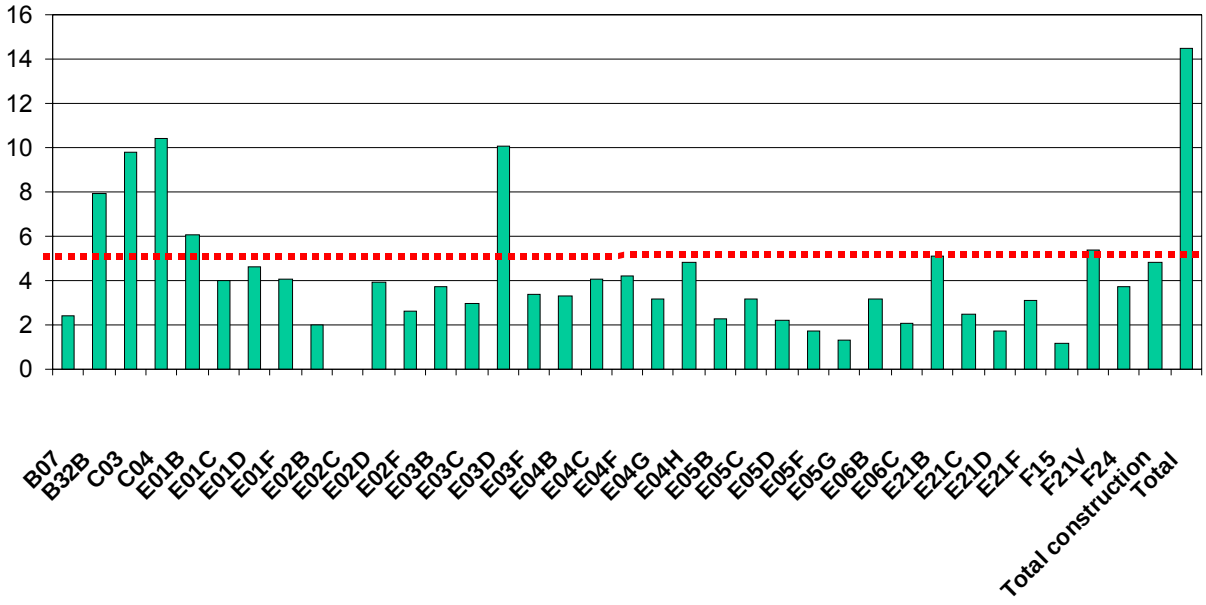


Source: CIFS.

The patent classes with a relatively high participation of women inventors in 2004 are:

- **B32B:** *Layered products, i.e. products built up of strata of flat or non-flat, e.g. cellular or honeycomb, form.*
- **C03:** *Glass; mineral or slag wool.*
- **C04:** *Cements; concrete, artificial stone; ceramics; refractories.*
- **E21C:** *Mining or quarrying.*
- **F24:** *Heating, ranges, ventilating.*

Figure 6. Proportion of female inventors by patent classes in construction, compared to sectoral average (4.8%). 1994-2004 total.



Source: CIFS.

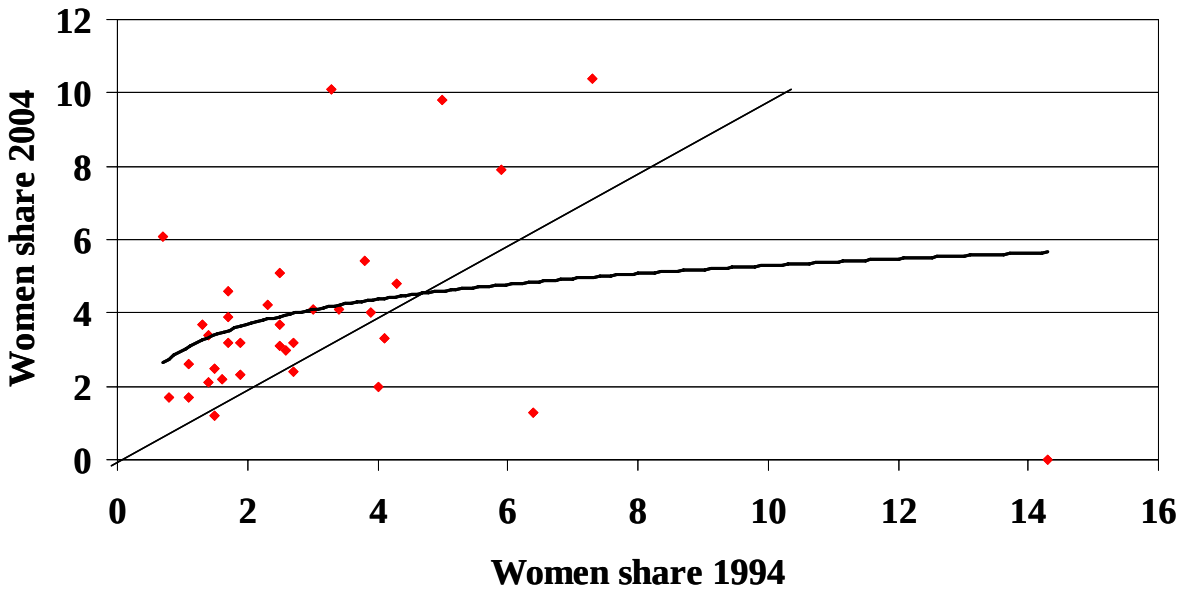
Note: Here, 'total' indicates proportion of women inventors in construction, chemistry and pharmaceutical sectors.

The average proportion of women inventors in the construction sector is 4.8%. In a few patent classes the women share of inventors is higher. These are B32B, C03, C04 (described above) and furthermore:

- **E03D:** *Water-closets or urinals with flushing devices; flushing valves.*

Figure 7 shows a positive correlation between the proportion of female construction inventors in 1994 and 2004, indicating a general growth of the women share in the construction sector in the time series studied. The proportion of female inventors has increased slightly in the majority of construction patent classes.

Figure 7. Correlation of the proportion of women inventors in 1994 with the proportion of women inventors in 2004 by patent classes in construction. Figures in %.



Source: CIFS.

3.1.3. Changes in Construction Patenting 1994-2004

3.1.3.1. Changes in Numbers of Women Inventors

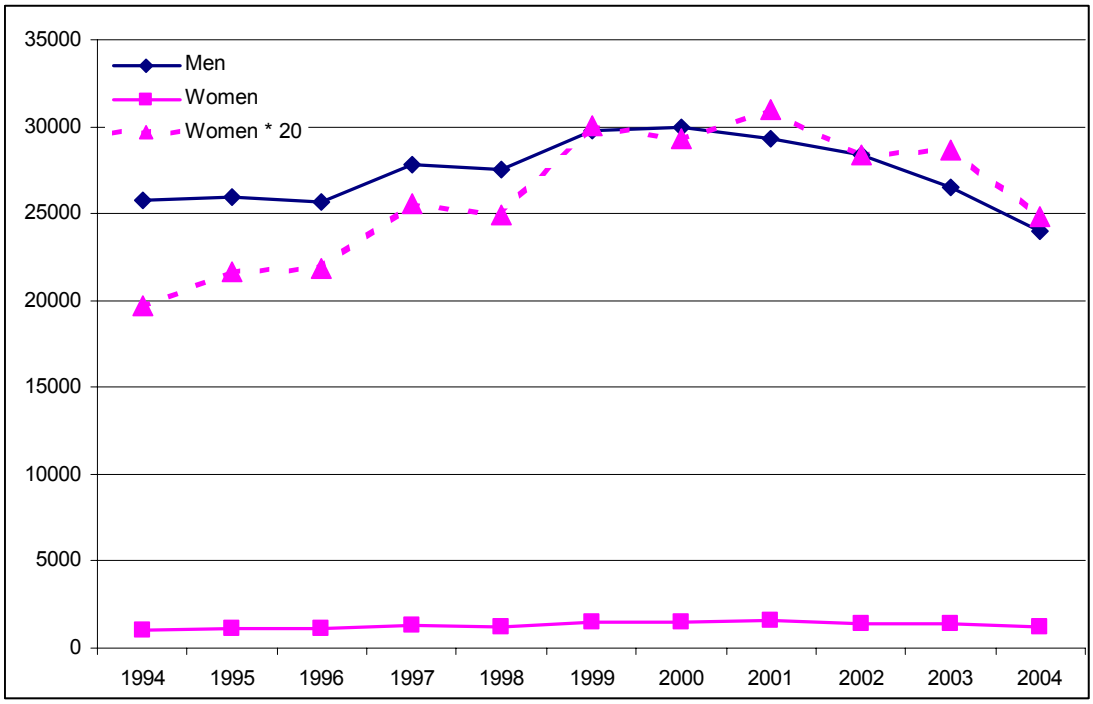
This section describes the changes in the construction sector over a period of 11 years (1994-2004) and analyses the direction the sector is heading in terms of the overall number of women inventors.

In studies of patents such as this one, time series must be considered in relative terms, because the course of patent application administration may take up to three years from the date of application until a patent is eventually granted[10]. The PATSTAT data includes only granted patents, which are registered by their date of application. This implies that in the most recent years there is a systematic decline in the number of patents, because only few of the patents applications have been granted, while most applications are still in process.

[10] Danish Patent and Trademark Office (Patent- og Varemærkestyrelsen): http://startguiden.dkpto.dk/_brochurer/patent/PATvejledning.pdf

Initial inquiries into the entire PATSTAT database showed a steady growth of patents for all years until 2004, after which the numbers decreased dramatically. Hence, 2004 and "ten years back" were selected as the time series for this study. However, figure 8 (below) shows that a systematic decrease in the number of inventors started as soon as 2000 (for men at least).

Figure 8. Change in numbers of men and women inventors in construction 1994-2004.



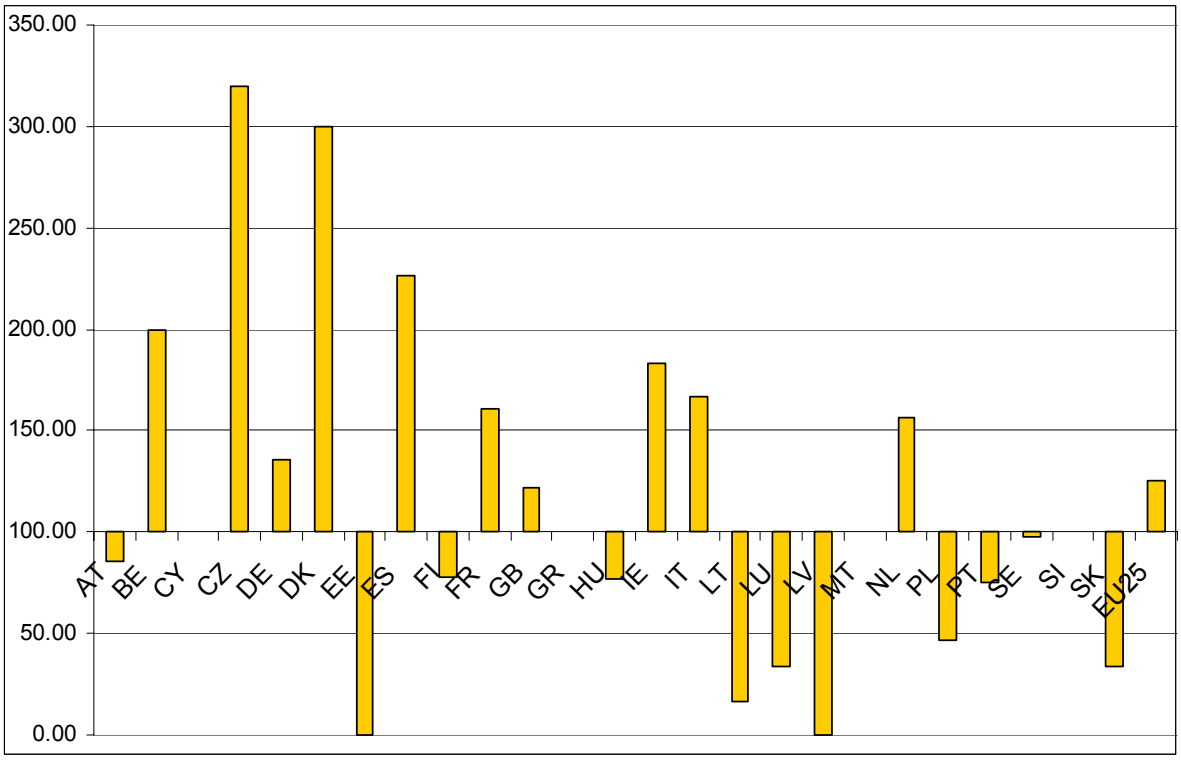
Source: CIFS.

In figure 8, the 'Women' curve seems to express a constant number of women inventors in contrast to the 'Men' curve. However, in order to gain a better understanding in the absolute numbers of women inventors, the Women-Core team multiplied 'Women' figures by 20 ('Women * 20') in order to create a comparable illustration to 'Men'. The 'Women *20' curve shows a slight 'catch-up' effect. From 1994 to 2000, the number of women grew relatively more than the number of men. After year 2000, the 'Women *20' and the 'Men' curves run in parallel, showing that the relative changes in number of inventors have been similar for men and women.

Figure 8 also illustrates that from 1994 to 2004, the overall number of male inventors declined while the number of female inventors increased.

Figure 9 shows the growth in actual numbers of women inventors in the construction sector. Overall, the number of women inventors in construction increased by 25.73% between 1994 and 2004, but there are significant differences between the countries.

Figure 9. Index: Change in number of women inventors in construction by country, 1994-2004 (1994=100).



