Not Her Business? Young Women STEM Entrepreneurs and Managers – A Systematic Review

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Abstract

Objectives – The objective of this paper is to investigate the state-of-the-art concerning young women STEM entrepreneurs and -managers in SMEs, with a special focus on their career entry and career advancement.
Prior Work – While governments all over the world try to close existing gender gaps, women are still less educated in science, technology, engineering and mathematics, the so-called STEM fields. Girls and young women still prefer female-dominated professions, resulting in a strong gender segregation for more science- and technology-driven fields of studies such as IT and engineering. Even where women graduate in the same study fields as men, their occupational choices and career-paths differ. STEM fields experience a large pipeline leak with regard to women: The higher the educational or professional level in STEM fields, the less women participate in leadership positions. Although many studies broach the issues of STEM in conjunction with school-girls and female students, to date less research focusses on factors related to career entry and career advancement of young women STEM professionals, who are already educated in STEM fields and now starting or advancing their careers in those fields.
Approach – We conducted a systematic literature review (SLR), focussing on young women STEM entrepreneurs and managers, so called young women STEM professionals (YWSP), during both career entry and -advancement. The database for the literature review is based on a systematic search for combinations of keywords ("wom*/fem*/gender entrepren*", "wom*/fem*/gender manag*", "wom*/fem*/gender leader*" and "wom*/fem*/gender career" combined with "STEM", "science", "technology", "engineering", "mathematics", and "informatics"). After checking for duplications our data corpus comprised 678 articles. Out of these, we got a final sample of 65 articles for further analysis.
Results – Our results demonstrate that the term STEM is not clear defined and rarely discussed related to YWSP. Career entry and advancement of the YWSP is a widely underexplored topic. Nevertheless, stereotypes and perceptions seem to play an important role. These and other key issues women STEM entrepreneurs face are congruent with the issues women entrepreneurs face in general.
Implications and Value – Our study is a first step to identify topics for future research and to derive conclusions for those women, who are interested in making their careers in STEM.

1. Introduction

All over the world, governments take actions in order to close existing gender gaps, but women are still less educated in Science, Technology, Engineering and Mathematics, the so-called STEM fields, which remain male dominated areas. Girls and young women still prefer female-dominated professions, resulting in a strong gender segregation for more science- and technology-driven fields of studies such as IT and engineering. In Germany, for example, only 25% of the female elementary students target technological professions such as engineering and informatics (Habermalz, 2017). Young women are even more likely to choose an occupation in female-dominated fields and sectors if their parents comply with traditional roles within the household. In contrast, if the mother worked full-time and pursued an occupational career, the daughter is more likely to choose an occupation, which is non-typical for females and/or in male-dominated fields (Busch, 2013). Greene et al. (2013) found a positive influence of women entrepreneurs on the daughter's entrepreneurial propensity. Furthermore, appropriate role models affect whether girls are interested in technology, science or engineering (Trauth et al., 2008) as well as their entrepreneurial propensity (Ndinguri et al., 2014). Even if women graduate in the same fields of study as men, their occupational choices and career-paths differ afterwards. STEM fields experience a large pipeline leak with regard to women: The higher the educational or professional level in STEM fields, the less women participate in it. In leadership positions, for example, only 15 % are women (Vongalis-Macrow, 2016). Even more – *if* women have a STEM background, they are still less likely to foster their career or to start a business in a STEM field, compared to men (Adams and Kirchmaier, 2016). Although there are many programs, initiatives and research projects, that focus on schoolgirls and how to awake their interest in STEM as a field of study, far less research has been done related to the young women STEM professionals (YWSP): young women entrepreneurs and –managers, who are educated in STEM and still working in the so-called STEM fields.

Against this background, our aim is to detect and depict the research state-of-the-art concerning the career entry and -advancement of these young women STEM professionals: Therefore, we conducted a systematic literature review (SLR), to learn more about the contemporary discussed issues and findings, related to our aim. The systematic literature review is part of a three-year-lasting research project, funded by the German Federal Ministry of Education and Research. The project started in April 2017. The subordinate project objective is, to investigate the career entry and career advancement of young women entrepreneurs and women managers in STEM fields, aiming to identify opportunities, barriers and challenges of women working in these fields. Amongst others, the project address the following questions related to the YWSP: What do their previous career paths look like? How did they handle arising challenges? What enabled a higher career level or what inhibited it? Which persons influenced their way in which manner? Not least, how do YWSP perceive themselves and how do others perceive them? How does that influence their further career development? In later stages of the project, we will conduct interviews with young women entrepreneurs and young women managers working in STEM professions in small and medium sized businesses (SMEs). The SME focus arose out of several reasons. At first, about 99.6% of all German enterprises are small and medium sized. Second, SMEs provide the majority of jobs in Germany (IfM Bonn, 2017). For this reason and with the increasing digitalization in mind, high-qualified young women have apparently good surrounding conditions for making career in STEM fields in SMEs. Apart from that – if not choosing an occupation in an already established enterprise, self-employment seems to be another alternative for getting a job that enables career entry and –advancement, even though to date only one third of all enterprise foundations is realized by women (bundesweite gründerinnenagentur, 2015). Due to the fact, that both women leaders and women entrepreneurs are underrepresented in STEM fields, we look at the career paths of both groups. With the systematic literature review, we will identify themes and topics for in-depth interviews, which are part of our research project at a later stage, to achieve "best evidence for informing policy and practice" (Tranfield et al., 2003: 207) within our whole project.

Our paper is organized as follows: In the following section, we will present some background information about Women in STEM, using the example of Germany as the described project is settled here. Afterwards we describes our methodology, particularly the chosen database, and our course of action during our systematic literature review. That followed, we present the first results of our review. We discuss the results afterwards in chapter 5 and finish the paper with some concluding remarks for our further investigation and an outlook on future research needs.

2. Background

For Germany, statistical data give evidence that the technical knowledge of highly qualified specialists is decisive for the success of the local export-oriented economy. This applies especially to the fields of mathematics, informatics, natural sciences and technology, subsumed under the term "STEM fields" (Anger et al., 2017). Instead of taking this as a great occupational opportunity for building their careers in this promising area, latest

statistics show, that women still less often choose a qualification (Statistisches Bundesamt, 2017) or an occupation (Bundesagentur für Arbeit, 2017) in this sector than men do. The quota of female elementary students in STEM fields is growing – but still just slowly. In winter semester 2007/2008 nearly 31 % of all elementary students in STEM fields, that started their qualification at German universities, were female, whereas in winter semester 2016/2017 their proportion went up to 32 % (Statistisches Bundesamt, 2017). The Organisation for Economic Co-operation and Development (OECD, 2017) also points out, that the proportion of women entering tertiary-level studies in STEM fields in an international context is still very low. In 2015, this proportion in OECD-countries amounted to 24 % in engineering and even only to 19 % in fields of information and communication technology (ICT). However, in natural sciences, maths and stats, the quota of females came to 50 % for OECD-countries. In head-to-head record, according to the OECD data, Germany did worse than the OECD-countries in general: In 2015, the proportion of females who started their studies in STEM fields amounted to 28 %, whereby the proportion of females in all OECD-countries came to 30 % (OECD, 2017).

