

# Gender Equality in Information Technology Processes: A Systematic Mapping Study

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**Abstract.** Information Technology (IT) plays a key role in the world we live in. As such, its relation to the 17 Sustainable Development Goals (SDGs) stated by the United Nations to improve lives and health of the people and the planet is inexorable. In particular, the SDG 5 aims to enforce gender equality and states 9 Targets that drive the actions to achieve such goal. The lack of women within IT has been a concern for several years. In this context, the objective of this study is to get an overview of the state of the art on gender equality in IT processes. To do so, we conducted a Systematic Mapping Study to investigate the addressed Targets, challenges, and potential best practices that have been put forward so far. The results we have obtained demonstrate the novelty of this field, as well as a set of opportunities and challenges that currently exist in this regard, such as the lack of best practices to address gender equality in IT processes and the need to develop proposals that solve this problem. All of this can be used as a starting point to identify open issues that help to promote research on this field and promote and enhance best practices towards a more socially sustainable basis for gender equality in and by IT.

**Keywords:** Gender Equality, Information Technology, Processes, Sustainability, Systematic Mapping Study.

## 1 Introduction

The United Nations (UN) proposed 17 Sustainable Development Goals (SDGs) for sustainable development, with the aim of making the world work together for peace and progress [1]. The Goals call out for environmental, social, and economic sustainability [2] to better the world; perspectives that can be seen in relation to Information Technology (IT).

IT has revolutionized the world as we know in the past decades [3] within areas such as education, social interactions, and defense, among others. However, this revolution has been accompanied by negative aspects for the three perspectives of sustainability (environment, society, and economy) [2], which must be considered to achieve true sustainable development. An example of this is the marginal representation of women in IT research, practice, and education [4].

Numbers from 2019 show that just 16% of engineering roles are held by women and 27% of roles within computing [5]. While gender gaps have evened out in many fields and parts of the society in recent decades, it seems to lag in IT [6].

There are several questions that need to be addressed, such as why not more women enter IT, why women often leave IT, and what they specifically bring to IT. Studies show that women leave IT at a higher rate than men, and that of the already few women in tech, 50% of them will resign from their tech role before they turn 35 [7].

In the same way, for the past years, IT development has created different kinds of tools that help improve people's lives and make it easier to communicate, among other relevant functions and characteristics. So, how does the lack of female input in development of IT solutions and, generally, in IT processes, affect the resulting application? This is a difficult question to answer and one that has not yet been adequately addressed. Albusays et al. [4] stated the following: "Although it is well accepted that software development is exclusionary, there is a lack of agreement about the underlying causes, the critical barriers faced by potential future developers, and the interventions and practices that may help".

For these reasons, the objective of this study is to understand the state of the art and how it corresponds to the Goal of gender equality (SDG 5 [1]) in IT processes, a topic that, until now, had not been explored or analyzed in previous works. By going through the current research and identifying the challenges and current best practices (through a Systematic Mapping Study) the prospect is to find out how IT processes can be improved and adapted to enhance gender equality.

The rest of this study is organized as follows: Section 2 includes the background about gender equality and IT; Section 3 presents the methodology followed to conduct the analysis of the state of the art; Section 4 shows the results obtained; Section 5 discusses the main findings, as well as the limitations and implications; and Section 6 contains the conclusions reached. In the same way, Appendix A includes the list of references of the selected primary studies; and Appendix B shows a mapping of the answers to the research questions from each of these primary studies.

## **2 Background**

### **2.1 Gender Equality**

The SDG 5 that the UN put forward in 2015 [1] targets gender equality. The UN recognize that progress between the SDGs is integrated, and that technology has an important role to play in achieving them. In the past decades progress in gender equality has been made, and there are today more women in leadership and political positions [8]. However, numbers from the UN show that there is still a long way to go; in agriculture women own only 13% of the land, and representation in politics is still low at 23.7%, even though it has increased<sup>1</sup>. In developing countries genital mutilation and child marriage are some of the biggest threats affecting girls and women [9] [10]. The UN emphasizes that: "*Ending all discrimination against women and girls is not only a*

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<sup>1</sup> <https://www.un.org/sustainabledevelopment/gender-equality/>

*basic human right, it is crucial for sustainable future; it is proven that empowering women and girls helps economic growth and development”<sup>2</sup>.*

Gender equality is a complex goal with many dependencies that needs to be fulfilled. The main goal of gender equality is to make all discrimination against all women cease. This goal affects many different issues and types of discrimination and has a set of 9 Targets [1]. The Targets help articulate in more detail the different challenges from child mutilation to equal opportunities in political leaderships, among others, as can be seen in Table 1 (extracted from [1]).