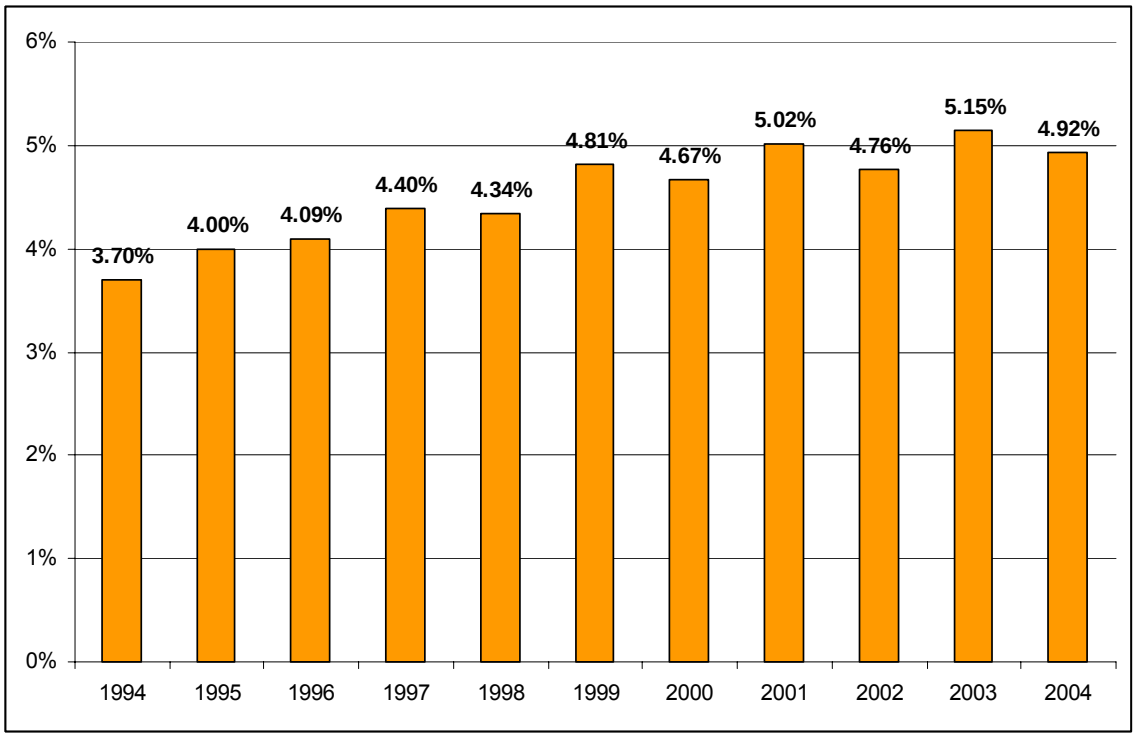
Source: CIFS.

The Czech Republic, Denmark, Spain and Belgium have had the largest increase (200% or more) in the number of women inventors in the construction sector. Six of the nine countries with most inventors in the construction sector had an increase in the numbers of women inventors. Four of these countries had an increase in the number of women inventors of 150% or more. Simultaneously, 7 of the 10 countries with the fewest inventors experienced a decline in the total number of female inventors. In some countries, the number of female inventors dropped to zero in 2004 (Estonia and Latvia), a fall of 100%. For Cyprus and Malta, the lack of change actually hides the fact that there were no female construction inventors in both countries in 1994 and 2004.

3.1.3.2. Changes in Women Shares of Inventors.

In prior sections, measures of shares of female inventors have proved an important indicator of women's participation in construction patenting. In this section we look at the changes in the proportion of female inventors.

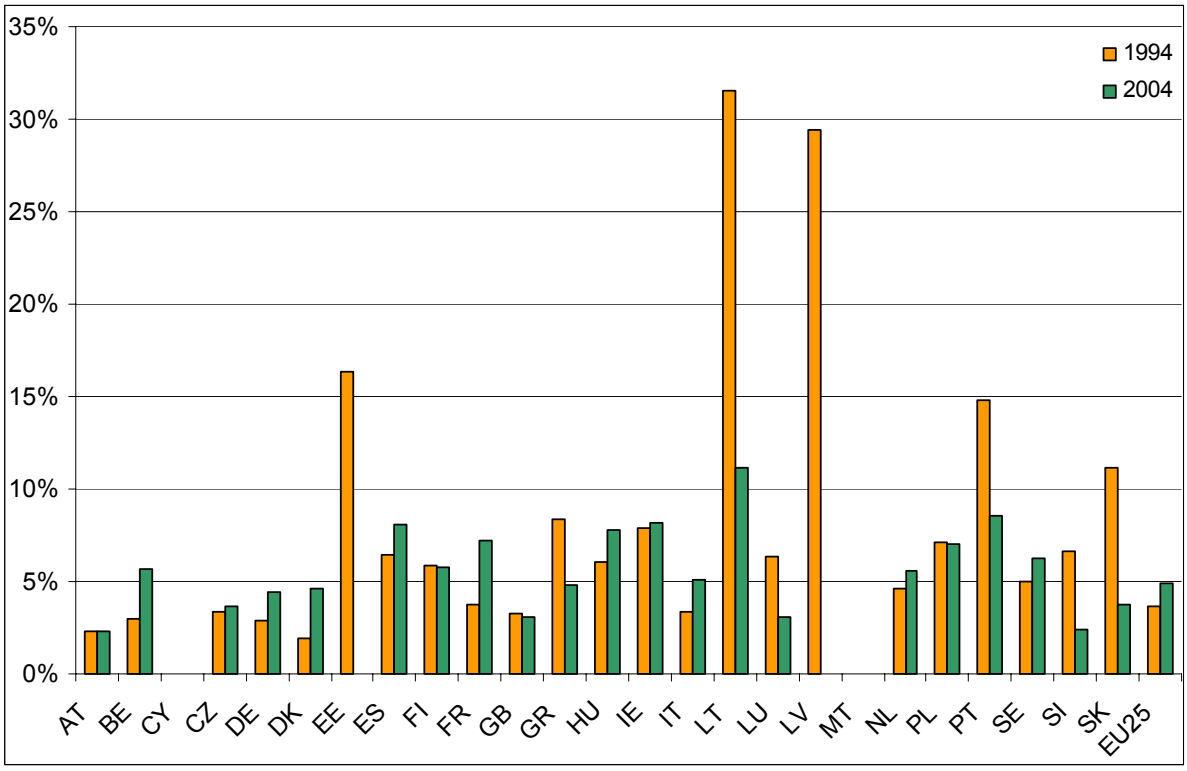
Figure 10. Proportion of women construction inventors in EU25 (1994-2004 total.).



Source: CIFS.

In figure 10, the change in the proportion of women construction inventors indicates a slow, but steady growth. The share of women construction inventors in EU25 grew by 1.22 percentage points from 1994 to 2004. The largest proportion of women inventors occurred in 2001 (5.02%) and 2003 (5.15%). The figure for year 2004 (4.92%) is presumably influenced by the aforementioned European-wide decline in granted patents.

Figure 11. Change in women's overall share of inventors in construction by country, 1994-2004.



Source: CIFS.

The proportion of women inventors increased in six of the 9 countries with the most construction inventors[11] between 1994 and 2004: (Germany (1.57 percentage points, p.p.), Spain (1.68 p.p.), France (3.46 p.p.), Italy (1.78 p.p.), Netherlands (0.95 p.p.) and Sweden (1.18 p.p.)). Besides these countries, Belgium, Denmark and Hungary also experienced increases in the proportion of female inventors. The most significant increases in women shares of inventors are in France (3.46 percentage points, p.p.), Belgium (2.72 p.p.), and Denmark (2.69 p.p.).

Estonia, Greece, Lithuania, Latvia, Portugal, Slovenia and Slovakia experienced significant decreases in women's share of construction inventors. These 7 countries are all minor players in construction patenting in EU25 (less than 1,000 construction inventors in total). This implies that if the total number of inventors is very low, even minor changes in numbers of women inventors appear as significant changes in the *proportion* of women inventors.

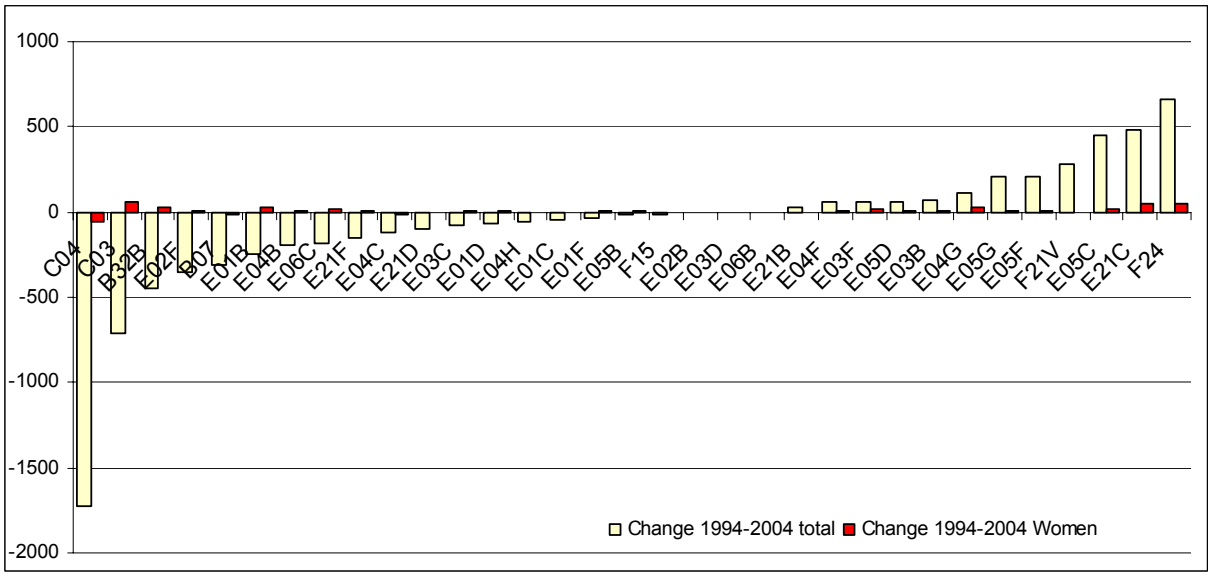
[11] The nine countries with most construction inventors are: Germany, UK, France, Netherlands, Italy, Poland, Spain, Austria and Sweden (see table 5).

In conclusion, the overall number of women construction inventors has increased from 1994 to 2004, and this increase was relatively higher than the increase of men until 2001. The share of female inventors increased in the countries with most inventors in construction research, while countries with relatively few inventors experienced further reduced proportions of female inventors.

3.1.3.3. Changes by patent classes

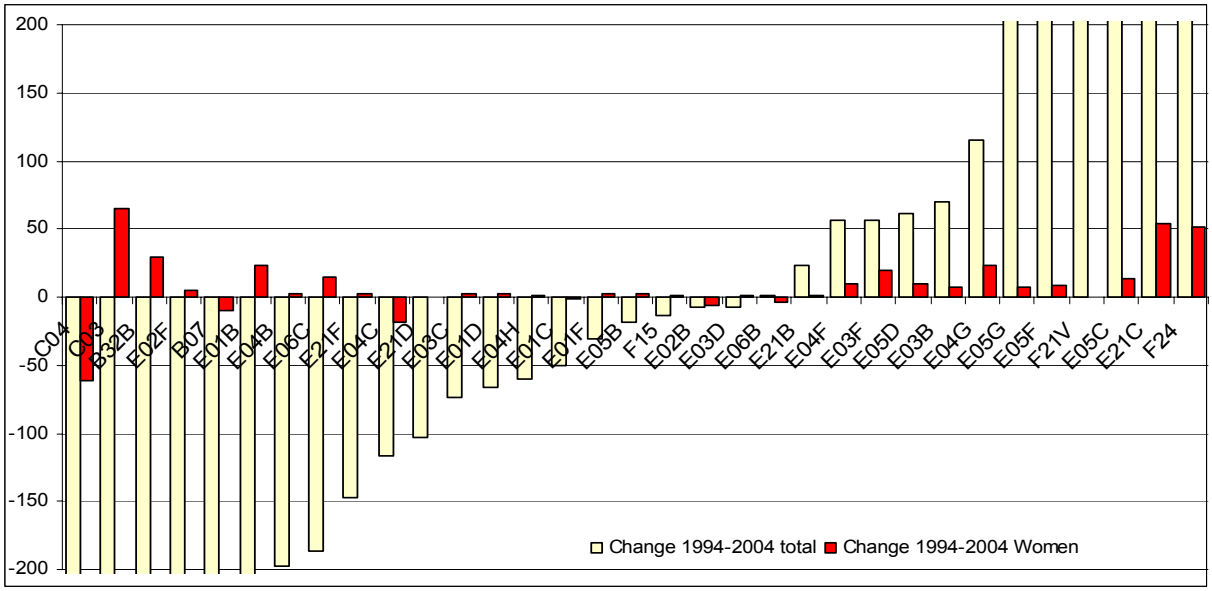
Figures 12a-b (below) presents changes in numbers of female inventors from 1994-2004 in the construction sector by patent class. A data table of dynamics figures is presented at the end of this section.

Figure 12a. Dynamics in construction 1994-2004. Changes in numbers of women construction inventors and total construction inventors by patent class.



Source: CIFS.

Figure 12b. Dynamics of inventors in construction 1994-2004. Changes in numbers of women construction inventors and total construction inventors. (*Figure 12a enlarged).*



Source: CIFS.

Patent classes were sorted according to their absolute increase or decrease in numbers of inventors.

Within the timeframe, the numbers of inventors dramatically decreased in two patents classes: **C04** *Cements, concrete, artificial stones, ceramics* with a 45% reduction of total inventors (1,730 of 3,726 inventors) and **C03** *Glass; mineral or slag wool* with a 25% reduction of total inventors (708 of 2,770 inventors). Such extreme decreases suggest a major structural change that is not related to countries or to gender[12].

At the other end of the scale, the number of total inventors in **F24** *Heating; ranges; ventilation* increased by 661 inventors or 70% over the original 943 inventors.

Our immediate interpretation of changes of this magnitude suggests major structural trends in Europe that are not related to countries or to gender and tend to overrule the small-scale differences between sexes and countries.

[12] Part of the reduction relates to the systematic decline in granted patents, as discussed in the section 3.1.3, but this reduction is general and should influence equally on all patent classes and genders.

In 20 of 33 patent classes, the numbers of inventors decreased, resulting in an overall negative change in construction inventors (-2204 inventors).

The overall number of women inventors grew by 261 women inventors – (or approximately 25% as was also shown in section 3.1.3.1). The number of female inventors has increased in most patent classes (25 of 33) – including all high growth classes. In 14 of 20 patent classes, the number of women increased while the total number of construction inventors was reduced.