According to women, who are employed in STEM fields, the ascertained figures are even worst. For example in informatics and other ICT-professions (information and communication technology), the proportion of women comes to 15.8 % and as a matter of fact in professions of mechatronics, energy and electric, the female quota amounts merely to 10.6 %. However, the proportion of females in professions of natural sciences like mathematics, biology, chemistry and physics seems relatively high with its 37 % (Bundesagentur für Arbeit, 2017). These data show, that only few women dare to take the step of registration for STEM-studies and pursue a college degree in this future oriented area, but alike few if not even fewer women actually work in STEM-professions. Even if women study STEM, they do less likely take a job, appropriate to their qualification afterwards (Weber-Braun and Eschke, 2012). Furthermore, the authors illustrate typical female-dominated sectors: compared to men, women still prefer working in jobs settled in social fields, such as occupations that deal with children and their education, where 84.2 % of all occupants are females. Another example is health care, where the proportion of women amounts to 83 % (Bundesagentur für Arbeit, 2017). The OECD illustrate similar preferences for women studying in social fields (OECD, 2017).

STEM fields, as well as business ownership and leadership careers, are perceived as masculine areas (Shapiro and Sax, 2011; Kawamaki et al., 2000). Women entrepreneurs operate in a social space that is unsympathetic to their gender (Marlow and McAdam, 2015). These effects appear to intensify with regard to business ownership in STEM, as research on women entrepreneurs in high-technology fields demonstrates (Tan, 2008). Where adequate STEM role models are lacking for girls and young women, this may foster their persistent self-selection into non-technical fields. Early attributions of gender specific roles and responsibilities within the parental household, as well as the behaviour of role models affect the affinity for science and technology in general. Already at a young age, differences exist between boys and girls regarding the use of modern technology. While boys deal with new media in a more explorative way, girls use the same technology more reactively and consumption-oriented (Hoffmann and Vance, 2007; Katz et al., 2006). These initial patterns shape the relationship to technology later in life, with young women showing less interest in technology-driven professions and industries than men and disposing a lower level of technological knowledge. Role models also influence societal perceptions of occupations considered ‘appropriate’ or ‘non-appropriate’ for women. Where a gendered division of labour results in housebound roles for women, they experience longer career breaks, as is the case, for example, in Germany (Bijedic et al., 2016). Consequently, this reduces their social and financial capital base and may additionally hinder them in entering STEM fields, both as entrepreneurs and as employees, when returning to the labour market in later stages of their life.

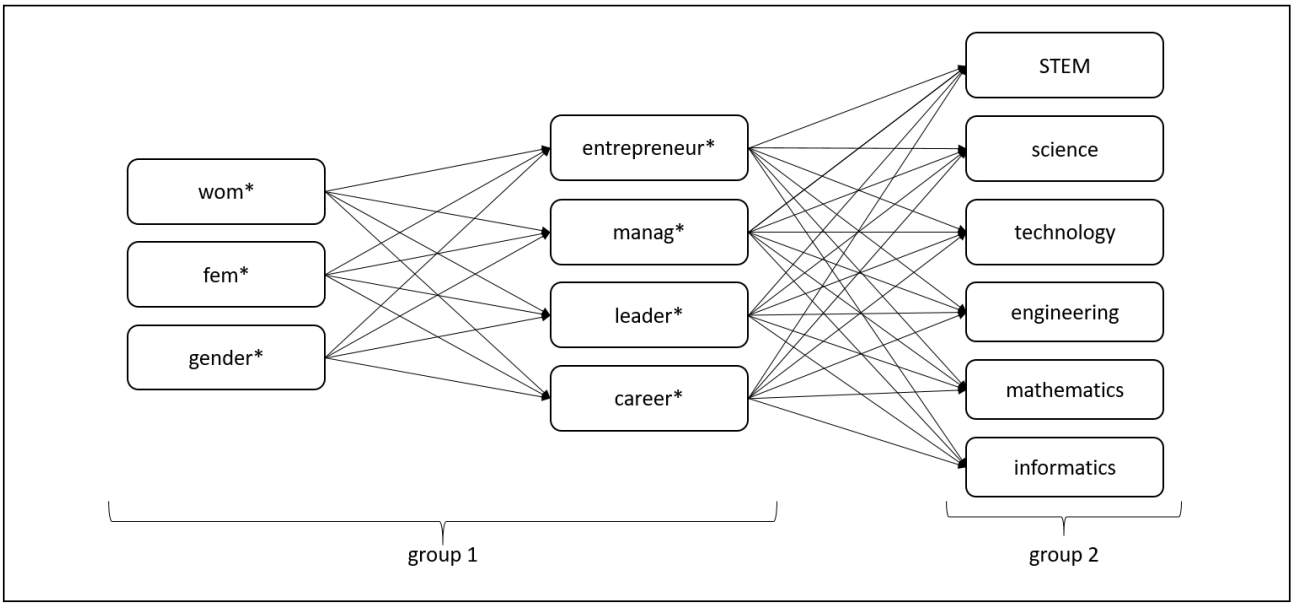
3. Methodology

In order to draw a comprehensive and concurrently reproducible picture of the state-of-the art of research about career entry and -advancement of young women STEM professionals, we started a systematic literature review (SLR) based on the approach of Tranfield et al. (2003). According to Tranfield et al. (2003), a systematic literature review consists of three phases: (1) planning the review, (2) conducting a review and (3) reporting and dissemination.

We first determined the basic conditions for our SLR in phase 1 (planning the review). We limited our search on a combination of two search word groups. The first group comprises meaningful descriptions and synonyms for women professionals, both in self-employment and employed positions. Hence, we choose the describing expressions *entrepreneur*, *manager* and *leader* for our target group and decided to add *career,* to gain articles dealing with aspiring persons as well. To account for the gender component, we combined the terms in each case with *woman*, *female* and *gender*. We asterisked the terms, to include similar word-forms with different

spellings (e.g. *woman* and *women*) and endings (e.g. *entrepreneur* and *entrepreneurship*). In total our first group consisted of twelve periphrases, namely *wom* entrepreneur*, fem* entrepreneur*, gender entrepreneur*, wom* manag*, fem* manag*, gender manag*, wom* leader*, fem* leader*, gender leader*, wom* career, fem* career** and *gender career** (see figure 1). In a second group of search words, we connected our different first-group expressions with STEM-terms. Here we choose the six keywords: *STEM*, *science*, *technology*, *engineering*, *mathematics* and *informatics*. We included the word "informatics" due to the fact, that the German counterpart of the abbreviation *STEM* (called *MINT*) does include it.