It is important to point out that in gender equality all genders should be included, and this no longer only contains men and women. However, this study will revolve around the gender equality dilemma that women face, as this is what is pointed out in the SDG's and what is presented in the current literature analysis.

**Table 1.** SDG 5 Targets [1].

Target	Description
Target 5.1	End all forms of discrimination against all women and girls everywhere.
Target 5.2	Eliminate all forms of violence against all women and girls in the public and private spheres, including trafficking and sexual and other types of exploitation.
Target 5.3	Eliminate all harmful practices, such as child, early and forced marriage and female genital mutilation.
Target 5.4	Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate.
Target 5.5	Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life.
Target 5.6	Ensure universal access to sexual and reproductive health and reproductive rights as agreed in accordance with the Programme of Action of the International Conference on Population and Development and the Beijing Platform for Action and the outcome documents of their review conferences.
Target 5.a	Undertake reforms to give women equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance and natural resources, in accordance with national laws.
Target 5.b	Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women.
Target 5.c	Adopt and strengthen sound policies and enforceable legislation for the promotion of gender equality and the empowerment of all women and girls at all levels.

## 2.2 Gender Equality in IT

From the Target 5.5 of the SDG 5, promoting more women within IT positions at all levels is presented, which can seem superficial in comparison to child mutilation, but having more women in these positions can help by putting more focus on the dangers girls face. As Diekmann et al. state: *“Lower numbers of women in STEM result in a narrower range of inquiry and progress in those fields; fields that have experienced increases in diversity also witness an increase in the range of topics pursued...”* [11].

<sup>2</sup> <https://www.undp.org/sustainable-development-goals#gender-equality>

The lack of women within IT has made them high in demand for many employers, and it is interesting to get an understanding of why women are sought-after in the IT market [12]. There are examples of how companies with more women create better styles of management and more creative and innovative processes as well as more focus on better user experiences [13]. To increase women in IT many resources are in play, and some of the main enactments consist of university and mentoring programs [14]. These aim to create woman networks and get them to continue their degree, but it is also necessary to look further into why women leave IT and how this can be addressed.

The lack of diversity within software development is well known but the barriers that future developers will face, as well as the practices that can help, are not thoroughly discussed and agreed upon [4]. One barrier that we are already seeing is that the lack of female input during the development of IT can lead to non-inclusive solutions [4]. A part of gender equality that can be perceived as conflicting for many is the drive for equality while still focusing on the differences such as in the missing female perspective in IT. It is important to note that even though the gender equality is achieved there will always be different perspectives that can only be obtained through the inclusion of all.

It is for this reason that it becomes essential to include women (in addition to other discriminated social groups regardless of their race, culture, and other types of discrimination) and to achieve a balance throughout all processes that involve IT. When we talk about processes, ISACA (Information Systems Audit and Control Association) defines a process as a series of practices that are affected by procedures and policies, taking inputs from several sources and using these to generate outputs [15]. Further it is explained that processes also have a defined purpose, roles, and responsibilities, as well as a performance measure. In this study we understand IT processes as processes, frameworks, and/or best practices leading to the development of IT solutions.

### 3 Research Method

The study will be conducted as a Systematic Mapping Study (SMS) and will follow the guidelines established by Kitchenham [16], adopting also the lessons learned for the data extraction and analysis identified by Brereton et al. [17].

#### 3.1 Research Questions

Table 2 shows the research questions (RQs) established to address the objective of the SMS, as well as the motivation of each of them. As one of the prospects of the study is to see connections to the SDG 5, the RQ2 addresses this through the Targets of the SDG 5. Further the statistics found and included above showed that many women leave IT, so this motivated RQ3 and RQ4, addressing what challenges are present in IT and the best practices for gender equality in IT processes.