The number of female inventors increased significantly (i.e. by more than 50 persons) in **C03** *Glass; mineral or slag wool* (+65 persons), **E21C** *Mining and quarrying* (+54 persons), and **F24** *Heating; ranges;ventilating* (+51 persons).

The most significant decrease of women inventors happened in **C04** *Cements; concrete, artificial stone, ceramics; refractories* (-61 persons).

Overall, three patent classes have a relatively high proportion of women inventors in construction (see table 7):

- **C04** *Cements; concrete, artificial stone, ceramics; refractories*,
- **B32B** *Layered products* and
- **C03** *Glass; mineral or slag wool*.

The patent classes also have a markedly higher participation of women (in numbers). These patent classes together hosted 60% of women inventors in 1994 and 48% in 2004. **C04** accounts for 61% of the total reduction of women, while **C03** and **B32B** together account for 26% of the total increase of women inventors.

As for the other 30 patent classes, the overall number of women is very low, which is why a further division of the data by country is not carried out.

Table 7. Dynamics of inventors in construction 1994-2004, inventors total compared to women inventors.

Patent class	Description of patent classes	Change total		Change women	
		Total 1994	94-04	Women 1994	94-04
C04	CEMENTS; CONCRETE; ARTIFICIAL STONE; CERAMICS; REFRACTORIES	3,826	**-1,730**	279	**-61**
C03	GLASS; MINERAL OR SLAG WOOL	2,770	**-708**	138	**65**
B32B	LAYERED PRODUCTS, i.e. PRODUCTS BUILT-UP OF STRATA OF FLAT OR NON-FLAT, e.g. CELLULAR OR HONEYCOMB, FORM	3,197	**-445**	188	**30**

E02F	DREDGING; SOIL-SHIFTING	866	**-356**	15	**5**
B07	SEPARATING SOLIDS FROM SOLIDS; SORTING	778	**-311**	21	**-10**
E01B	PERMANENT WAY; PERMANENT-WAY TOOLS; MACHINES FOR MAKING RAILWAYS OF ALL KINDS	706	**-248**	5	**23**
E04B	GENERAL BUILDING CONSTRUCTIONS; WALLS, e.g. PARTITIONS; ROOFS; FLOORS; CEILINGS; INSULATION OR OTHER PROTECTION OF BUILDINGS	488	**-198**	7	**3**
E06C	LADDERS	1,650	**-187**	32	**15**
E21F	SAFETY DEVICES, TRANSPORT, FILLING-UP, RESCUE, VENTILATION, OR DRAINAGE IN OR OF MINES OR TUNNELS	497	**-147**	4	**2**
E04C	STRUCTURAL ELEMENTS; BUILDING MATERIALS	1,667	**-117**	69	**-18**
E21D	SHAFTS; TUNNELS; GALLERIES; LARGE UNDERGROUND CHAMBERS	265	**-103**	4	**0**
E03C	DOMESTIC PLUMBING INSTALLATIONS FOR FRESH WATER OR WASTE WATER	238	**-74**	3	**3**
E01D	BRIDGES	175	**-66**	3	**2**
E04H	BUILDINGS OR LIKE STRUCTURES FOR PARTICULAR PURPOSES; SWIMMING OR SPLASH BATHS OR POOLS; MASTS; FENCING; TENTS OR CANOPIES, IN GENERAL	621	**-60**	17	**1**
E01C	CONSTRUCTION OF, OR SURFACES FOR, ROADS, SPORTS GROUNDS, OR THE LIKE; MACHINES OR AUXILIARY TOOLS FOR CONSTRUCTION OR REPAIR	620	**-50**	24	**-1**
E01F	ADDITIONAL WORK, SUCH AS EQUIPPING ROADS OR THE CONSTRUCTION OF PLATFORMS, HELICOPTER LANDING STAGES, SIGNS, SNOW FENCES, OR THE LIKE	467	**-31**	16	**2**
E05B	LOCKS; ACCESSORIES THEREFOR; HANDCUFFS	793	**-18**	34	**3**
F15	FLUID-PRESSURE ACTUATORS; HYDRAULICS OR PNEUMATICS IN GENERAL	238	**-13**	6	**1**
E02B	HYDRAULIC ENGINEERING	302	**-7**	12	**-6**
E03D	WATER-CLOSETS OR URINALS WITH FLUSHING DEVICES; FLUSHING VALVES THEREFOR	344	**-7**	9	**1**
E06B	FIXED OR MOVABLE CLOSURES FOR OPENINGS IN BUILDINGS, VEHICLES, FENCES, OR LIKE ENCLOSURES, IN GENERAL, e.g. DOORS, WINDOWS, BLINDS, GATES	78	**1**	5	**-4**
E21B	EARTH OR ROCK; OBTAINING OIL, GAS, WATER, SOLUBLE OR MELTABLE MATERIALS OR A SLURRY OF MINERALS FROM WELLS	74	**23**	1	**1**
E04F	FINISHING WORK ON BUILDINGS, e.g. STAIRS, FLOORS	722	**56**	22	**10**
E03F	SEWERS; CESSPOOLS	211	**57**	7	**20**
E05D	HINGES OR OTHER SUSPENSION DEVICES FOR DOORS, WINDOWS,	531	**61**	9	**10**

	OR WINGS				
E03B	INSTALLATIONS OR METHODS FOR OBTAINING, COLLECTING, OR DISTRIBUTING WATER	358	**70**	4	**7**
E04G	SCAFFOLDING; FORMS; SHUTTERING; BUILDING IMPLEMENTS OR OTHER BUILDING AIDS, OR THEIR USE; HANDLING BUILDING MATERIALS ON THE SITE; REPAIRING, BREAKING-UP OR OTHER WORK ON EXISTING BUILDINGS	933	**115**	21	**23**
E05G	SAFES OR STRONG-ROOMS FOR VALUABLES; BANK PROTECTION DEVICES; SAFETY TRANSACTION PARTITIONS	697	**209**	8	**7**
E05F	DEVICES FOR MOVING WINGS INTO OPEN OR CLOSED POSITION; CHECKS FOR WINGS; WING FITTINGS NOT OTHERWISE PROVIDED FOR, CONCERNED WITH THE FUNCTIONING OF THE WING	550	**212**	9	**8**
F21V	FUNCTIONAL FEATURES OR DETAILS OF LIGHTING DEVICES OR SYSTEMS THEREOF; STRUCTURAL COMBINATIONS OF LIGHTING DEVICES WITH OTHER ARTICLES, NOT OTHERWISE PROVIDED FOR	1,191	**277**	18	**0**
E05C	BOLTS OR FASTENING DEVICES FOR WINGS, SPECIALLY FOR DOORS OR WINDOWS	1,151	**447**	22	**14**
E21C	MINING OR QUARRYING	1,131	**483**	28	**54**
F24	HEATING; RANGES; VENTILATING	943	**661**	36	**51**
	Total – net	29,078	**-2,204**	1,076	**261**
	Negative - gross		**-4,876**		**-100**
	Positive - gross		**2672**		**361**

Source: CIFS.

3.1.4. Inventor Groups in Construction

In this section, we employ a different analytical approach by taking patent data, not inventor data, as the point of departure. This allows us to analyse the patterns in the constitution of research teams and determine whether these are gender biased.

To look at gender trends in this approach, we must look at the gender characteristics of the inventor teams. This can be teams of female inventors (1 or more women) versus teams of male inventors (1 or more) versus mixed groups (with both female and male members in the group). Furthermore, in some cases we cannot identify the gender of one or more of the inventors. This is due to a number of factors: the FNDB does not contain all first names; some first names do not clearly identify gender; and there are errors in the EPO database (e.g. names of inventors and the companies they work for are inputted in the wrong data fields.). Furthermore, it is very common to register the company, which the inventors work for as an inventor in the patent application.

There are a number of ways to classify these groups based on size and gender composition. In this section of the report, we have chosen to work with seven different types of inventor groups described in table 8 below:

Table 8. Definition of the 7 categories of inventor teams.

Identifiable inventor teams used in the data:
i) One woman - the first type of pure female group**.**
ii) 2+ women, two or more women – the second type of pure female group.
iii) *Mix m/w* - Mixed group with women and men. A 'clean' group of persons only, with both sexes represented and no firms or unknown.
iv) Mix unknown - group that includes men and/or women and one or more company or NN (indicating a person of unknown sex). A sort of residual group, with at least two inventors, where the mix of gender, etc. is unknown.
v) One man – the first type of pure male group.
vi) 2+ men - two or more men – the second type of pure male group**.**
vii) One firm/NN – one company or person of unknown sex.

Source: CIFS.

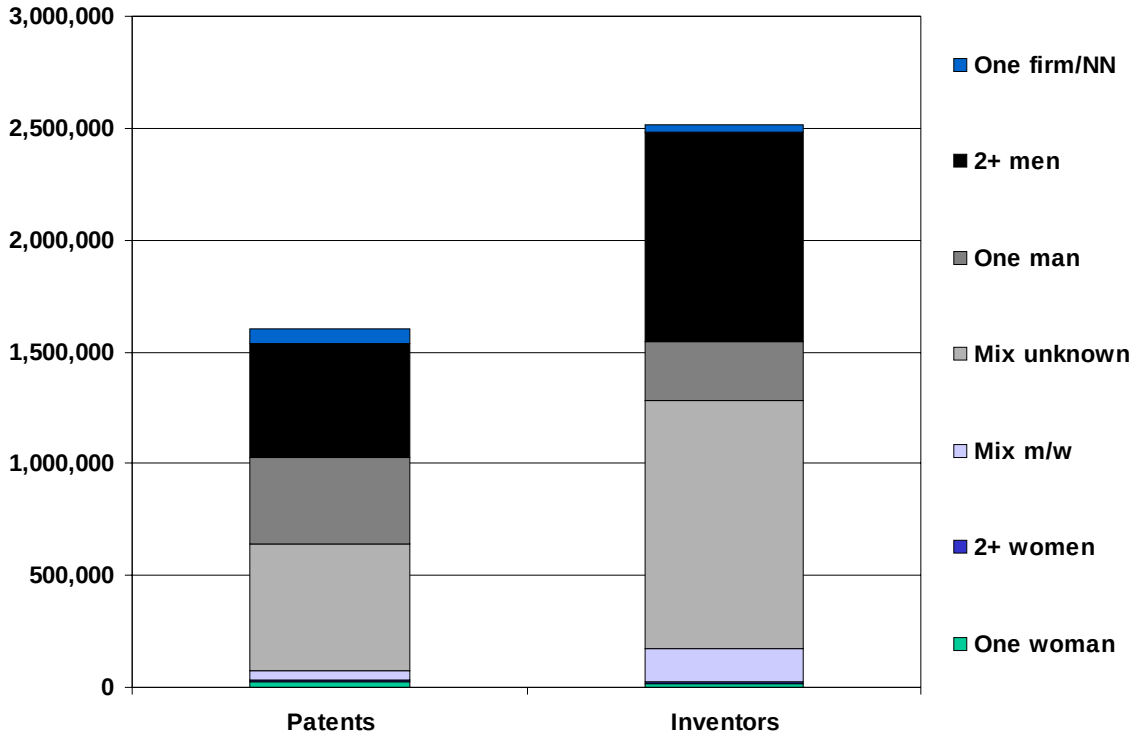
Women are obviously included in the purely female groups, i) and ii), as well as in the mixed gender group, iii)[13]. Given that companies are often registered as inventors in the patent applications, the *Mix unknown* category appears as the largest in the results (see figure 13 below).

From earlier sections of this report, we know that the proportion of women investors has grown from 1994-2004,[14] and we know that the number of patents and inventors declined during the last few years under consideration. As a result, we base the analysis of gender trends on changes in the relative shares that each of seven types of groups listed above has in the total number of patents taken.

[13] Women *may* also be included in group vii) – there is no way to know this based on the general method of gender identification used in this report.

[14] See e.g. figure 10, section 3.1.3.2.

Figure 13: Numbers of patents and inventors by inventor group type, 1994-2004 total, sum of construction, chemistry and pharmaceuticals patent groups.



Source: CIFS.

Figure 13 is a graphical presentation of the composition of research teams in the compiled data from the construction, chemistry and pharmaceuticals sectors. As mentioned above, the largest proportion of inventors and patents belong to the category of *Mix unknown* – 43.91 % of inventors and 35.52% of patents. The category of *2+ men* is also very large (37.08% of inventors and 32.22% of patents). The research teams with only men – *2+ men* and *One man* – together account for 47.79% of inventors and 55.88% of patents in the three sectors. The women exclusive research teams – *One woman* and *2+ women* – have a marginal presence with just 1.03% of inventors and 1.85% of patents.

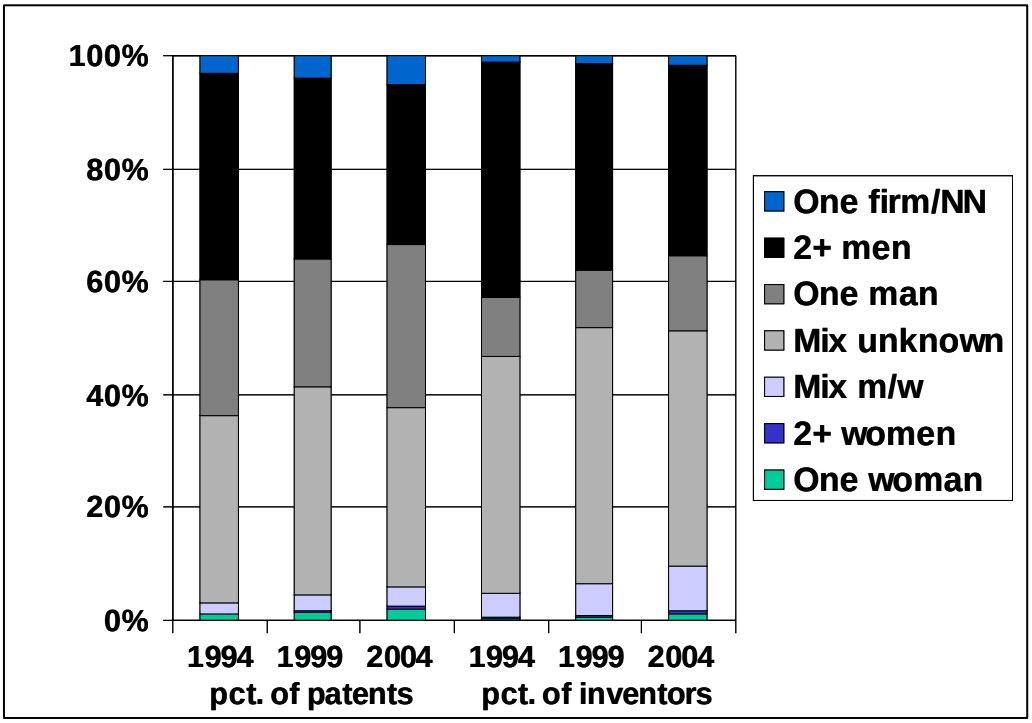
Table 9: Shares of patents and of inventors by inventor group type, 1994-2004 total, sum of construction, chemistry and pharmaceuticals patent groups, in percent of total.