Figure 1: Key words search

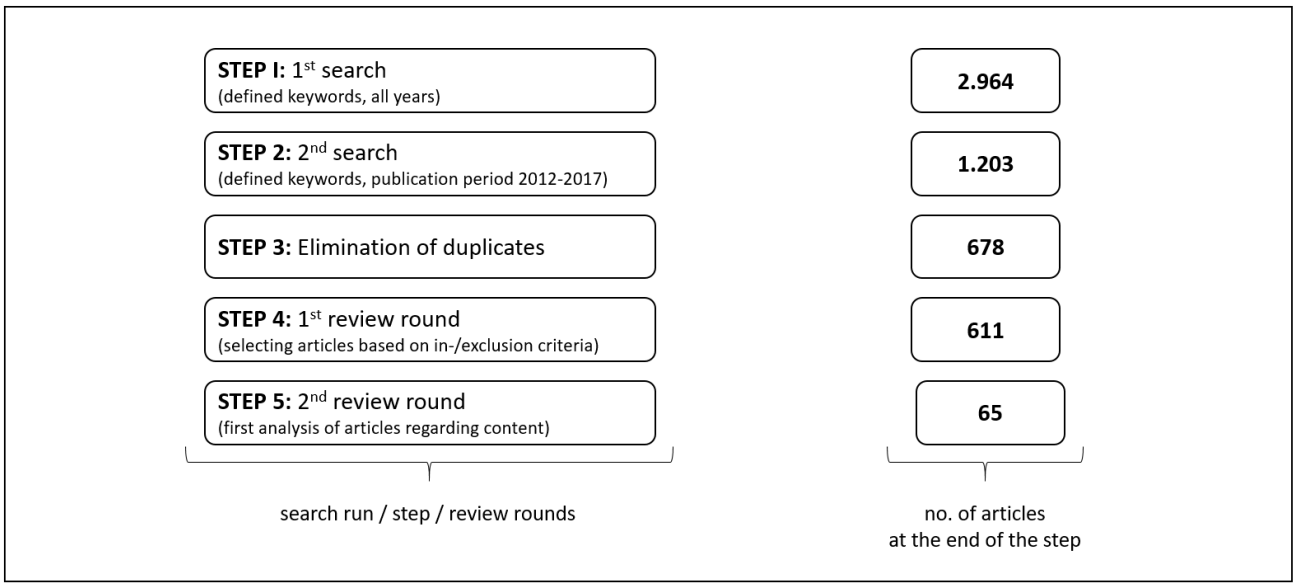


(Source: Own figure)

As an appropriate database for our search, we selected *Business Source Complete*. *Business Source Complete* is a business database, which provides a leading collection of bibliographic and full text content, including indexing and abstracts for the most important scholarly business journals (Business Source Complete, 2017). According to the data bases own statement, journal ranking studies reveal that "*Business Source Complete* is the overwhelmingly superior database for full text journals in all disciplines of business, including marketing, management, MIS, POM, accounting, finance and economics" (ibid.) Beside other sources, the database includes more than 3,500 academic journals. These provided academic journals represent a broad and well-selected cross section of the most important and most relevant journals that deal with research topics related to entrepreneurship and SMEs worldwide. High ranked as well as low ranked journals are included. Thus, our sample allowed us, to cover highly topical debates in leading journals, as well as rather niche topics of less prominent interest, but potentially likewise societal, political and economic relevance. A general business focus of the database allowed us, to consider likewise SME-, entrepreneurship- and general business administration journals. Beside the quality of the database, our access to it determined our choice.

We conducted our first search in Business Source Complete in July 2017 without any further restrictions, besides limiting our search on "academic journals". We entered the expressions out of our first keywords group in the first row and expressions of the second keyword group in the second row, in order to maximize the range of results and allow the different keywords to appear in different parts of the paper (e.g. in title and abstract). When entering terms from both keyword-groups in the same row, the database only searches for articles, where both given expressions are in the same part of the paper (both either in the title or in the abstract etc.). Our first search (STEP 1) resulted in 2.964 articles. To narrow down the number of hits without losing meaningfulness and still covering the topicality of the debate, we made a second search limited on the publication period 2012-2017, not specified on month. This second search (STEP 2) resulted in altogether 1.203 articles.

Figure 2: SLR process and article numbers



(Source: Own figure)

Table 1: Key word matrix and article numbers 2012-2017 in STEP 2

	STEM	science	technol-ogy	engineer-ing	mathemat-ics	informat-ics	Total
Wom* Entrepreneur*	1	57	35	8	0	0	**101**
Fem* Entrepreneur*	1	34	19	4	1	1	**60**
Gender Entrepreneur*	0	28	17	8	1	1	**55**
Wom* Manag*	3	103	54	27	4	1	**192**
Fem* Manag*	1	59	40	22	6	0	**128**
Gender Manag*	1	76	46	11	2	1	**137**
Wom* Leader*	2	73	27	6	2	0	**110**
Fem* Leader*	2	41	7	4	4	1	**59**
Gender Leader*	0	52	19	5	2	1	**79**
Wom* Career*	17	72	41	29	17	0	**176**
Fem* Career*	3	19	9	3	3	0	**37**
Gender Career*	7	31	12	10	7	2	**69**
Total	**38**	**645**	**326**	**137**	**49**	**8**	**1.203**

(Source: Own table)

We downloaded and organized all these articles with computer-based assistance of a reference management software, called Citavi 5. Citavi allows entering the bibliographic data of articles, to open the pdf files within the software, search for keywords within the files, highlight text, mark quotations, add annotations, and to sort whole articles or single quotations into a self-created category system. In a first step, we categorized the articles according to the underlying search word combinations. In a next step, we checked for duplicates, viz. articles, which were hits in more than one category. Through sorting out the duplicates (STEP 3), we minimized the number of articles to 678.

To focus within this database on those articles, which are relevant for answering our research question, we continued following the approach of Tranfield et al. (2003), and defined inclusion/exclusion criteria for the further analysis. The inclusion criteria clearly referred to our topic of research: we focus on Young Women Professionals in STEM fields. Therefore, we determined to include strictly all articles, dealing with Women STEM Entrepreneurs, Women STEM Managers, Women STEM Leaders or women making career in STEM fields. In this context, we define STEM as that special part of the work environment, that is often perceived as masculine and

a male-dominated area. On that account, we did not regard the great scope of academic science, but natural sciences. Furthermore, although pharmacy is commonly associated as part of STEM, according to our perception, it is no typical occupation that is practiced chiefly by men. Hence, we likewise disregarded this sector in our research. Indeed, we did not only restrict the regarded sectors, but rather expanded them and added informatics (as explained above). We excluded articles, which dealt with women entrepreneurs, women managers, women leaders or any other women, making career in non-STEM fields. Furthermore, we decided to disregard articles that deal with students, even though in combination with STEM, but with no focus on career/development after leaving the university. Apart from these substantial limitations, we targeted some rigorous standards. We excluded 38 non-English written articles (e.g. articles with an English abstract but foreign language title and text). 25 articles were excluded, because they seemed not to be conform to requirements of scientific articles (e.g. if the author(s) were not named within the texts) or because they were no scientific articles in a classical meaning (e.g. book reviews). Furthermore, we did not incorporated four articles, because we could not get access to the full-texts. Consequently, we excluded 67 articles in the first review round (STEP 4), and ended up with 611 remaining articles in our database.