**Table 2.** Research questions.

Research question	Motivation
<b>RQ1.</b> What kind of studies exist on IT processes and gender equality?	Discover what studies exist on IT processes and gender equality and how they are distributed to get an overview of the field.

Research question	Motivation
<b>RQ2.</b> What gender equality Targets are addressed by IT processes?	Based on the Targets from the SDG 5, identify which targets are covered.
<b>RQ3.</b> What are the main challenges to achieve gender equality in IT processes?	Identify the main challenges reported by existing studies in order to understand the obstacles that women in the IT sector face.
<b>RQ4.</b> What are the best practices established to address gender equality in IT processes?	Uncover best practices that have been reported to promote gender equality in IT processes.

### 3.2 Search Strategy

To define the keywords to be used to implement the searches, 3 main topics related to the research were identified:

- The first topic refers to the field of technology. Concepts as IT, information technology, or information systems could be used, but it was concluded that technology itself represents the field well and covers the expected scope.
- The second topic addresses processes and best practices, where both terms were implemented in the search string.
- The third topic represents the gender equality, so terms in this regard were implemented in the search string.

To address all the Targets from the SDG 5, it was decided to conduct specific searches that focused on each Target. As a result, 10 different searches were performed. Table 3 shows the search strings established for each one of these searches.

**Table 3.** Search strings.

Scope	Search string
General	(Technology AND (Process* OR "Best practice*")) AND (Gender OR "Women rights" OR "Social sustainability" OR "SDG 5"))
Target 5.1	(Technology AND (Process* OR "Best practice*")) AND ((Women OR Girls OR Gender) AND Discrimination))
Target 5.2	(Technology AND (Process* OR "Best practice*")) AND ((Women OR Girls OR Gender) AND (Violence OR Exploitation OR Trafficking)))
Target 5.3	(Technology AND (Process* OR "Best practice*")) AND ((Women OR Girls OR Gender) AND ("Harmful practices" OR Mutilation)))
Target 5.4	(Technology AND (Process* OR "Best practice*")) AND ("Social protection policies" OR "Care work" OR "Domestic work"))
Target 5.5	(Technology AND (Process* OR "Best practice*")) AND ((Women OR Girls OR Gender) AND ("Equal opportunities" OR Participation OR Leadership)))
Target 5.6	(Technology AND (Process* OR "Best practice*")) AND ((Sexual OR Reproductive) AND (Health OR Rights)))
Target 5.a	(Technology AND (Process* OR "Best practice*")) AND ((Women OR Girls OR Gender) AND Rights AND Equal*))
Target 5.b	(Technology AND (Process* OR "Best practice*")) AND ((Women OR Girls OR Gender) AND Empower*)
Target 5.c	(Technology AND (Process* OR "Best practice*")) AND ((Women OR Girls OR Gender) AND (Equal* OR Empower*) AND (Policies OR Legislation*))

### 3.3 Selection Criteria

In order to select the primary studies, a set of criteria were put forward to include all relevant studies and exclude those that would not aid the task. So, first, the criteria for including a study were established as follows:

- **I1.** English studies published between 2016 (the year after the publication of the SDGs [1]) and 2021 about gender equality in and by the IT sector.
- **I2.** Complete studies that are peer reviewed in journals or conferences.

And, in the same way, the exclusion criteria defined were the following:

- **E1.** Studies presenting opinions, or such as abstracts or presentations.
- **E2.** Studies that do not revolve around IT processes and gender equality.
- **E3.** Duplicated work, only the most recent will be considered.

### 3.4 Data Sources and Study Selection

The selection of data sources and studies were performed through the following steps:

- **Data Source Selection.** The searches were all performed with the bibliographic database *Scopus*, through the advanced search functions.
- **Initial Search.** The initial search consisted of 10 search strings that resulted in a total of 4,206 studies. The study selection was performed by first reading through the titles and abstracts of all the studies and selecting according to the inclusion and exclusion criteria, which resulted in 50 potential studies.
- **Limiting the Studies.** The 50 potential studies were further narrowed down by applying the selection criteria on the whole study. This resulted in 15 primary studies that were analyzed in detail and data extraction was performed.