Inventor Group categories	Share of patents	Share of inventors
One woman	1,46	0,66
2+ women	0,39	0,37
Mix m/w	2,75	5,84
Mix unknown	35,52	43,91
One man	23,66	10,71
2+ men	32,22	37,08
One firm/NN	3,99	1,42
Total	100,00	100,00

Source: CIFS.

As we see, the total share of purely female inventor groups is quite small in this sample of total number of patents from the three industries from 1994-2004. However, the female share is growing, see figure 14 below.

Figure 14. Shares of patents and inventors by inventor group type, 1994, 1999 and 2004, sum of construction, chemistry and pharmaceuticals patent groups, in percent.



Source: CIFS.

The share of inventors that were involved in purely female inventor teams grew from 1994 to 2004. The share of inventors in the category *One man* was also increased, but the *2+ men* category was reduced, so overall the share of inventors in purely male research teams declined.

Female participation in patent origination is very small in construction, chemistry and pharmaceutical sectors. The table below shows the shares of patents and inventors in the research team categories where we know that women are involved.

Table 10. Share of patents and inventors in exclusively female inventor teams by sector, 2004. Figures in percent of total.

	Construction		Chemistry		Pharmaceuticals	
Inventor group type	**Patents**	**Inventors**	**Patents**	**Inventors**	**Patents**	**Inventors**
One woman	0,8	0,4	0,5	0,2	0,8	0,4
2+ women	0,1	0,1	0,1	0,1	0,3	0,3
Sum of these groups	0,9	0,5	0,6	0,3	1,1	0,7

Source: CIFS.

In 2004, there were fewer inventors in purely female research teams in the construction sector than there were in the pharmaceutical sector (0.5% and 0,7% of total inventors, respectively). There were, however, more in construction than there were in chemistry in relative terms (0.3% of total inventors in chemistry).

One remarkable thing is that even though the figures are quite small, groups with more than 2 women in them in the pharmaceutical sector have three times as many patents compared with their colleagues in the construction sector. This could be an indication of relatively more female collaboration in R&D within pharmaceuticals than in construction. A much larger share of inventor teams categorized as *2+ women,* however, is to be expected in pharmaceuticals than in construction, as the share of women inventors is much larger than in construction.

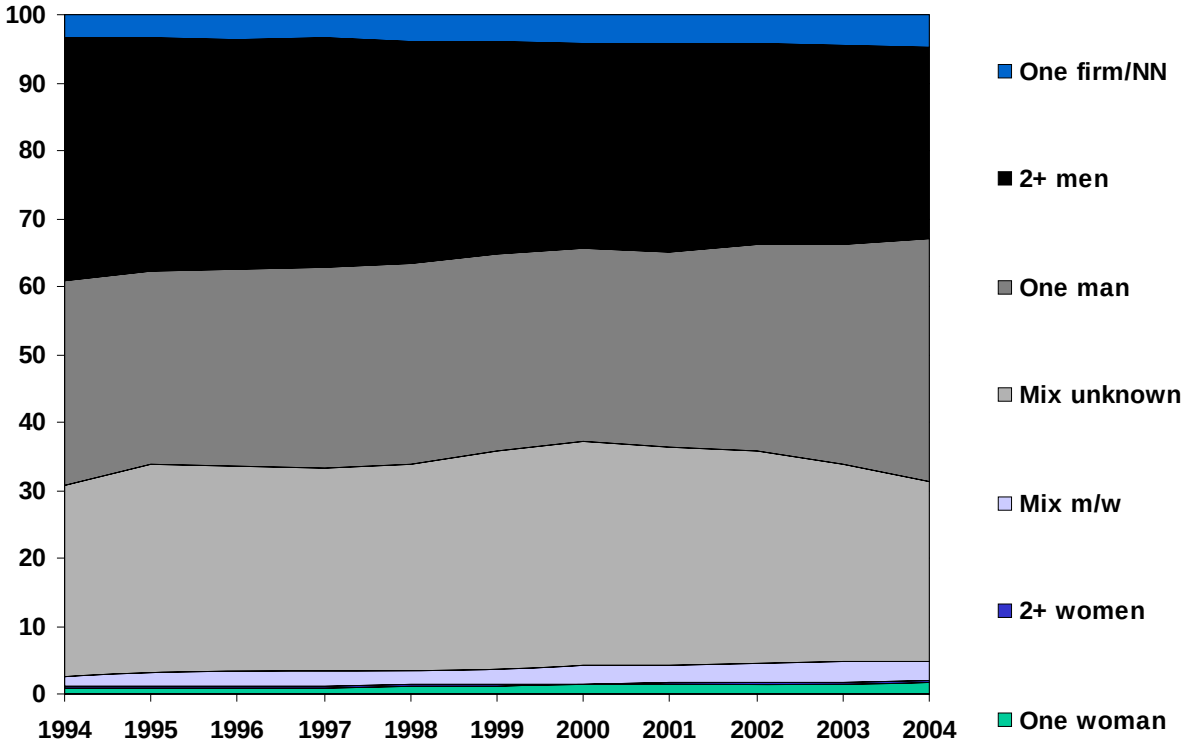
There is a large portion of inventor teams whose gender makeup is unknown. These teams are categorized as *One firm/NN* and *Mix unknown* and together constitute 45,33% of inventors in all three sectors (see table 9). There is also a degree of uncertainty regarding the mixed gender inventor group *Mix m/w*. The proportion of female inventors within the “Mix m/w” group can vary greatly. For example, if the group size is 2, than the group is obviously 50% male, 50% female. If the group size is larger, male inventors could constitute 2/3 of the group or vice versa). The large portion of inventor groups whose gender makeup is unknown combined with the large variability in the male-female ratios within *Mix m/w* leaves room for a large degree of uncertainty regarding women’s relative share in patenting.

In the section below, we focus on trends in inventor groups within construction-related patents.

3.1.4.1. Construction patents and inventor groups

The following figure shows the developments in patents originated by different inventor team categories in the construction sector from 1994-2004. The overall picture is similar to the aggregated picture from the last section; the share of patents originated by teams with female representation has increased from 1994-2004.

Figure 15. Share of construction patents by inventor group in percent (1994-2004).

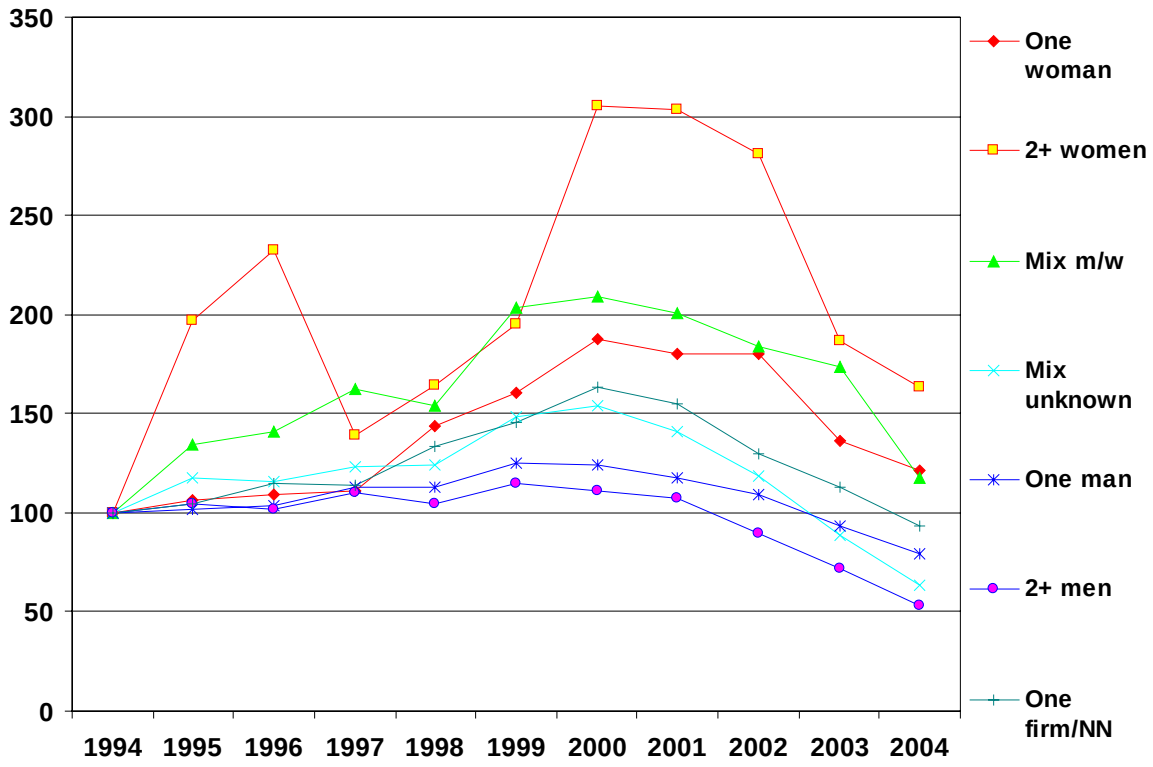


Source: CIFS.

The share of women's patents in 2004 is quite small if we focus on the two female inventors exclusive team categories. However, the share of women's patents has clearly been growing over the eleven years analyzed.

The indexed development of patents for the different inventor groups is shown in the figure below.

Figure 16. Construction patents by inventor group. Index, 1994=100.



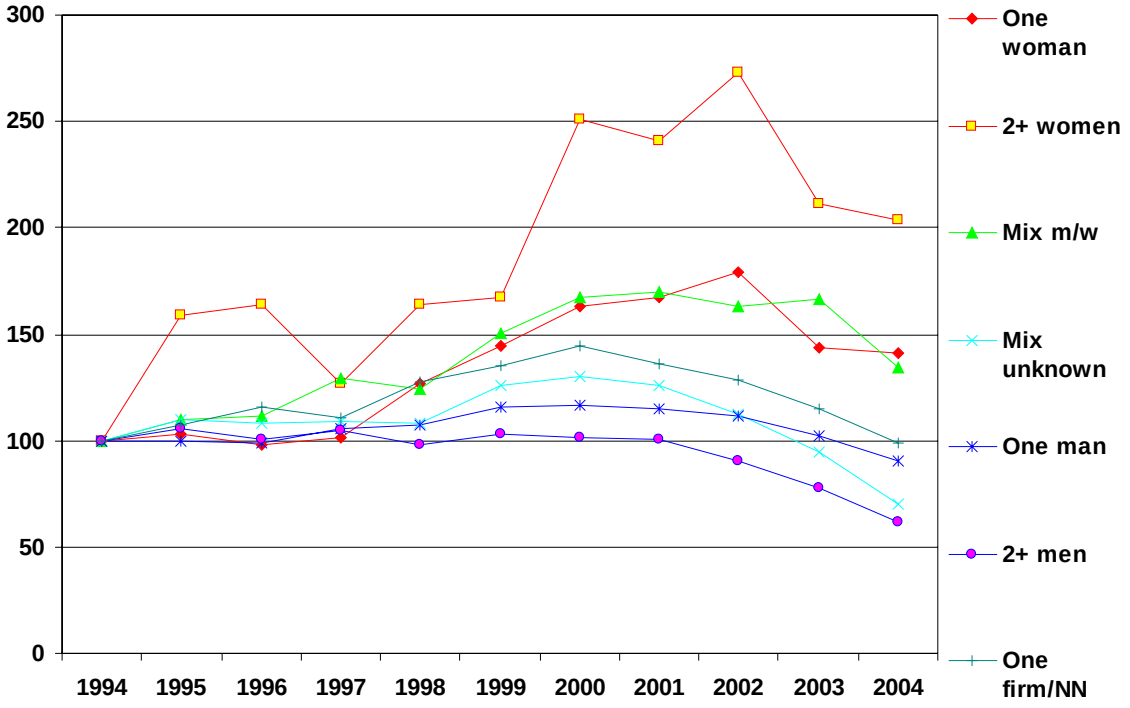
Source: CIFS.

As discussed earlier, the total number of patents has decreased since 2000. This is reflected in all team categories, with teams of 2 or more males (*2+ men*) having the largest relative reduction.

It is quite clear from the figure that the share of patents by purely female team categories (*One woman* and *2+ women*), as well as the *Mixed m/w* category, has grown relative to other types of inventor groups. Particularly the *2+ women* category has increased its share, although it must be remembered that this group's share was extremely small from the outset.

Looking at the numbers of inventors behind the patents, the picture is similar. Figure 17 shows the share of inventors associated with each category of inventor team.

Figure 17. Inventors of construction patents, grouped by inventor team category. Index number of inventors by team category in 1994=100.