To review these remaining 611 articles, our exemplary course of action in the next step was the following: We scanned the articles by reading the title, abstract, introduction and conclusion section to get a clearer idea, what the article is about and to decide, if we include or exclude it in the final detail review. Here we proceeded a bit more flexible: In some cases, the title revealed perfectly well, what the research is about: In these cases, we were able to assess the relevance of the paper quickly. In other cases, we read the abstract before categorizing the article as relevant or irrelevant for our review. In some cases, we needed to scan the full text for getting a distinct impression of the content. After this second review round (STEP 5), 65 articles remained for a more detailed review. Each of these 65 articles met all of our inclusion criteria and manifested none of the exclusion criteria (Tranfield et al. 2003). Table 2 shows the final sample under specification of the search-word classification (double entries possible, if an article appeared under different keyword combinations). An overview over the articles within the final sample is to be found in appendix 1.

Table 2: Key word matrix and articles in the final sample

	STEM	science	technology	engineering	mathematics	informatics	Total
Wom* Entrepreneur*	-	3	4	2	-	-	**9**
Fem* Entrepreneur*	-	2	4	1	-	-	**7**
Gender Entrepreneur*	-	2	4	1	-	-	**7**
Wom* Manag*	2	6	10	9	1	-	**28**
Fem* Manag*	-	2	5	4	-	-	**11**
Gender Manag*	1	6	11	6	-	-	**24**
Wom* Leader*	1	3	4	2	1	-	**11**
Fem* Leader*	1	2	2	2	1	-	**8**
Gender Leader*	-	3	2	3	-	-	**8**
Wom* Career*	9	14	15	15	7	-	**60**
Fem* Career*	1	1	3	1	1	-	**7**
Gender Career*	2	5	4	3	2	-	**16**
Total	**17**	**49**	**68**	**49**	**13**	**-**	**196**

(Source: Own table)

During our further analysis we classified all of the paper in an emerging category system related to the

1) **core subject of investigation** – women and entrepreneurship; women and management; women and leadership; women and career
2) **addressed STEM field** – STEM in general; science; technology; engineering; mathematics; SET; finance; software development; I(C)T; service sector; manufacturing; construction; industry; male dominated sectors in general; agriculture; medicine; renewable resources; renewable energy sector
3) **main topic** – career entry; career re-entry; difficulties/barriers; career advancement; stay in STEM; project management; stress; earnings; access to finance / funding; self-perception; perception of others; top management teams; SMEs

4) **approach/method** – case study; experiment; longitudinal study; theoretical/conceptual approach; meta-analysis; mixed methods; qualitative approach; quantitative approach; introduction / editorial; (S)LR)
5) **country focus** – no focus; unknown focus; international; Europe; Asia; Australia; Amerika; Africa; developing countries

During that process, we tried to find recurring topics and patterns related to our research question.

4. Results

Within the following sections, we describe selected findings, derived from our first analysis of the final sample. All presented results are work in progress and the analysis is not yet finished. Nevertheless some recurring topics and patterns are striking.

4.1 STEM is not clear defined and rarely discussed related to YWSP

Surprisingly for us, our search run with the search term "STEM" in the second search word group led to just comparatively few hits (see table 1 and 2). The German pendant to STEM, "MINT" (mathematics, informatics, natural sciences, and technique) is of width use, when researcher as well as practitioners and politicians talk about the technical- or natural science-related part of the work environment, which is male dominated and often perceived as a mostly masculine sphere. Apparently, STEM is not a just as prominent used expression in an international (research) context, as MINT in Germany is, when referring to those fields. Only nine of the 65 articles in our final sample focus explicitly literally on "STEM".

Alongside, different other expressions are used to describe (parts of the) STEM field. "SET", an abbreviation for science, engineering and technology was used in our final sample within seven articles and so nearly as often as "STEM". Although our data collection was finished, we tested the number of hits, when combining "SET" as a second group search word with our first group words in the chosen database and got a 40 times higher number of results. We made a similar observation with the expression "informatics" – here we gained just a very low number of hits, although many of our articles broach the issue of "IT" (information technology) or "ICT" (Information communication technology). Fifteen of the 65 articles in our final sample discussed IT or ICT in connection with women professionals. In 13 articles, the term "computer science" was used. Beside informatics, we gained just few hints relating to "mathematics", a word that is both part of the German and the English abbreviation. Differently to "informatics" which is covered by the term I(C)T, mathematics was no topic within the articles at all, except under the umbrella "STEM". Even if articles use either the terminology STEM, others of the common abbreviations, or single parts of the term STEM, that does not assure, that they talk about the same subject matters. A conspicuous example is the wording "science". Before our first review round (STEP 4) was finished, our database included many articles that dealt with the broad field of academic science, not limited on natural sciences. In our final sample, the term "natural sciences" was mentioned in only 4 articles, and even then predominantly in quotes of other sources (Glass et al., 2013; Lee and Marvel, 2014; Marvel et al., 2015; Ceci et al., 2014).

Although all articles in our final sample were scored through searching for "STEM-terms" in the 2nd search-word group, they pick various disciplines/branches out as main themes, for instance biological sciences, chemistry, computer science, earth and atmospheric sciences, electrical engineering and physics (Parker and Welch, 2013) or information/computer sciences, life sciences, physical sciences and mathematics (Gnilka and Novakovic, 2017). Deemer et al. (2014) focus on the disciplines physics and chemistry, although they also discuss implications for STEM fields in a more general way. Consequently the comprehension of the term STEM seem to be kind of matter of interpretation. Perhaps therefore some authors start to create their own terminologies, as, for instance, Adams and Kirchmaier (2016) do, who write about women on boards and thereby created a new abbreviation "STEM&F" STEM industries and finance.

Beside the manifold, but seldom use of the term STEM, our review confirmed, what we expected beforehand: what we define as STEM, the part of the work environment, which is male dominated and often perceived as a mostly masculine sphere, is rarely discussed in context of women entrepreneurs, -leaders and –managers. This makes it, beside the somewhat problematic use of the term STEM, even worse, to derive conclusions from the existing literature stream about Young Women STEM professionals.