### 3.5 Strategy for Data Extraction and Analysis

Table 4 shows the classification scheme related to the possible answers identified during the planning for each of the RQs. In addition to the general information of each study (title, authors, venue...), this classification helps to identify and extract specific data such as the type of study, scope, practices and challenges in this regard, etc.

**Table 4.** RQs classification scheme.

Research question	Answers
<b>RQ1.</b> What kind of studies exist on IT processes and gender equality?	<b>a.</b> State of the art <b>c.</b> Validation <b>b.</b> Proposal <b>d.</b> Others
<b>RQ2.</b> What gender equality Targets are addressed by IT processes?	<b>a.</b> Target 5.1 <b>d.</b> Target 5.4 <b>g.</b> Target 5.a <b>b.</b> Target 5.2 <b>e.</b> Target 5.5 <b>h.</b> Target 5.b <b>c.</b> Target 5.3 <b>f.</b> Target 5.6 <b>i.</b> Target 5.c
<b>RQ3.</b> What are the main challenges to achieve gender equality in IT processes?	<i>Keyword extraction to identify answers (due to the large scope of answers that this RQ can have)</i>
<b>RQ4.</b> What are the best practices established to address gender equality in IT processes?	<i>Keyword extraction to identify answers (due to the large scope of answers that this RQ can have)</i>

\*The answers to RQ1 have their origin in an adaptation from the example of Petersen et al. [18].

## 4 Results

### 4.1 RQ1: What Kind of Studies Exist on IT Processes and Gender Equality?

The RQ1 is set to discover what studies exist in the field of IT processes and gender equality. Following the extraction plan visualized in Fig. 1, we find that out of the 15 primary studies there are 5 state of the art analysis ([S06], [S07], [S10], [S12], and [S15]), 1 proposal ([S05]), 4 validations ([S04], [S08], [S09], and [S13]), and 5 categorized as others ([S01], [S02], [S03], [S11], and [S14]).

All results were limited to the last 6 years, which is a short publication period whose purpose is to have a quick overview and a first approach to the most recent and updated works. It is worth mentioning that 7 of the studies were published from 2020-2021, 3 in 2019, and the resulting 5 from 2016-2018, indicating a growing interest in the area.

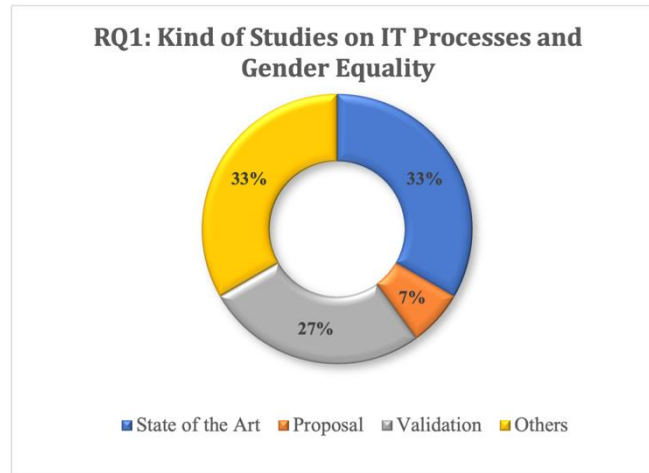
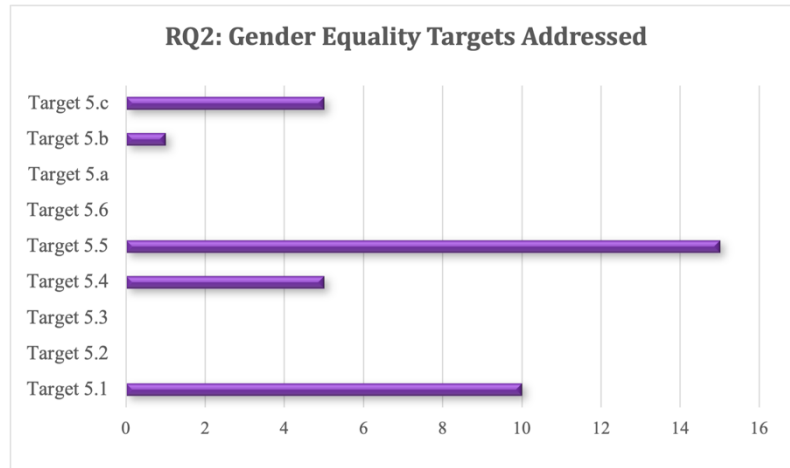


Fig. 1. Results from data extraction of RQ1 (percentage of the kind of studies).