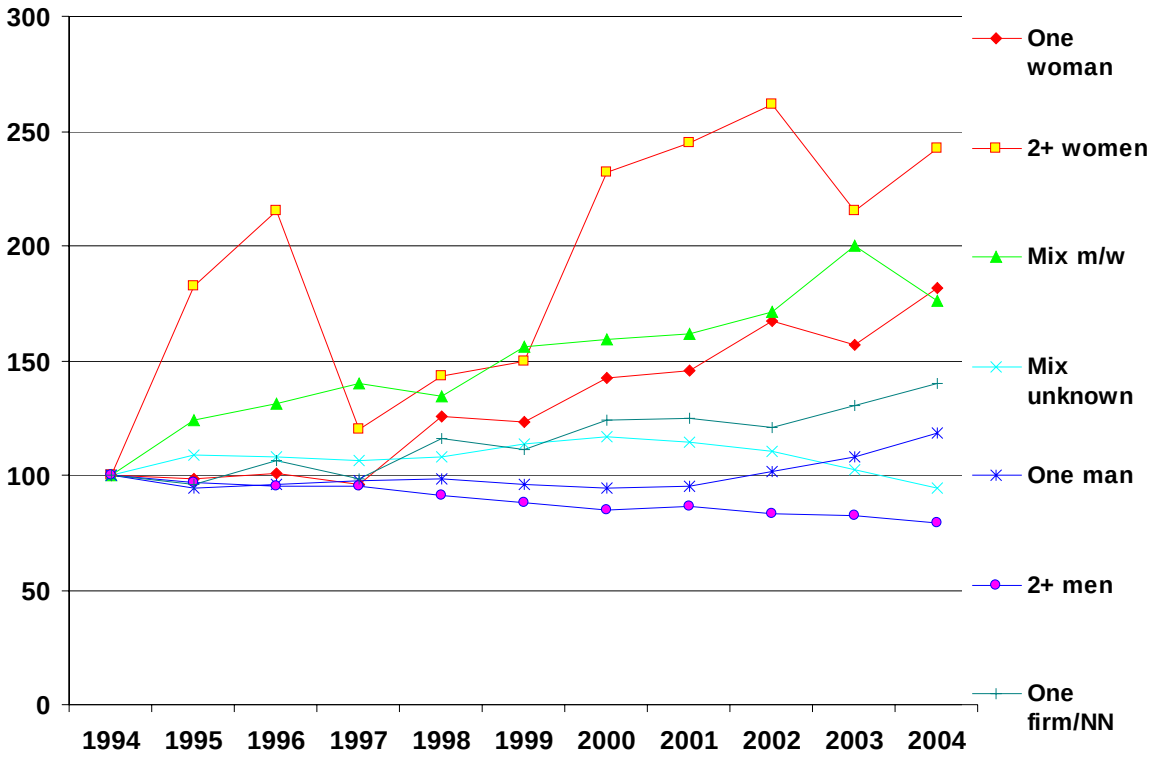
Source: CIFS.

Note that the trends in the numbers of inventors do not mirror the trends in the number of patents. This is due to the fact that the average size of groups with more than one member may increase or decrease.

Again, it is clear that the relative share of groups with female inventors has grown relative to other groups of inventors within construction.

In all the figures above, the declining number of patents has influenced the overall picture in the last years (2000-2004). To compare the various types of inventor groups, it may be useful to consider trends in a normalized way by adjusting for the change in the number of patents from year to year. This is done in the figure 18 below.

Figure 18. Construction patent index by inventor team category, 1994-2004, 1994=100, normalized to a total patent index=100 in all years.



Source: CIFS.

Relatively speaking, all the groups with women inventors demonstrated growth rates ranging from 75% -- 150%. The relative share of patent taking among groups with 2 or more males is declining. This does not mean that these groups have necessarily performed badly. Rather, it may mean that more men are collaborating with women, and hence the share of pure-male groups has declined.

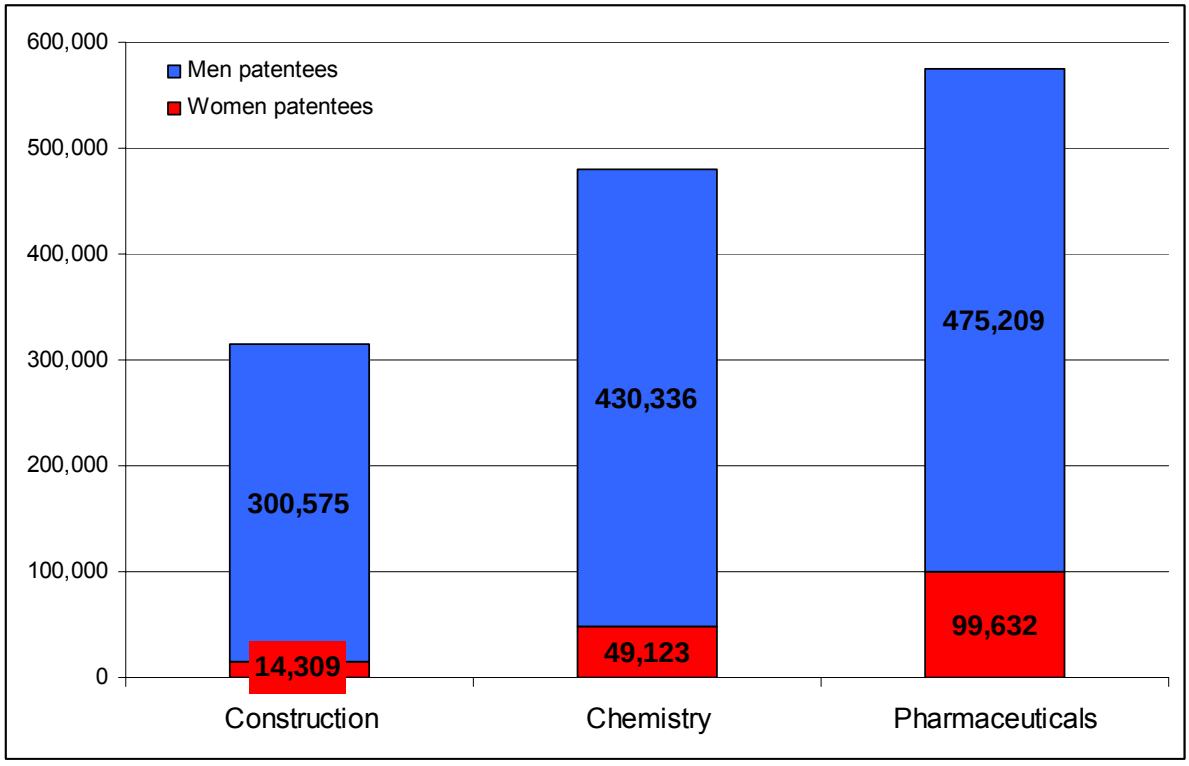
It is quite clear from the analysis in this report that the share of women in the invention of construction-related patents has grown during the period studied (1994-2004). All results indicate that patent taking research teams are formed by a random selection of inventors. There is no indication of gender-bias in the formation of research teams. The increasing proportion of research teams with female inventors involved is merely a consequence of an increased share of women in the pool of researchers.

3.2. COMPARISON OF CONSTRUCTION, CHEMISTRY AND PHARMACEUTICAL SECTORS

In this section the research team will compare the three sectors by number and proportions of inventors and patents, as well as by gender and by country. We compare the numbers of researchers and inventors in EU25 in order to show women researchers' participation in patent taking. The changes in numbers and proportions of inventors during 1994-2004 will also be analysed.

3.2.1. Patents and Inventors by Sector

Figure 19. Number of inventors by gender and sector. 1994-2004 total.



Source: CIFS.

The pharmaceutical sector is clearly the largest sector in terms of patenting of the three with a total of 574,841 inventors between 1994-2004. This compares to 479,459 inventors in the chemistry sector and only 314,884 inventors in the construction sector. In addition, the pharmaceutical sector also has the largest number of women inventors. Detailed data is presented in table 14 on the next page.

Inventors in chemistry and pharmaceutical sectors are as unevenly distributed as in the construction sector. Germany accounts for more than half (51.27%) of all inventors in the

chemistry sector, while in the pharmaceutical sector just 37.47% of inventors have a German working address. The top three countries in each sector (Germany, UK and France) account for approximately 70% of EU25 inventors (construction 68.93%; chemistry 72.77%; pharmaceuticals 68.97%).

Table 11. Inventors in numbers, % of total and cumulative percent by sector and country. 1994-2004 total.

Construction				Chemistry				Pharmaceuticals			
Country	Patentees	Share in %	Cumulative %	Country	Patentees	Share in %	Cumulative %	Country	Patentees	Share in %	Cumulative %
DE	153,677	48.80%	48.80%	DE	245,820	51.27%	51.27%	DE	215,409	37.47%	37.47%
GB	32,066	10.18%	58.99%	GB	53,724	11.21%	62.48%	GB	100,740	17.52%	55.00%
FR	31,307	9.94%	68.93%	FR	49,356	10.29%	72.77%	FR	80,331	13.97%	68.97%
NL	13,870	4.40%	73.33%	NL	25,875	5.40%	78.17%	IT	32,470	5.65%	74.62%
IT	13,136	4.17%	77.51%	IT	22,615	4.72%	82.88%	NL	23,829	4.15%	78.77%
PL	12,044	3.82%	81.33%	BE	17,734	3.70%	86.58%	SE	20,352	3.54%	82.31%
ES	9,859	3.13%	84.46%	SE	10,198	2.13%	88.71%	DK	19,485	3.39%	85.70%
AT	9,721	3.09%	87.55%	AT	9,695	2.02%	90.73%	BE	17,157	2.98%	88.68%
SE	9,614	3.05%	90.60%	FI	9,318	1.94%	92.67%	ES	16,803	2.92%	91.60%
FI	8,627	2.74%	93.34%	PL	8,526	1.78%	94.45%	HU	12,535	2.18%	93.78%
DK	5,591	1.78%	95.12%	ES	8,107	1.69%	96.14%	FI	10,265	1.79%	95.57%
BE	5,348	1.70%	96.82%	DK	7,553	1.58%	97.72%	AT	9,575	1.67%	97.24%
CZ	3,327	1.06%	97.87%	CZ	2,789	0.58%	98.30%	PL	5,054	0.88%	98.11%
HU	2,022	0.64%	98.52%	HU	2,728	0.57%	98.87%	CZ	2,984	0.52%	98.63%
IE	1,346	0.43%	98.94%	IE	1,503	0.31%	99.18%	IE	2,210	0.38%	99.02%
SI	935	0.30%	99.24%	SK	1,140	0.24%	99.42%	SI	1,378	0.24%	99.26%
SK	571	0.18%	99.42%	LU	762	0.16%	99.58%	SK	1,277	0.22%	99.48%
LU	432	0.14%	99.56%	SI	612	0.13%	99.71%	PT	926	0.16%	99.64%
EE	428	0.14%	99.69%	PT	337	0.07%	99.78%	LV	673	0.12%	99.76%
PT	357	0.11%	99.81%	GR	329	0.07%	99.85%	GR	667	0.12%	99.87%
LV	243	0.08%	99.88%	EE	324	0.07%	99.91%	EE	268	0.05%	99.92%
GR	216	0.07%	99.95%	LV	225	0.05%	99.96%	LT	239	0.04%	99.96%
LT	113	0.04%	99.99%	LT	135	0.03%	99.99%	LU	186	0.03%	100.00%
CY	20	0.01%	100.00%	CY	50	0.01%	100.00%	CY	27	0.00%	100.00%
MT	14	0.00%	100.00%	MT	4	0.00%	100.00%	MT	1	0.00%	100.00%
EU25	314,884	100.00%		EU25	479,459	100.00%		EU25	574,841	100.00%	

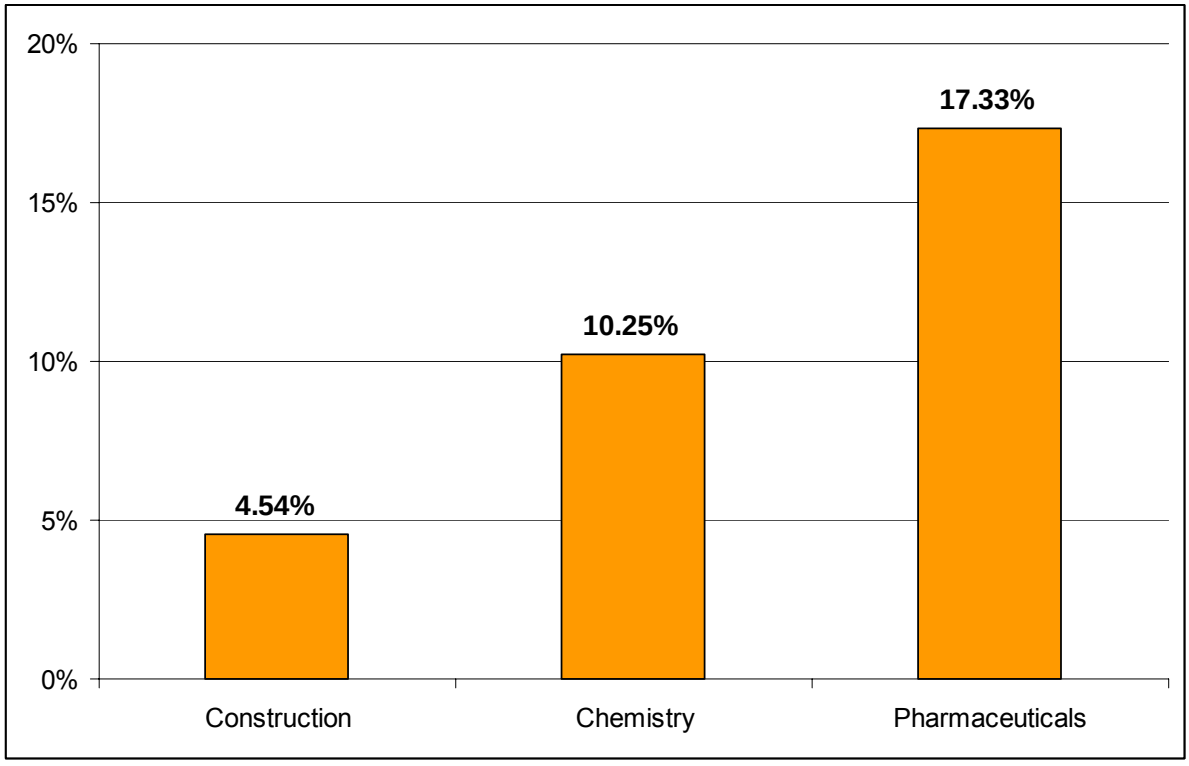
Source: CIFS.

As in the construction sector, the top-9 countries in chemistry and pharmaceuticals sectors account for more than 90% of the inventors engaged in the sectors. This points to a general concentration of patent origination within a group of countries that in all 3 sectors includes Germany, UK, France, Netherlands, Italy and Sweden.