4.2 Career entry and -advancement of YWSP is a widely unexplored topic

We targeted to investigate female careers (Arditi et al., 2013) in STEM fields with a special focus on career entry and advancement, focusing on both women entrepreneurs as well as women managers in SMEs. Anyway, the career paths of young women STEM professionals are not (yet) a prominent topic in current research (2012-2017) and none of the articles focused explicitly on women in STEM within SMEs. Only 24 articles in our final sample address female careers in STEM fields and merely a few of them deal with the critical points in women professionals career paths. Articles rather focus on specific groups in specific countries, than exploring the topic in a more general, theoretical driven manner. However, these articles provide some interesting insights. Abbasi and Sarwat (2014) for example explored the career entry of young women professionals in Pakistan. They focused on influencing factors of students' career choices in five specific professions, namely management/administration, agriculture, engineering, pharmacy and medicine. Their results show, that the social environment of the students is of great importance for their later career decisions, even more in case of female students. Xu (2017) focused on college graduates in the US in STEM fields and examined how the individual character as well as the social structure influences students' career choice. As a result, students cost benefit factors are responsible for students' decision for an occupation in STEM fields after graduation. A high family income has a negative impact on this decision, especially according to females' decisions. Furthermore, Xu (2017) pointed out, that women STEM professionals are more than twice as likely to choose an occupation that differs from their major-field of study, when they graduate at the age of 25 or younger, instead they graduate in a greater age (ibid.). Gnilka and Novakovic (2017) likewise researched the imminent career entry in STEM fields in the US. They investigated how the perfectionism of STEM students influences the perceived barriers for their personal career entry and found that female students perceive these barriers much higher than their male counterparts do. As a possible explanation, they mention the stereotype threat of females, which leads to attrition for women in STEM (ibid.), in line with Deemer et al. (2014), who found out, that stereotype thread could have a negative influence on the career choice of women professionals.

Regarding the career paths of high qualified women in male dominated sectors, Glass et al. (2013) found, that women STEM professionals mostly don't leave STEM fields in order to quit the labour market, but to take an occupation in a non-STEM-field. This leads to the question what causes STEM professionals to change their field of occupation or what determines that they stay in their jobs. Hanappi-Egger (2012) look at these question based on Women in SET in Austria, whereas Buse et al. (2013) and Quesenberry and Trauth (2012) refer to Women in the IT industry in the United States. Hanappi-Egger investigated 12 computer scientists, who had quit their jobs. With help of qualitative interviews, she identified their motives and reasons as well as experiences of these women professionals in the male-dominated sector of SET. Her results show, that there is need for a change in the "habitus" in the field of engineering, and that diversity management can contribute to women's retention in this area (ibid.). Quesenberry and Trauth (2012) gained similar results according to the IT industry. Buse et al. (2013) as well investigated women's retaining in engineering professions in the United States through qualitative interviews, in order to identify reasons for retaining quitting a job. Actually, they found, that the persisting women have high levels of self-efficacy and were motivated by the challenges as well as the recency of the profession. Furthermore, they detected, that these women engineers were less likely to be married moreover had fewer children. Against this, women who quit their occupation in engineering sometimes reported they felt as if they were pushed into engineering. Their results yield in a model, that should help to understand the reasons of women engineering professionals for retaining in their job and Buse et al. (2013) argue, that this model can also be transferred to other sectors.

Only three articles in our final sample deal explicitly with career advancement of women STEM professionals. Two of them are quantitative studies with a special focus on India (Barik and Bhosle, 2014; Kundu and Mor, 2017). One qualitative study deals with women professionals in Canada, focussing on the perceived barriers of career advancement in the advanced technology sector (Orser et al., 2012). In India, the number of women professionals in the so-called "male-domains" increases, but even though, the percentage of women filling top managerial positions is very low. Barik and Bhosle (2014) explain it with the glass ceiling effect and conclude, it is difficult, but not impossible, to overcome the glass ceiling. According to their results, women professionals do have the skills as well as the competences, to do so; hence, all they need is the awareness that they are able to break the glass ceiling. Societal pressure prevent them from realizing it. Orser et al. (2012) found out, that women most frequently blame gender for the challenges they face and that the women question the usefulness of mentoring for solving all their problems.

4.3 Stereotypes and perceptions are of great importance for YWSP

A recurring topic within the investigated articles, regardless of the specific addressed STEM area, are stereotypes and perceptions. 38 out of the 65 articles mention stereotypes in context of women STEM professionals and 41 articles mention perceptions in this regard. Both topics are that much thematised, that Croft et al. (2015) examined the influence of stereotypes on the communal role of *men*, referring to roles, that are traditionally occupied by women, bringing forward the argumentation, that the impact of stereotypes has been comprehensively researched regarding women, but not regarding men. However, many scientists attend to the impact of existing stereotypes with regard of women's career, their actual career opportunities and their perceived barriers in male dominated sectors. Deemer et al. (2014) for instance deal with the so-called "stereotype threat", which often influence women's career choices in a negative way. This phenomenon appears for example, when female students make their career choice and evaluate their options for career entry in a male dominated sector. In this situation, women might perceive specific barriers caused of stereotypes according to her gender. Therefore, they perceives their chances for making career in STEM fields worse than they actually are (ibid.). Moreover Gnilka and Novakovic (2017) assume, that the threat of negative stereotyping inhibits women's engagement for activities that may foster their self-efficacy in career choices. Barbulescu and Bidwell (2013) also found out, that women are less likely to apply to jobs in the area of finance or consulting. They examined this conjuncture, but found no evidence, that women are really less likely to get job offers, when they have applied to these male-dominated occupations. Hence, we deduce, that women STEM professionals' perceptions of their personal career opportunities and the actual opportunities often does not coincide, because of perceived stereotypes. Kyriakidou (2012) conducted a study, which deals with the construction-process of professional identity. She argues that professional identity consists of attributes, beliefs, values, motives and experiences. According to her study, the regarded women engineers were fully aware of the existing stereotypes about female engineers, but decided to pursue careers in leading positions, anyway.

These and other findings show, that stereotypes build upon perceptions. Kundu and Mor (2017) therefore state, that a positive perceptibility is necessary for a successful implementation of actions that should minimize stereotypes. Hence, in addition to invest in initiatives that contribute to a better gender/diversity management, organizations has to assure, that employees are able to positive assess those initiatives. Kundu and Mor (2017) recommend, that organisation managers have to ensure, that both majorities *and* minorities are involved in the initiatives, in order to foster its acceptance and effectiveness.