### 4.2 RQ2: What Gender Equality Targets are Addressed by IT Processes?

All the primary studies have been assessed for which of the 9 Targets from the SDG 5 [1] they contribute to. The results obtained in this regard (and represented in the Fig. 2) show that all of the 15 studies foster Target 5.5 that is concerned with ensuring women's participation and opportunities at all levels in public life. Further 10 out of the 15 primary studies ([S01], [S02], [S04], [S05], [S06], [S11], [S12], [S13], [S14], and [S15]) condition Target 5.1 that is related to end all forms of discrimination. A third of the studies ([S04], [S05], [S06], [S10], and [S13]) address Target 5.4 that applies to promoting equality and shared responsibility within household and domestic care. A third of the studies again ([S04], [S05], [S06], [S08], and [S10]) contribute to Target 5.c concerning policies for promoting empowerment of women and gender equality. Finally, Target 5.b is also hit by one study ([S08]), regarding using enabling technology to promote the empowerment of women. It is equally important to highlight the Targets that were not address by any study, which are Targets 5.2, 5.3, 5.6, and 5.a.



**Fig. 2.** Results from data extraction of RQ2 (number of studies addressing each of the Targets within the SDG 5).

#### 4.3 RQ3: What are the Main Challenges to Achieve Gender Equality in IT Processes?

With the aim of discovering the current challenges on gender equality in IT processes, a keyword extraction was performed, identifying those concepts in this regard that each study deals with. Fig. 3 shows as an overview all the challenges that have been identified in two or more studies. In the same way, it is important to remember that the mapping of the full data extraction results can be found in Appendix B.

First, the challenge that is most frequently mentioned is gender bias, appearing in 8 studies ([S02], [S03], [S04], [S05], [S06], [S07], [S08], and [S14]). To better understand what this challenge refers to, the APA Dictionary of Psychology describes gender bias as “*any one of a variety of stereotypical beliefs about individuals on the basis of their sex, particularly as related to the differential treatment of females and males*” [19]. Therefore, this challenge refers to preconceptions without evidence of the involvement, performance, responsibilities, and possibilities, among others, of women in IT processes.

Second, imposter syndrome is the next challenge that occurred with most frequently in 7 studies ([S02], [S04], [S08], [S09], [S11], [S12], and [S13]). Embedded in the term imposter syndrome is the fear of being revealed as a fraud or seen as incompetent for one’s job. Di Tullio [S13] states that we often become what we think others expect of us, and in this case imposter syndrome can lead to increased insecurity and the belief that others also believe that one is a fraud.

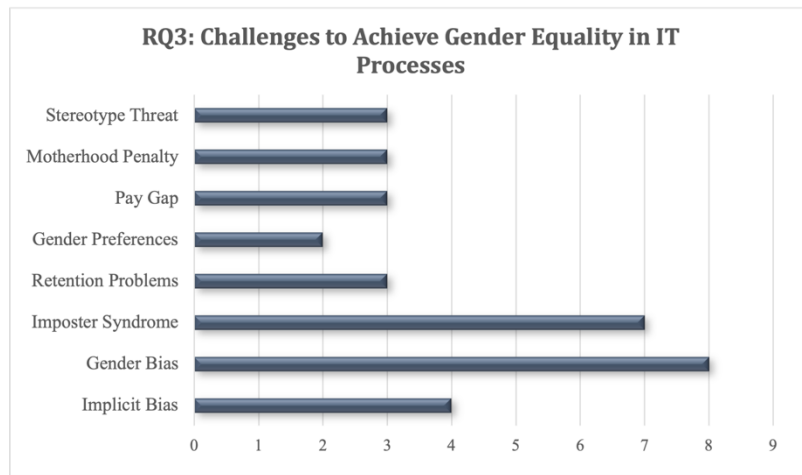
And, third, with 4 occurrences ([S01], [S07], [S13], and [S15]), implicit bias refers as the result of internalized bias that one is unaware of posing and is generally understood as people acting on stereotypes or prejudice without intention. Implicit bias is often gender bias, but due to the people unawareness it leads to other challenges than just gender bias.