Poland is a special case. Poland has a significantly higher number of construction inventors than it does in the chemistry or the pharmaceutical sectors. Poland accounts for 3.82% of construction inventors in EU25, while only 1,78% of chemistry inventors and 0.88% of pharmaceuticals inventors. Austria, Czech Republic and Estonia also have more inventors in construction than in the other sectors.

3.2.2. Women's Share of Inventors by Sector and Country

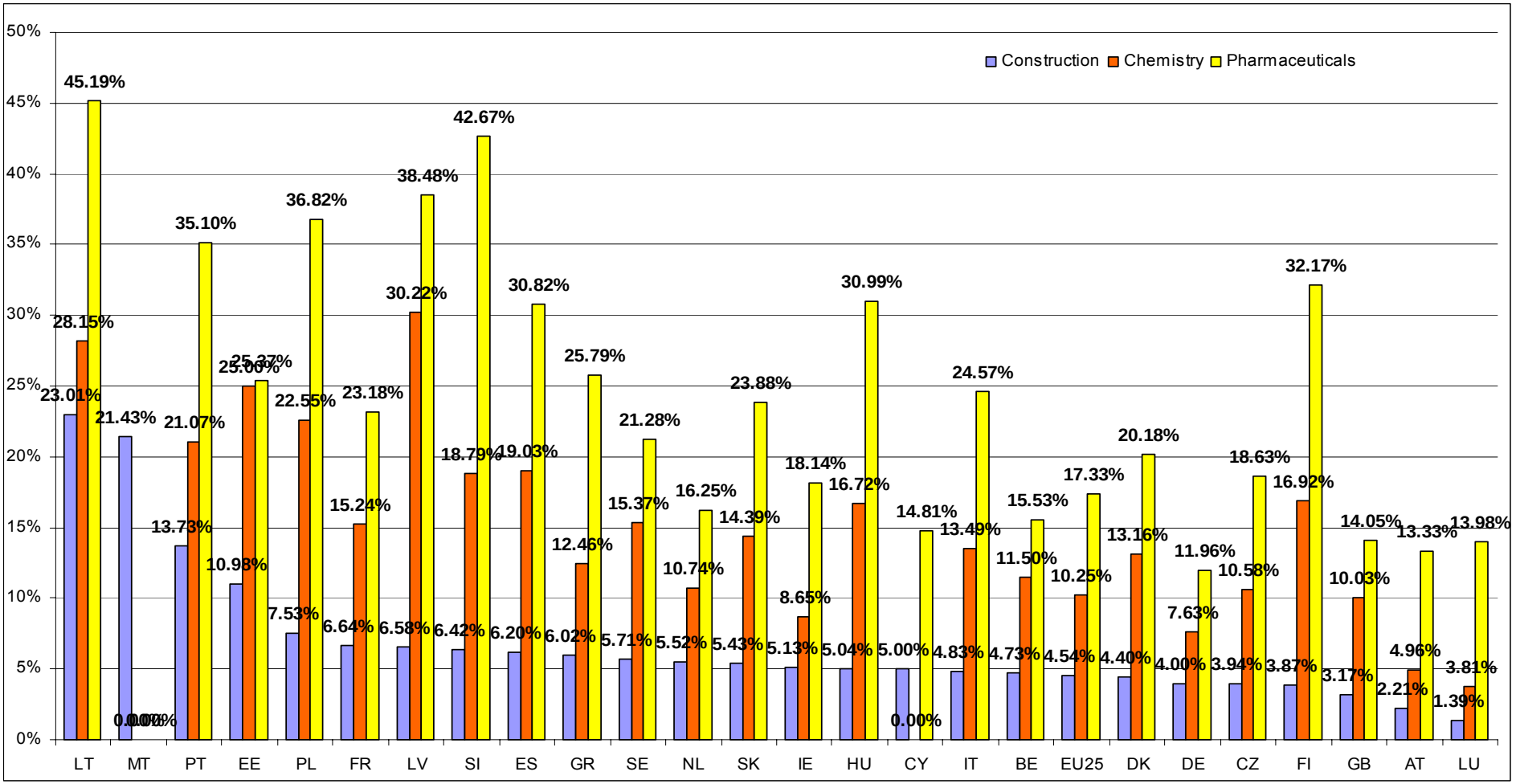
Figure 20. Share of female inventors by sector. 1994-2004 total.



Source: CIFS.

As indicated in the section above, the share of women inventors is higher in the chemistry (10.25%) and pharmaceutical (17.33%) sectors compared to construction (4.54%). A further division of the data by countries is presented in figure 21 (below), which sketches out national differences in the representation of women inventors in the three sectors.

Figure 21. Proportions of women inventors by sector and country in %. Ordered by share of women construction inventors. 1994-2004 total.

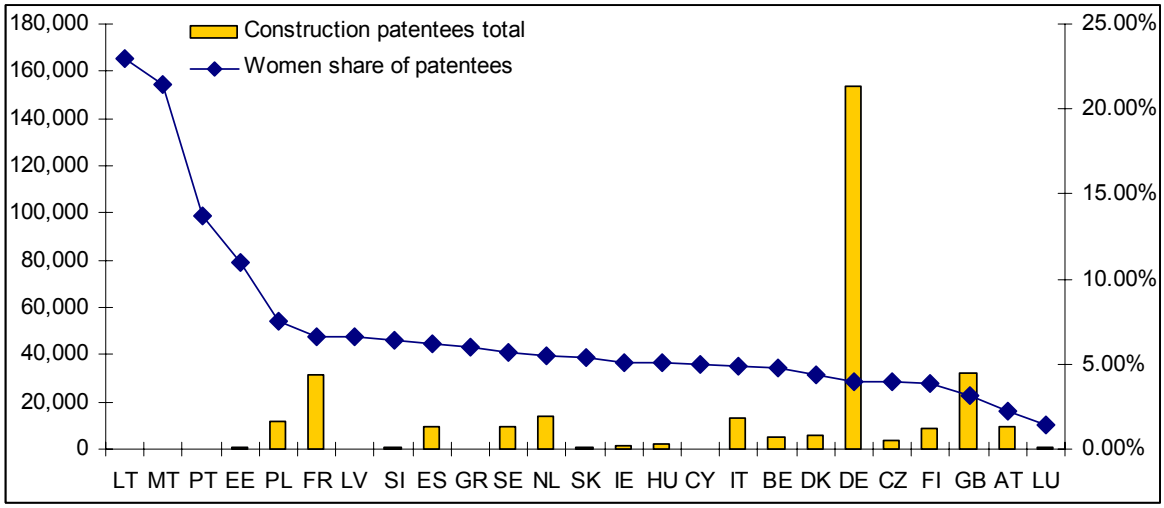


Source: CIFS.

In all countries, the share of women inventors is the highest in the pharmaceutical sector and lowest in the construction sector.

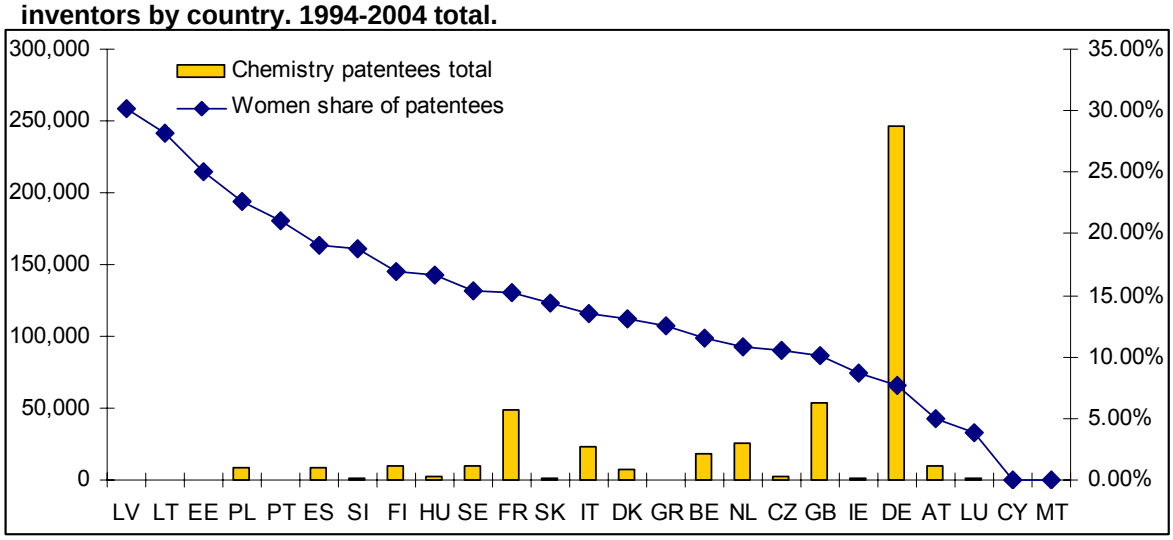
Relatively high proportions of women inventors are concentrated in the countries with relatively few inventors in each sector, as in, e.g., Lithuania. In Lithuania, women inventors constitute 45% of inventors in pharmaceuticals, 28% in chemistry, and 23% in construction. This relationship is described in figures 22a-c below.

Figure 22a. Total construction inventors and share of female construction inventors by country. 1994-2004 total.



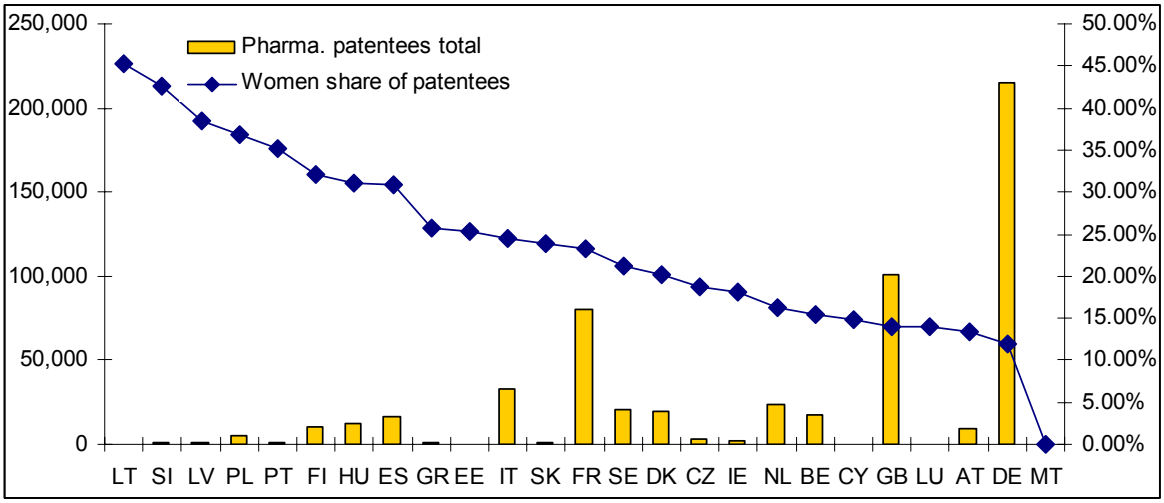
Source: CIFS.

Figure 22b. Total number of chemistry inventors and share of women chemistry inventors by country. 1994-2004 total.



Source: CIFS.

Figure 22c. Total number of pharmaceutical inventors and share of women pharmaceutical inventors by country. 1994-2004 total.



Source: CIFS.

France stands out as a country with both a relatively high number of inventors and a relatively large proportion of women inventors in all 3 sectors (23.18% in pharmaceuticals, 15.24% in chemistry and 6.64% in construction). Luxembourg has a very low number of inventors and also a low proportion of women inventors in all three sectors.

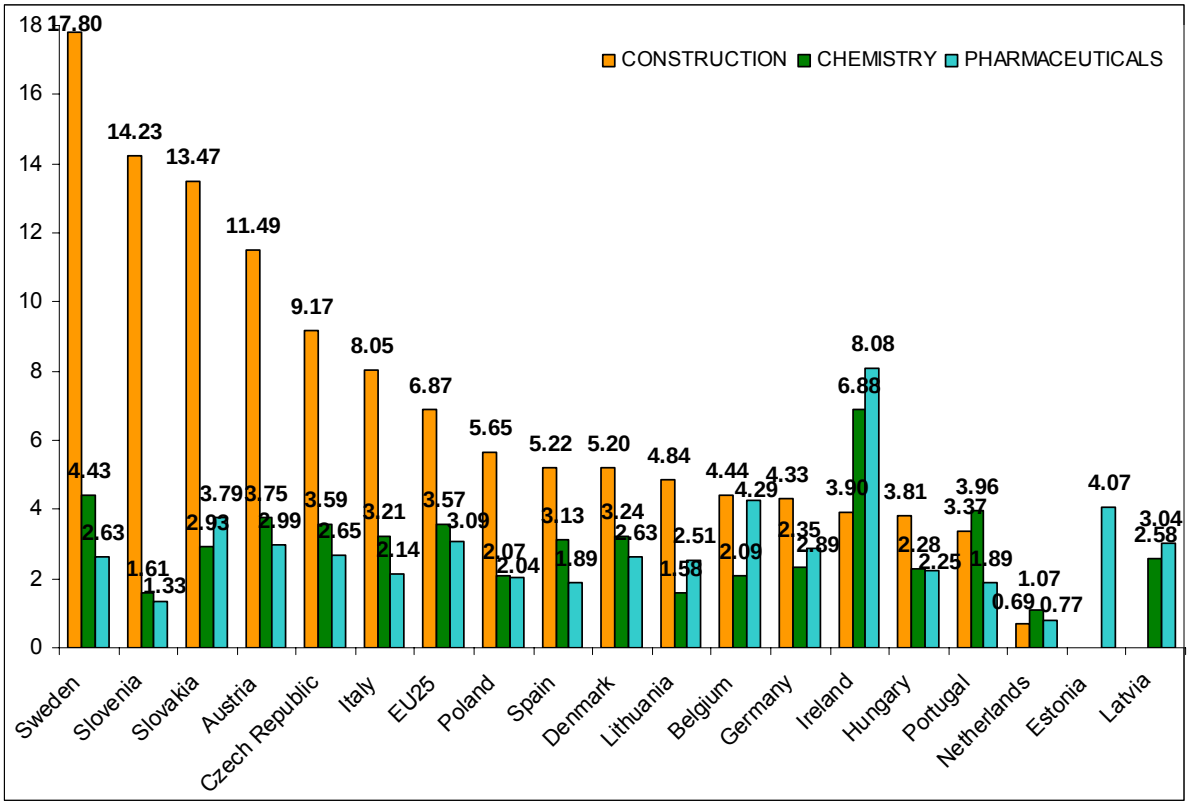
3.2.3. Researchers and Inventors by Sector

What is the relationship of researchers and inventors? How big is the proportion of researchers who are able to take patents, and is there a gender bias in this regard?