4.4 Women STEM entrepreneurs key issues are congruent with women entrepreneurs issues in general

The number of women STEM entrepreneurs increases all over the world (Brush and Cooper, 2012) and multiple shapes and facets related to women entrepreneurs in STEM are discussed in the academic literature. The regarded literature gives evidence, that more and more women see entrepreneurship as a good alternative, to occupy themselves in STEM fields. It is even stated, that the role of gender in entrepreneurship has been thoroughly investigated (Gicheva and Link, 2015). Evermore studies focus on individual difficulties women face, when they become entrepreneurs. Studies dealing with Women STEM entrepreneurs often focus on specific sectors or selected countries. For example, while identifying main reasons for women founding their own businesses, Vier Machado et al. (2016) discuss barriers and difficulties women entrepreneurs face, when they found and establish their businesses in the industry sector. They compare women entrepreneurs in industry sectors with women in the area of commerce or the service sector. Thus, they ascertain, that female entrepreneurs are no homogenous group – but rather divers in terms of reasons for their self-employment, for instance financial independence, perception of opportunities, fulfilment, dedication to what one wanted to do and earning more and more money (ibid.). Wing-Fai (2016) argues differently, that founding a business is not the decision of a single person, but of the whole family respective the household behind the founder. Through qualitative interviews, the author examined innovative internet- and mobile technology companies in Taiwan. There, most businesses were established through involvement of whole families or at least together with the spouses. Many of the interview-partners accounted, that the issue of founding a business has been intensively discussed previous to founding, among the family members. Actually, usually wife and husband both lead the company and therefore both can be seen as entrepreneurs. The author concludes, that becoming an entrepreneur isn't a matter of gender, but a family-decision (ibid.).

Pejić Bach et al. (2016) focus on the ICT industry in Croatia respective Slovenia. They detected a strong influence of gender on the entrepreneurial intention. Based on the results of their conducted investigation, they conclude, that the kind of influence on the intention of becoming an entrepreneur differs. While the regarded male ICT students seem to be more driven by extrinsic factors, females seem to be more driven by intrinsic

ones. Furthermore, they point out, that the ICT industry provides great opportunities for women, who wants to become entrepreneurs. They conclude that a good education is advisable for strengthening women's self-esteem as well as their belief in their own success (ibid.). Maksimović et al. (2016) also try to foster female entrepreneurship by developing recommendations for rural-living females, who plan to start their own business. They focus on agrarian women entrepreneurs in Serbia and likewise emphasize the high importance of women's education.

So far, discussed topics and findings about women entrepreneurs in STEM fields do not greatly differ from findings about women entrepreneurs in general. An exception is the topic of "access to finance", which seems to be much more prominent related to women STEM entrepreneurs. Gicheva and Link (2015) investigated women's access to private investments, when they plan to develop a new technology. They found, that female entrepreneurs thereby are disadvantaged, especially in the West and Northeast of the USA. Kuschel et al. (2017), Gicheva and Link (2015) and Wiederhold (2014) all scrutinize, how technology businesses that are owned by women can get funding. While Wiederhold (2014) does not focus on a specific ethnicity of female entrepreneurs, Kuschel et al. (2017) focus on Latin American women start-up founders. They found, overall ten factors that influence women entrepreneurs' access to finance, which are captured in the three categories: capital needs, networks and individual characteristics (ibid.)

5. Discussion

Although STEM is a well-known term, it is not clear defined, what STEM is like – our results show it as a broad and highly diverse field. The broadness of the term makes it difficult, to compare the results of particular studies with each other. One common ground in all of the presented studies is the focus on fields/branches/areas, which are male-dominated and often perceived as mostly masculine spheres. This could be the hub, the core of what we define as STEM fields, without naming the branches explicitly. Problematic are different associations while using same words. For instance, the German abbreviation MINT does not contain science, but natural sciences as only one facet of science in general. Difficulties are also noticeable, when we talk about informatics: a common term in Germany, it does not seem to be that ordinary used in academic literature. We see, what makes it difficult to talk about STEM, is the contextualization of the term. To cover its notion better, it seems to be necessary to include SET, ICT and IT as well as search-words in a comprehensive literature review. To date it is up to every team of authors' resp. study, to clarify, what they talk about, when they talk about STEM or facets of STEM. Unfortunately, many authors do not define it that clear or not at all. It needs to be discussed, if the term STEM is too broad to derive conclusions and if a more differentiated focus is necessary or the opposite. What speaks against this deduction, is the fact, that although career entry and –advancement of young women STEM professionals is so far a widely unexplored topic, described results are conferrable to different contexts in terms of regional, spatial and social circumstances. Especially the great importance of stereotypes and perceptions seem to be a central theme for women in STEM fields, as well women managers as women entrepreneurs.

Themes and topics discussed and conclusions derived from research about women entrepreneurs in STEM, seem not to be that different from research results about women entrepreneurs in general. The reason could be the gendered nature of entrepreneurship itself, which lead to similar structures, than STEM fields do. The main challenge for women entrepreneurs in STEM fields is the "doubled stereotyping" as women in the masculine, male dominated entrepreneurship field and at the same time women in masculine, male dominated STEM fields. Maybe the gendered nature of entrepreneurship covers the gendered nature of STEM fields for the women entrepreneurs or overlap problematics, they would face as employees in STEM. Somehow or other, the linkage between women in STEM in entrepreneurship and women in SMEs in entrepreneurship need much further investigation. Especially the focus on SMEs was not at all broached as an issue.

Our study faces several limitations, which are in large part based in the systematic literature approach itself. We limited the included journals in terms of the journals available in the chosen database, included solely articles with specific years of publication and our search based on beforehand identified search-words. An advantage of this chosen approach is the transparency and traceability of our results. However, to incorporate other articles and studies in a further step of our analysis is necessary, to get a broader picture of the academic discussion. Even though we are aware of the limitations, we see the SLR as a good first step, to get an idea about the topic and to frame our further work within our whole research process.

6. Conclusion and Outlook

Without doubt, STEM fields are all over the world important for innovation-oriented economies, as prior presented and further statistical data show. Qualified leaders educated in the broad area of STEM are in great demand. Nevertheless, women are still underrepresented here and the glass ceiling seem to persist. Thus, the gap between the low number of women already working in STEM fields, especially in leadership positions, and the needed skilled personnel remains high. In principle, both self-employment and SMEs offer chances for women of wide scope, to get in leadership positions within STEM. Further research about Women in STEM, especially young women STEM professionals, can help to identify barriers, chances and activities, which anyhow increase or decrease the number of women participating here. Preliminary results of our systematic literature review indicate that more research is needed about women, who are already "STEM-educated" and on their way into professional occupation within STEM. The so far more prominent topic of sensitization of women for STEM fields covers only one facet of the whole picture.