Other challenges mentioned are the stereotype threat, pay gap, motherhood penalty, gender preferences, and retention problems. Stereotype threat concerns the fear of



failing and thereby confirming a negative stereotype, which can lead to a decrease in career interest [S08] [S10]. The pay gap between genders is not just a problem, but also a direct indication of the value employees of different genders has in a company [S06] [S07] [S12]. Challenges about motherhood penalty are many, and one example is the perception that parenthood builds men’s commitment, but reduces women’s commitment [S04] [S11] [S12]. Some studies also present gender preferences, referring to the fact that women often choose occupations that are seen as “softer”, which is also a factor within IT where women often choose “softer” roles [S06] [S10].

Likewise, some challenges are only mentioned once, such as code acceptance, disengagement, few women, poor management, symbolic violence, queen bee syndrome, gender-based discrimination, self-efficacy, stereotype bias, and negative environment.



**Fig. 3.** Results from data extraction of RQ3 (number of studies dealing with the challenges to achieve gender equality in IT processes).

#### 4.4 RQ4: What are the Best Practices Established to Address Gender Equality in IT Processes?

For the RQ4, the data extraction model was based on keyword extraction identifying the best practices to address gender equality in IT processes. Of all the selected primary studies, 5 of them provide best practices or frameworks that tackle the challenges presented in the previous subsections, but none of them were specifically for IT processes. However, despite not being specific best practices for IT, their characteristics and points of view allow them to be easily adapted and made applicable to the IT context. So, the best practices found in these 5 primary studies are presented below.

First, study [S04] presents the importance of women having their own safe place to discuss challenges and support each other through women only workshops or other arenas (online forums, offline networks...), where the main point is that women feel free to talk openly. This can keep more women in tech and combat retention problems.

Second, study [S05] presents “nudging” as a way to encourage gender equality by establishing its importance without setting hard demands. Nudge theory can be

established on different levels, where the main point is nudging behavior in a direction to remove negative biases in a predictable way without changing policies or mandates. This practice can address several challenges; for example, an organization could ask all contractors to provide a pay equity report, nudging them to diminish the pay gap, or ask for the percentage of women leaders, to establish a gender balance criterion in tenders.

Third, study [S06] presents the habit-breaking approach to reduce bias, which applies to both gender bias and implicit bias. The first step towards breaking a bias is being made aware of it and the consequences it has. The second step consists of using strategies that are set to address the bias, this can be done through, for example, perspective-taking, individualization, or counter-stereotype exposure.

Fourth, study [S08] puts forward the goal congruity model as a way of understanding how people often follow gender roles. The model suggests that women often chose not to go into IT because it goes against the communal goals society has set for women. However, this model implies that by changing the social expectations for women, they can feel more valued in their IT role or motivated to pursue a career in this field.

Finally, study [S10] promotes anti-bias and gender-blind training to create more tolerance and awareness for diversity in the workplace, helping people to work more smoothly together. Although in this case this is applied to the field of gender equality, it should be highlighted that it is a method applicable to any type of discrimination.

## 5 Discussion

### 5.1 Principal Findings

**Lack of Studies on IT Processes and Gender Equality.** The primary studies selected cover a diverse field of studies in psychology, neuroscience, business, sociology, and technology. Since the field of gender equality and IT is an intersection between several fields, this also generates a great variation in the studies analyzed. This diversity and interdisciplinarity are undoubtedly a very positive aspect and help to obtain better results in the developments and research performed.

However, due to the large number of studies found (4,206 in total), we expected to have obtained more relevant studies and not just the 15 primary studies. This shows that, although the concepts of IT and gender equality are very common and have already been analyzed before [20] [21], the direct intersection of IT processes and gender equality is an innovative and novel field that should be investigated in more detail.

**Low Number of Proposals and Validations.** There is only 1 study classified as a proposal, which presents new research ideas that have not yet been implemented. In addition, there are 4 studies that validate their approach using a gold standard measure and are thereby assessed as a validation study following the definition of Fox et al. [22].