The research team has analysed this by comparing statistics on researchers from Eurostat with our own data about patent originating inventors.

The figure below presents the results of this analysis as a ratio of male researchers to male inventors and the ratio of female researchers to female inventors. This measure may seem abstract, but we may interpret it as an expression of probability; e.g. the probability of a Swedish male construction researcher to participate in patent origination is 17.8 times higher than for a Swedish female construction researcher.

Figure 23. Ratio of male inventors per researcher and female inventors per researcher by country - 2004.



Source: R&D Survey; Eurostat and CIFS.

Exceptions to 2004: Belgium, Germany, Denmark, Netherlands, Portugal and Sweden; 2003. No data available on researchers in Finland, France, Greece, Luxembourg and UK.

Figure 23 shows that women researchers generally are under-represented in patent origination, and that this under-representation is much more significant in the construction sector than in chemistry and pharmaceuticals. Ireland, Portugal and Netherlands are exceptions, where the difference between men and women in regard to participation in patenting is bigger within chemistry (and for Ireland also in pharmaceuticals) than in construction. There are no women inventors in construction and chemistry in Estonia and no women inventors in the construction sector in Latvia.

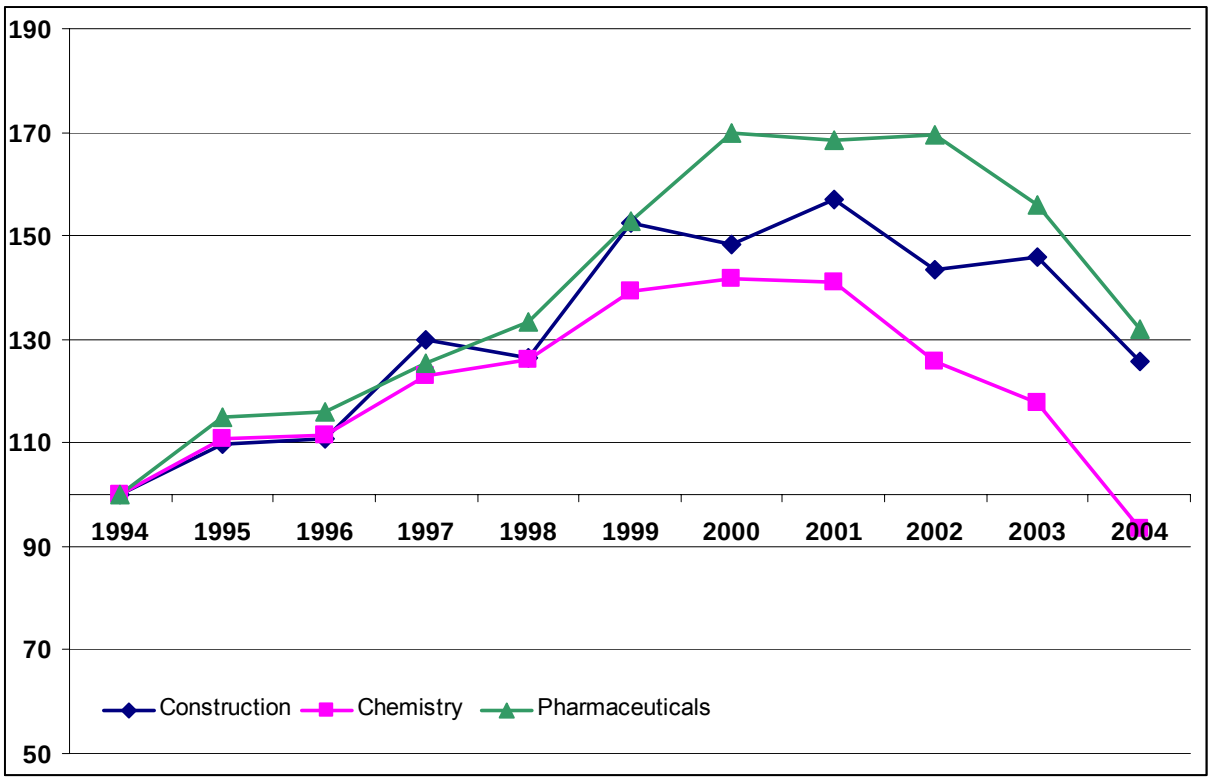
The overall ratio of male researchers per inventor to female researchers per inventor in EU25 is 6.87 in construction, 3.57 in chemistry and 3.09 in pharmaceuticals. The male/female ratio of researchers per inventor is more than 10:1 in Sweden (17.8), Slovenia (14.23), Slovakia (13.47) and Austria (11.49).

The Netherlands has very low ratios in all three sectors (construction 0.69; chemistry 1.07; pharmaceuticals 0.77), indicating that the difference between men and women researchers in their participation in patent origination is relatively low.

Using male/female ratios for researchers per inventor as an indicator reveals a remarkable difference between the three sectors we analyse here.

3.2.4. 1994-2004: Changes by Sector

Figure 24. Index: Changes in the number of female inventors by sector (1994-2004), 1994=100.



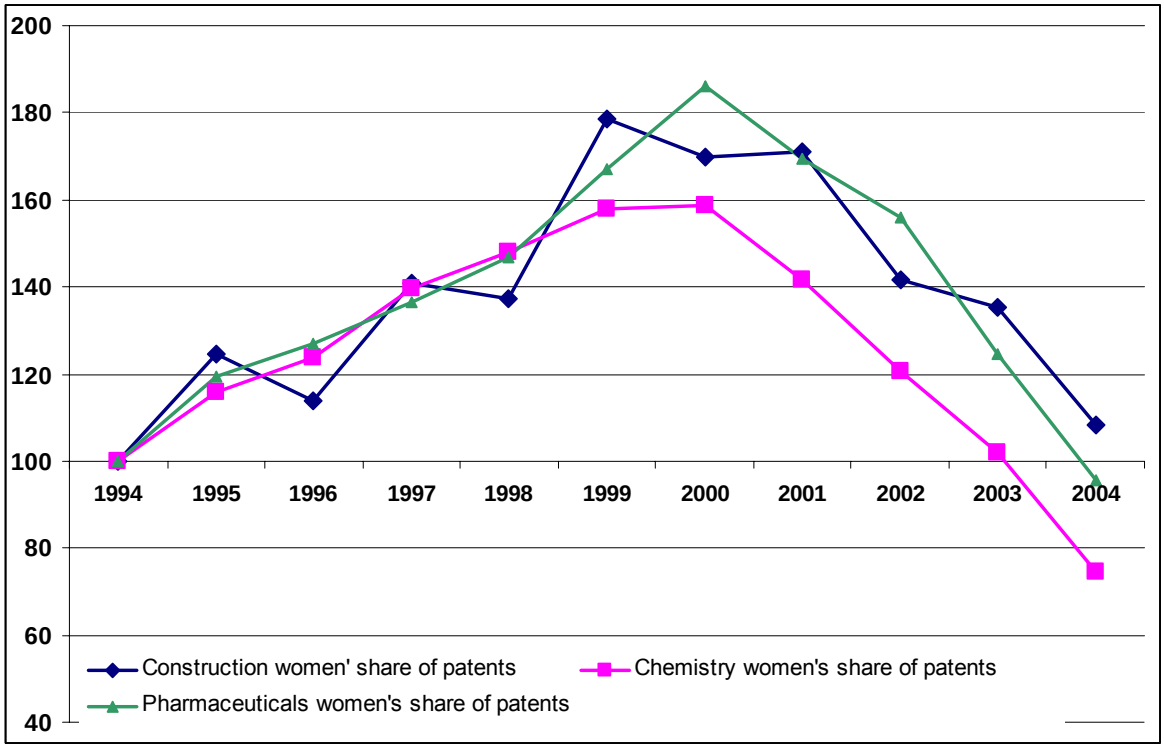
Source: CIFS.

In figure 24 (above), we compare the changes in the total number of female inventors by sector. As in the time series analysis in section 3.1.3., there is a data related decline from year 2000 (depending on the sector). The number of women in the pharmaceutical sector increased the most until this decline. The construction and chemistry sectors had a similar increase in the total number of women inventors in 1994-1996, after which the growth of women in construction exceeded that of women in chemistry. The proportion of female inventors continued to grow until 2001.

Similarly, women's share of patents in construction grew relatively more than in chemistry and even exceeds the growth of women's share of patents in pharmaceuticals in some years (figure 24).

One must not forget that the total number of construction inventors and patents is lower than in chemistry and pharmaceuticals. The changes in this time series, however, definitely appear promising for women's participation in construction patents, if the development in years 1994-2000 continues in the future.

Figure 25. Index: Changes in women's share of patents* by sector (1994-2004), 1994=100-

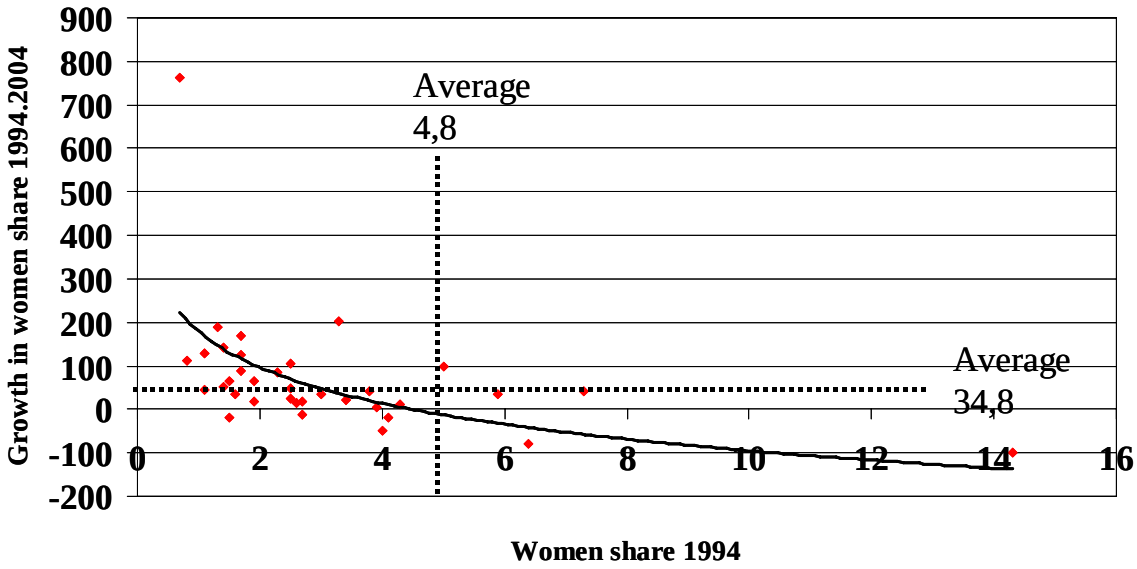


Source: CIFS.

***) Patents related to women (women involved in origination).**

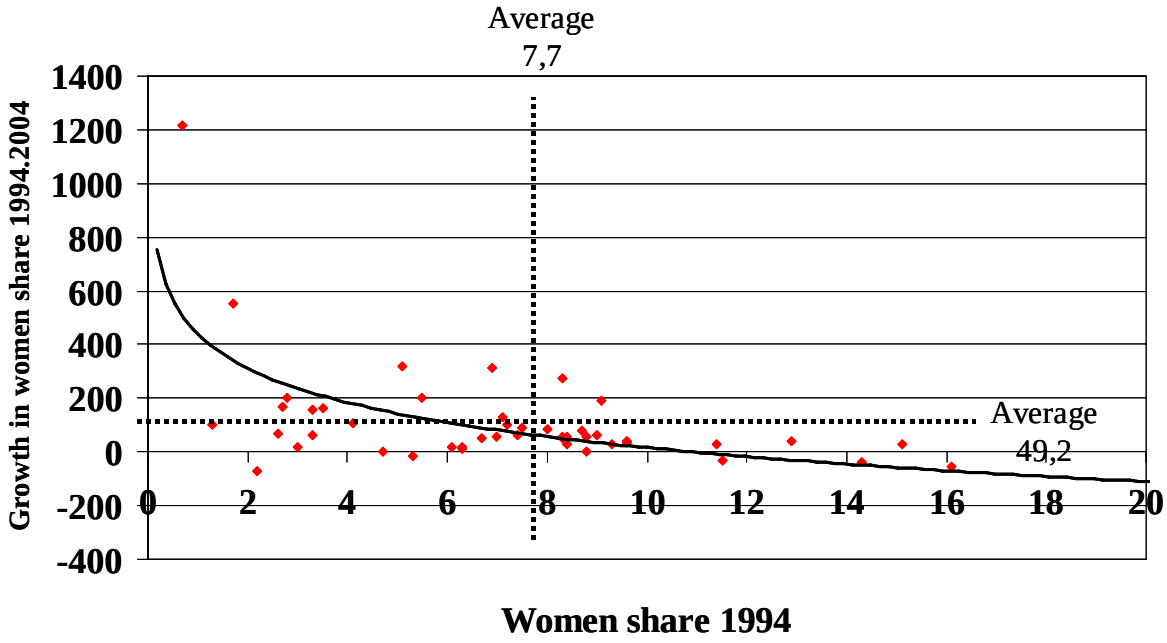
Figures 26a-c describes the correlation between shares of women in 1994 and the subsequent growth in the proportion of female inventors in the years between 1994-2004 for each sector. Patent classes with a small proportion of women inventors in 1994 tend to have higher growth rates than patent classes with larger proportions of women.

Figure 26a. Negative correlation between share in 1994 and growth in share of women inventors within construction, by patent class. Figures in percent.