The next step in our literature review will be a more detailed analysis of the so far as relevant identified articles. Beside, we will extend our keyword search and add the terms "SET", "IT" and "ICT" in the second search word group. Within the underlying research project, our next step will be the conception and processing of first qualitative interviews with young women STEM managers and entrepreneurs. Concerning this matter, the preliminary findings discussed in this paper helps us, to prepare our interview guide. In terms of Tranfield et al. (2003: 220) we thereby achieve to "provide collective insights through theoretical synthesis into fields and sub-fields", to help to "develop a reliable knowledge base by accumulating knowledge from a range of studies" addressed to both researcher and practitioners and thereby contribute to the 2017s RENT conference call for "Relevance in Entrepreneurship Research". Entrepreneurship research as a discipline can contribute to the whole management research in widening its scope and better integrate research results about women entrepreneurs into SME-related discussions, e.g. about leadership. In our study, we try to connect it by means of young women STEM entrepreneurs and young women STEM managers in SMEs and accordingly women on their way into those positions.

Appendix 1: As relevant classified articles in the final sample (65 articles)

Author	Year	Title	Journal	Vol.(No.), pp.
Abbasi, Muhammad Nauman; Sarwat, Nosheen	2014	Factors Inducing Career Choice: Comparative Study of Five Leading Professions in Pakistan	Pakistan Journal of Commerce and Social Sciences	8(3), 830-845
Adams, Renée B.; Kirchmaier, Tom	2016	Women on boards in finance and STEM industries	American Economic Review: Papers & Proceedings	106(5), 277-281
Amore, Mario Daniele; Garofalo, Orsola	2016	Executive gender, competitive pressures, and corporate performance	Journal of Economic Behavior & Organization	131, 308-327
Arditi, David; Gluch, Pernilla; Holmdahl, Marie	2013	Managerial competencies of female and male managers in the Swedish construction industry	Construction Management & Economics	31(9), 979-990
Barbulescu, Roxana; Bidwell, Matthew	2013	Do Women Choose Different Jobs from Men? Mechanisms of Application Segregation in the Market for Managerial Workers	Organization Science	24(3), 737-756
Barik, Prathiba; Bhosle, Ranika	2014	Time to crack the glass ceiling: India context	International Journal of Research in Commerce & Management	5(7), 28-30
Baruah, Bipasha	2015	Creating Opportunities for Women in the Renewable Energy Sector: Findings from India	Feminist Economics	21(2), 53-76
Bowen, Paul; Edwards, Peter; Lingard, Helen	2013	Workplace Stress Experienced by Construction Professionals in South Africa	Journal of Construction Engineering and Management	139(4), 393-403
Bowen, Paul; Edwards, Peter; Lingard, Helen; Cattell, Keith	2014	Workplace Stress, Stress Effects, and Coping Mechanisms in the Construction Industry	Journal of Construction Engineering & Management	140(3), o-S.
Bowen, Paul; Govender, Rajen and Edwards, Peter	2014	Structural Equation Modeling of Occupational Stress in the Construction Industry	Journal of Construction Engineering & Management	140(9), o-S.
Braun, Shirley; Turner, Rebecca A.	2014	Attitudes and company practices as predictors of managers' intentions to hire, develop, and promote women in science, engineering, and technology professions	Consulting Psychology Journal: Practice and Research	66(2), 93-117
Brodock, Kate; Massam, Geoff	2016	How and why to hire a diverse workforce: what you need to know	Strategic HR Review	15(5), 208-213
Brown, Steven D.; Lent, Robert W.	2016	Vocational Psychology: Agency, Equity, and Well-Being	Annual Review of Psychology	67(1), 541-565
Brush, Candida G.; Cooper, Sarah Y.	2012	Female entrepreneurship and economic development: An international perspective	Entrepreneurship & Regional Development	24(1/2), 1-6
Buse, Kathleen; Bilimoria, Diana; Perelli, Sheri	2013	Why they stay: women persisting in US engineering careers	Career Development International	18(2), 139-154
Ceci, Stephen J.; Williams, Wendy M.; Ginther, Donna K.; Kahn, Shulamit	2014	Women in Academic Science: A Changing Landscape	Psychological Science in the Public Interest	15(3), 75-141
Croft, Alyssa; Schmader, Toni; Block, Katharina	2015	An Underexamined Inequality: Cultural and Psychological Barriers to Men's Engagement With Communal Roles	Personality & Social Psychology Review	19(4), 343-370

Cross, Christine; Linehan, Margaret; Murphy, Caroline	2017	The unintended consequences of role-modelling behaviour in female career progression	Personnel Review	46(1), 86-99
Deemer, Eric D.	2014	Feeling the Threat: Stereotype Threat as a Contextual Barrier to Women's Science Career Choice Intentions	Journal of Career Development	41(2), 141-158
Gavious, Ilanit; Segev, Einav; Yosef, Rami	2012	Female directors and earnings management in high-technology firms	Pacific Accounting Review (Emerald Group Publishing Limited)	24(1), 4-32
Gicheva, Dora; Link, Albert N.	2015	The gender gap in federal and private support for entrepreneurship	Small Business Economics	45(4), 729-733
Gilal, Abdul Rehman; Jaafar, Jafreezal; Omar, Mazni; Basri, Shuib; Waqas, Ahmad	2016	A rule-based model for software development team composition: Team leader role with personality types and gender classification	Information and Software Technology	74, 105-113
Glass, Jennifer L.; Sassler, Sharon; Levitte, Yael; Michelmore, Katherine M.	2013	What's So Special about STEM? A Comparison of Women's Retention in STEM and Professional Occupations	Social Forces	92(2), 723-756
Gnilka, Philip B.; Novakovic, Alexandra	2017	Gender Differences in STEM Students' Perfectionism, Career Search Self-Efficacy, and Perception of Career Barriers	Journal of Counseling & Development	95(1), 56-66
Hanappi-Egger, Edeltraud	2012	"Shall I stay or shall I go"? On the role of diversity management for women's retention in SET professions	Equality, Diversity & Inclusion	31(2), 144-157
Haque, A. U.; Aston, J.	2016	A relationship between occupational stress and organisational commitment of IT sector's employees in contrasting economies	Polish Journal of Management Studies	14(1), 95-105
Hellens, Liisa von; Trauth, Eileen; Fisher, Julie	2012	Editorial	Information Systems Journal	22(5), 343-353
Herman, Clem	2015	Rebooting and Rerouting: Women's Articulations of Frayed Careers in Science, Engineering and Technology Professions	Gender, Work and Organization (Gender, Work & Organization)	22(4), 324-338
Herman, Clem	2015	Returning to STEM: Gendered factors affecting employability for mature women students	Journal of Education & Work	28(6), 571-591
Herman, Clem; Lewis, Suzan; Humbert, Anne Laure	2013	Women Scientists and Engineers in European Companies: Putting Motherhood under the Microscope	Gender, Work and Organization	20(5), 467-478
Hill, Kathy L.	2013	We've come a long way, baby, or have we?	Journal of Organizational Culture, Communications & Conflict	17(2), 29-36
Hodgson, Damian E.; Lindgren, Monica; Packendorff, Johann; Cicmil, Svetlana	2016	Introduction: The Politics of Projects in Technology-Intensive Work	New Technology, Work & Employment	31(1), 1-3
Karanja, Erastus; Zaveri, Jigish; Ntembe, Augustin	2015	From Classroom to Executive Management – Gender Diversity in the Information Technology Field	Journal of Information Technology Management	26(3), 33-48
Kundu, Subhash C.; Mor, Archana	2017	Workforce diversity and organizational performance: A study of IT industry in India	Employee Relations	39(2), 160-183

Kuschel, Katherina; Lepeley, María-Teresa; Espinosa, Fernanda; Gutiérrez, Sebastián	2017	Funding challenges of Latin American women start-up founders in the technology industry	Cross Cultural & Strategic Management	24(2), 310-331
Kyriakidou, Olivia	2012	Fitting into technical organizations? Exploring the role of gender in construction and engineering management in Greece	Construction Management & Economics	30(10), 845-856
Kyriakidou, Olivia	2012	Negotiating gendered identities through the process of identity constructionWomen managers in engineering	Equality, Diversity and Inclusion: An International Journal	31(1), 27-42
Laplonge, Dean	2016	A toolkit for women: The mis(sed) management of gender in resource industries	Journal of Management Development	35(6), 802-813
Lee, In Hyeock; Marvel, Matthew R.	2014	Revisiting the entrepreneur gender-performance relationship: a firm perspective	Small Business Economics	42(4), 769-786
Legault, Marie-Josée; Chasserio, Stéphanie	2012	Professionalization, risk transfer, and the effect on gender gap in project management	International Journal of Project Management	30(6), 697-707
Lin, Li; Abetti, Pier A.	2012	Entrepreneurship in China during the transition from state ownership to free market: case study of a woman entrepreneur (1994 to 2010)	International Journal of Entrepreneurship and Innovation Management	16(3/4), 137-158
Liu, Helena; Cutcher, Leanne; Grant, David	2015	Doing Authenticity: The Gendered Construction of Authentic Leadership	Gender, Work and Organization	22(3), 237-255
Machado, Hilka Pelizza Vier: Gazolo, Sebastiao; Dos Santos Fabrico, Joiceli; Moreno Anez, Miguel Eduardo	2016	Women Entrepreneur: Reasons and Difficulties for Starting in Business	Revista de Administração Mackenzie	17(3), 15-38
Maksimović, Goran; Otović, Slavica; Demirović, Dunja; Vermezović, Tatjana	2016	A Review Investigating Agrarian Female Entrepreneurship in the Republic of Serbia	Economics of Agriculture	63(1), 29-46
Marlow, Susan; McAdam, Maura	2012	Analyzing the Influence of Gender Upon High-Technology Venturing Within the Context of Business Incubation	Entrepreneurship: Theory & Practice	36(4), 655-676
Marvel, Matthew R.; Lee, In Hyeock Ian; Wolfe, Marcus T.	2015	Entrepreneur Gender and Firm Innovation Activity: A Multilevel Perspective	IEEE Transactions on Engineering Management	62(4), 558-567
Mayer, Claude-Hélène; van Zyl, Llewellyn E.	2013	Perspectives of female leaders on sense of coherence and mental health in an engineering environment	South African Journal of Industrial Psychology	39(2), 1-11
Ojokoh, Bolanle Adefowoke; Adeola, Oladele Stephen; Isinkaye, Folasade Olubusola; Abraham, Chon	2014	Career Choices in Information and Communication Technology among South Western Nigerian Women	Journal of Global Information Management	22(2), 48-77
Orser, Barbara; Riding, Allan; Stanley, Joanne	2012	Perceived career challenges and response strategies of women in the advanced technology sector	Entrepreneurship & Regional Development	24(1/2), 73-93
Parker, Marla; Welch, Eric W.	2013	Professional networks, science ability, and gender determinants of three types of leadership in academic science and engineering	The Leadership Quarterly	24(2), 332-348

Pejić Bach, Mirjana; Merkač Skok, Marjana; Suša, Dalia	2016	Determinants of Entrepreneurial Intentions in ICT Industry: Gender and country of origin perspective	Our Economy	62(1), 37-45
Quesenberry, Jeria L.; Trauth, Eileen M.	2012	The (dis)placement of women in the IT workforce: an investigation of individual career values and organisational interventions	Information Systems Journal	22(6), 457-473
Quintana-García, Cristina; Benavides-Velasco, Carlos A.	2016	Gender Diversity in Top Management Teams and Innovation Capabilities: The Initial Public Offerings of Biotechnology Firms	Long Range Planning	49(4), 507-518
Quintana-García, Cristina; Elvira, Marta M.	2017	The Effect of the External Labor Market on the Gender Pay Gap Among Executives	ILR Review	70(1), 132-159
Ravindran, Bharathi; Baral, Rupashree	2014	Factors Affecting the Work Attitudes of Indian Re-entry Women in the IT Sector	Vikalpa: The Journal for Decision Makers	39(2), 31-42
Roos, Hannelore	2013	In the Rhythm of the Global Market: Female Expatriates and Mobile Careers: A Case Study of Indian ICT Professionals on the Move	Gender, Work and Organization	20(2), 147-157
Ruiz-Jiménez, Jenny; Fuentes-Fuentes, María; Ruiz-Arroyo, Matilde	2016	Knowledge Combination Capability and Innovation: The Effects of Gender Diversity on Top Management Teams in Technology-Based Firms	Journal of Business Ethics	135(3), 503-515
Strøm, Reidar Øystein; D'Espallier, Bert; Mersland, Roy	2014	Female leadership, performance, and governance in microfinance institutions	Journal of Banking & Finance	42, 60-75
Warren, Clive M. J.; Antoniades, Hera	2016	Deconstructing the glass ceiling: Gender equality in the Australian property profession	Property Management	34(1), 29-43
Warrier, Uma	2013	A Study on Work-Life Balance as a Function of Demographic Variables at an IT Company in Bangalore	Journal of Organisation and Human Behaviour	2(3), 40-48
Wiederhold, Brenda K.	2014	How Can More Women-Owned Technology Businesses Get Funding?	Cyberpsychology, Behavior, and Social Networking	17(1), 1-2
Wing-Fai, Leung	2016	The strengths of close ties: Taiwanese online entrepreneurship, gender and intersectionality	Information, Communication & Society	19(8), 1046-1060
Wittbom, Eva Elisabeth	2015	Management control for gender mainstreaming – a quest of transformative norm breaking	Journal of Accounting & Organizational Change	11(4), 527-545
Woszczynski, Amy B.; Dembla, Pamila; Zafar, Humayun	2016	Gender-based differences in culture in the Indian IT workplace	International Journal of Information Management	36(4), 507-519
Xu, Yonghong Jade	2017	Attrition of Women in STEM: Examining Jon/Major Congruence in the Career Choices of College Graduates	Journal of Career Development	44(1), 3-19

(Source: Own table)

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