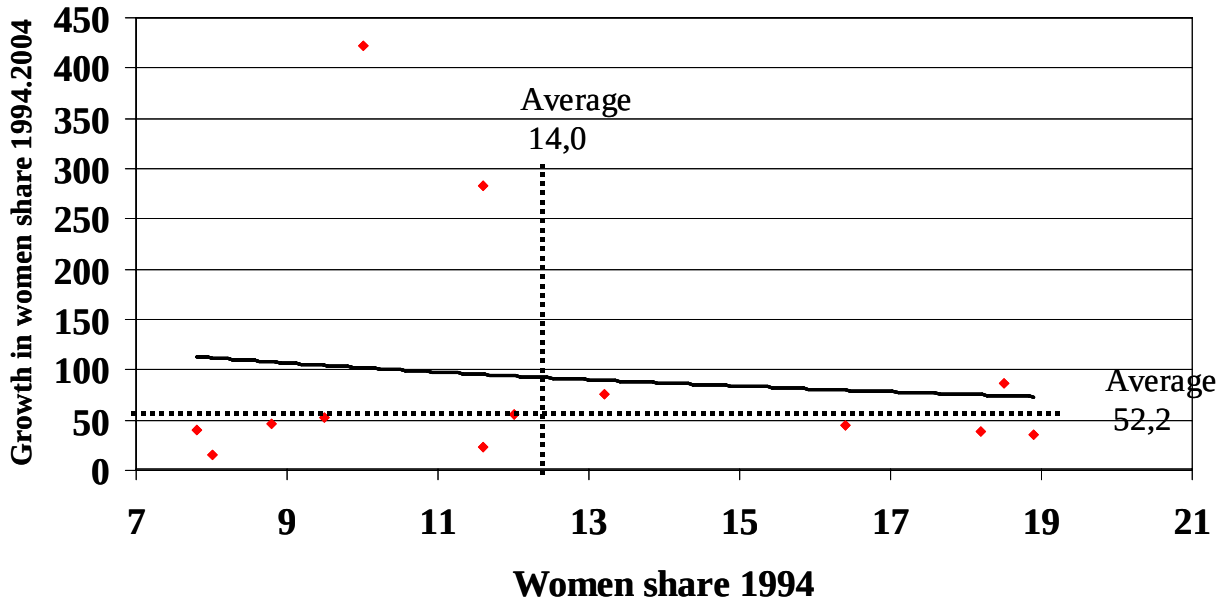
Source: CIFS.

Figure 26b. Negative correlation between share in 1994 and growth in share of women inventors in chemistry, by patent class.



Source: CIFS.

Figure 26c. Small negative correlation between share in 1994 and growth in share of women inventors within pharmaceuticals, by patent class.



Source: CIFS.

The pharmaceuticals and chemistry sectors had both larger proportions of women inventors in 1994 and faster proportional growth rates than the construction sector. The correlation between women's share in 1994 and the subsequent growth rate is negative for all three sectors. Although in the pharmaceutical sector, this pattern is not as strong as in the other sectors. Still, only 1-2 patent classes in each sector had figures above average on both axes.

4. CONCLUSIONS

Female inventors in construction constitute 4.54% of all inventors in the compiled data from 1994-2004. The female proportion of inventors is highest in the countries with a low overall number of construction inventors. France and Poland are exceptions to this pattern, with relatively high numbers of construction inventors (31,307 and 12,044 inventors respectively) and relatively high female proportions of inventors (France 6.64%; Poland 7.53%).

The average proportion of women per patent class in construction is 4.8% (total 1994-2004). In a few patent classes, women are much better represented. These are B32B, C03, C04 and E03D (refer to Annex 3 for description of patent classes).

Overall, both the number and proportion of women construction inventors increased from 1994 to 2004. In the analysis of patent classes (section 3.1.3.3.), we saw that the number of male inventors decreased from 1994 to 2004, while the number of women grew (although less markedly). 25 out of 33 patent classes in construction increased the number of female inventors. The number of women inventors increased most significantly in two quite different patent classes B32B and C03, which are also some of the patent classes in construction that have the highest participation of women inventors (measured in numbers and share).

The majority of construction inventors and patents taken are centred on very few countries in the EU25. Approximately 70% of inventors in construction research are registered as residing in Germany, UK, or France. More than 90% of inventors reside in 9 countries.

This pattern is replicated in both pharmaceuticals and chemistry sectors as well. The top–9 countries in all three sectors include: Germany, UK, France, Netherlands, Italy, and Sweden. Germany, UK, Italy, and France are countries with large populations. Sweden and Netherlands, however, are surprising in this regard. They have relatively small populations, but they still have a large number of inventors and a relatively large proportion of female inventors.

In all three sectors, France has both a relatively large share of women inventors and a large number of inventors. This is especially the case in the construction sector.

Of the 3 sectors compared in this report, the pharmaceutical sector has the largest number of inventors (574,841 male and female inventors) and the biggest proportion of women inventors (17.33%). This sector also had the highest growth rate in women's proportion of inventors (52.2%[15]). However, when we look at the total number of female inventors, the rate of growth in the construction sector exceeded the rate of growth in the chemistry sector.

[15] Average of growth rate of women proportion in all patent classes in the sector.

The growth in the proportion of female inventors was also reflected in the study of formation of research groups, which showed an increasing proportion of research teams consisting – exclusively or in part – of women. In addition, the proportion of patents related to women increased. One, however, must remember that these increases started from with a very low figure. The study of research teams' composition found no indications of prevalence for single sex research teams. The growth in research teams with female researchers present is mere a result of an increased presence of women in research.

The male/female ratio of researchers per inventors in construction was 6.87. This ratio showed that female researchers in construction are less likely to participate in patent origination than their male colleagues. The analysis also revealed that women researchers' participation in patent origination is generally better in chemistry and pharmaceutical sectors with male/female ratios of researchers per inventor of 3.57 and 3.09, respectively.

The large size of the pharmaceutical and chemistry sectors may be the reason for the greater number and larger proportion of female inventors than what is observed in construction. The fact that the pharmaceutical sector has a higher proportion of women and a faster growth rate in women's relative share of inventors may suggest that a critical mass of women researchers has been reached, attracting more even women to this type of research. In this regard, it is a point for discussion and a matter for a qualitative gender study as to whether - and why – chemistry and pharmaceuticals as research fields are more appealing to women than construction research. This matter will be investigated further in task 3.5 *New patterns in patent origination* of WOMEN-CORE.

4.1. RECOMMENDATIONS

Gender registration in patent application: The creation of the first name database for this task was very time-consuming. A more globalised world has led to increasing migration patterns and changing cultural traditions regarding naming traditions, which increases the variety of first names and makes analysis of them more difficult. Hence, gender differentiation by means of a first name database is a method that will be increasingly difficult and less cost-effective in the future. In order to ease the creation of gender segregated statistical data on patents, the research team suggests that patent applicants and inventors should be allowed to state their gender on the patent application form, which is more cost-efficient and will presumably provide more accurate data.

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WEB

http://books.nap.edu/openbook.php?record_id=2264&page=109

www.culturalpolicies.net/web/netherlands.php?aid=4210

http://europa.eu/abc/keyfigures/index_da.htm

http://ec.europa.eu/research/science-society/women/wir/pdf/wir-ulb_en.pdf

http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1090,30070682,1090_33076576&_dad=portal&_schema=PORTAL

www.epo.org/

www.freepatentsonline.com

www.freshpatents.com

http://ec.europa.eu/research/science-society/women/wir/index_en.html

www.wikipedia.org

APPENDIX 1 – FIRST NAME SOURCES

http://www.mvcr.cz/statistiky/jmena/zeny/index.html

http://www.mvcr.cz/statistiky/jmena/muzi/index.html

http://www.familiestyrelsen.dk/navne/1/?no_cache=1

www.beliebte-vornamen.de

UK National Statistics Office

Nombres por fecha (Instituto Nacional de Estadística)

www.ine.es/daco/daco42/mnp/nomnac05.xls

www.siseministerium.ee

www.vaekstorekisterikus.fi:

http://www.sci.fi/~kajun/finns/male.htm http://www.sci.fi/~kajun/finns/female.htm

SPF Economie - Direction générale Statistique et Information économique:

http://www.google.com/translate?u=http%3A%2F%2Fstatbel.fgov.be%2Fhome_fr.asp&langpair=fr%7Cen&hl=en&ie=UTF8

http://meilleursprenoms.com

www.behindthename.com

http://digilander.libero.it/gioer/vm.html

http://berni.calis.lv/uzzinu-birojs/paplasinatais-vardadienu-kalendars/

National Statistics Office Malta:

NSO News release no. 123/2002

NSO News release no. 194/2004

NSO News release no. 132/2006

www.behindthename.com/nmc/dut.php

http://www.meertens.knaw.nl/voornamen/index.html

http://www.svb.nl/internet/nl/regelingen/kinderbijslag/kindernamen/index.jsp

www.mswia.gov.pl

www.babynames.org.uk/polish-baby-names.htm

http://www.dgrn.mj.pt/civil/adm_nadm.asp

http://sk.wikipedia.org/wiki/Kateg%C3%B3ria:%C5%BDensk%C3%A9_men%C3%A1

http://sk.wikipedia.org/wiki/Kateg%C3%B3ria:Mu%C5%BEsk%C3%A9_men%C3%A1

http://www.stat.si/eng/imena_obdobja.asp

Statistiska Centralbyrån (Statistics Sweden):

www.csb.se

http://www.svenskanamn.se/

Roland Otterbjörk (1979): *Svenska fornamn.* Esselte Studium

Experts

Sysse Engberg, University of Copenhagen (Greek names)

Jana Nabelkova, CVUT (Czech names)

APPENDIX 2 – DATA PROCESSING: DATA PROCESSING AND CODE

(Refer to the attached PDF document: D16 – Data processing and Code)

APPENDIX 3 – PATENT CLASSES IN CONSTRUCTION RESEARCH

Patent class	Description of patent classes
B07	SEPARATING SOLIDS FROM SOLIDS; SORTING
B32B	LAYERED PRODUCTS, i.e. PRODUCTS BUILT-UP OF STRATA OF FLAT OR NON-FLAT, e.g. CELLULAR OR HONEYCOMB, FORM
C03	GLASS; MINERAL OR SLAG WOOL
C04	CEMENTS; CONCRETE; ARTIFICIAL STONE; CERAMICS; REFRACTORIES
E01B	PERMANENT WAY; PERMANENT-WAY TOOLS; MACHINES FOR MAKING RAILWAYS OF ALL KINDS
E01C	CONSTRUCTION OF, OR SURFACES FOR, ROADS, SPORTS GROUNDS, OR THE LIKE; MACHINES OR AUXILIARY TOOLS FOR CONSTRUCTION OR REPAIR
E01D	BRIDGES
E01F	ADDITIONAL WORK, SUCH AS EQUIPPING ROADS OR THE CONSTRUCTION OF PLATFORMS, HELICOPTER LANDING STAGES, SIGNS, SNOW FENCES, OR THE LIKE
E02B	HYDRAULIC ENGINEERING
E02F	DREDGING; SOIL-SHIFTING
E03B	INSTALLATIONS OR METHODS FOR OBTAINING, COLLECTING, OR DISTRIBUTING WATER
E03C	DOMESTIC PLUMBING INSTALLATIONS FOR FRESH WATER OR WASTE WATER
E03D	WATER-CLOSETS OR URINALS WITH FLUSHING DEVICES; FLUSHING VALVES THEREFOR
E03F	SEWERS; CESSPOOLS
E04B	GENERAL BUILDING CONSTRUCTIONS; WALLS, e.g. PARTITIONS; ROOFS; FLOORS; CEILINGS; INSULATION OR OTHER PROTECTION OF BUILDINGS

E04C	STRUCTURAL ELEMENTS; BUILDING MATERIALS
E04F	FINISHING WORK ON BUILDINGS, e.g. STAIRS, FLOORS
E04G	SCAFFOLDING; FORMS; SHUTTERING; BUILDING IMPLEMENTS OR OTHER BUILDING AIDS, OR THEIR USE; HANDLING BUILDING MATERIALS ON THE SITE; REPAIRING, BREAKING-UP OR OTHER WORK ON EXISTING BUILDINGS
E04H	BUILDINGS OR LIKE STRUCTURES FOR PARTICULAR PURPOSES; SWIMMING OR SPLASH BATHS OR POOLS; MASTS; FENCING; TENTS OR CANOPIES, IN GENERAL
E05B	LOCKS; ACCESSORIES THEREFOR; HANDCUFFS
E05C	BOLTS OR FASTENING DEVICES FOR WINGS, SPECIALLY FOR DOORS OR WINDOWS
E05D	HINGES OR OTHER SUSPENSION DEVICES FOR DOORS, WINDOWS, OR WINGS
E05F	DEVICES FOR MOVING WINGS INTO OPEN OR CLOSED POSITION; CHECKS FOR WINGS; WING FITTINGS NOT OTHERWISE PROVIDED FOR, CONCERNED WITH THE FUNCTIONING OF THE WING
E05G	SAFES OR STRONG-ROOMS FOR VALUABLES; BANK PROTECTION DEVICES; SAFETY TRANSACTION PARTITIONS
E06B	FIXED OR MOVABLE CLOSURES FOR OPENINGS IN BUILDINGS, VEHICLES, FENCES, OR LIKE ENCLOSURES, IN GENERAL, e.g. DOORS, WINDOWS, BLINDS, GATES
E06C	LADDERS
E21B	EARTH OR ROCK; OBTAINING OIL, GAS, WATER, SOLUBLE OR MELTABLE MATERIALS OR A SLURRY OF MINERALS FROM WELLS
E21C	MINING OR QUARRYING
E21D	SHAFTS; TUNNELS; GALLERIES; LARGE UNDERGROUND CHAMBERS
E21F	SAFETY DEVICES, TRANSPORT, FILLING-UP, RESCUE, VENTILATION, OR DRAINAGE IN OR OF MINES OR TUNNELS
F15	FLUID-PRESSURE ACTUATORS; HYDRAULICS OR PNEUMATICS IN GENERAL
F21V	FUNCTIONAL FEATURES OR DETAILS OF LIGHTING DEVICES OR SYSTEMS THEREOF; STRUCTURAL COMBINATIONS OF LIGHTING DEVICES WITH OTHER

	ARTICLES, NOT OTHERWISE PROVIDED FOR
F24	HEATING; RANGES; VENTILATING