These results not only demonstrate the novelty of the research area of gender equality and IT processes, but also the need to develop new and updated proposals to address gender equality in and by IT processes. Likewise, it is equally important to properly validate the proposals to really verify their effectiveness and efficiency in real contexts, creating high-quality research in these fields.

**Right Approach towards the Targets of the SDG 5.** We can observe that some of the Targets are not addressed by any study, such as the Targets 5.2 and 5.3, concerning exploitation, harmful practices, and mutilation [1]. These Targets are very important, but they have little and indirect relationship with IT processes, being considered outside the scope in this regard. However, although the approach of addressing at a first level the most fundamental Targets and that are directly related to IT processes is correct, it is important to also address these secondary Targets. For example, within IT processes, a series of practices can be established aimed at the specific development of IT proposals that address problems such as exploitation, harmful practices, and mutilation.

Focusing on the Targets that the studies complied with, we can observe several findings. First, Target 5.5, about improving women's participation and opportunities in all levels of public life, is addressed by all the primary studies and seems to be very coherent with the RQs focus of achieving gender equality in IT processes. Many of the studies emphasize that women have the skills and qualities required for IT jobs. For example, the study [S03] tests how a development team's risk-taking is affected by having more, fewer, or no women, and found no significant differences. Another example is the study [S08], which suggests that many women assess themselves as having lower abilities than men, even in situations where they are externally assessed as performing better than men. This can be seen in connection to those women who often only apply for a job if they feel fully qualified as stated by the study [S07].

Second, Target 5.1 is to end all discrimination against women, and this is also presented as one of the most addressed Targets. The studies contribute through creating awareness about challenges women face and providing statistics to highlight the inequality. For example, the study [S06] highlights the pay gap that women experience.

Third, Target 5.c is concerned with enforcing policies for the promotion of gender equality. It is very easy to see and understand the direct connection between this Target and IT processes, especially when it comes to implementing best practices that address gender equality. And this is demonstrated, since the 5 primary studies that deal with this Target ([S04], [S05], [S06], [S08], and [S10]) are the only ones that identify and establish a series of best practices in this regard.

Finally, Target 5.4 prompts the importance of valuing domestic work and promote shared responsibility within the household. The study [S06] portrays how motherhood is seen as lessening a woman's commitment to work, which can be seen both as a stereotype but also a real outcome in households where women are expected to stand for most of the childcare and additional household duties that come with an expanded family. The view of mothers as less committed can result in being passed over for promotions as well as salary increases in the workplace. Thus, it is necessary to understand that this is not the case and measures must be taken to raise awareness and put an end to these preconceived and erroneous ideas.

**Importance of Tackling all Challenges Together.** The challenges found through the primary studies affect human relational behaviors such as bias and other challenges related to women's self-efficacy as imposter syndrome and stereotype threat. However, most of the challenges apply more to the organizations and society as a whole, such as pay gap, retention problems, and challenges related to motherhood.

The challenges that affect how women are treated are often because of bias. Study [S01] states that most people agree that standards for excellence should be the same for all, but that it is difficult to achieve in practice due to gender bias.

Some challenges are also mainly affecting women's self-efficacy. An example is the stereotype threat, where the fear is of confirming the negative stereotypes of one's group, as identified by the study [S07]. This same study further explains that stereotype threat can affect motivation and interest in career, maybe one of the reasons why some women choose to leave the IT field. Likewise, an argument made by the study [S14] is that women should allow more external attributions for their setbacks, indicating that this can make them feel like they are in the right place even in an opposing environment.

Several of the challenges presented are complex and need to be addressed in organizations and society. One of the biggest and most complex challenges is the motherhood penalty, where, after having children, women are often seen as less committed, receive less opportunities, and are paid less [S06].

These examples together with the rest of the challenges found shows that, even though they are different challenges, each one has a certain connection with the others and, therefore, it is vital to address them together to really meet their particular objectives. For example, it is not possible to try to end the pay gap if the bias that leads to the idea that the work of a woman is not up to the work of a man is not addressed; and, in the same way, the pay gap leads women to feel less valued and capable of doing a job, materializing in other challenges such as imposter syndrome or stereotype threat.

**Lack of a Common Framework of Best Practices.** The lack of answers to the RQ4 and, therefore, of sets of best practices on gender equality with emphasis on IT processes generates a series of findings and opportunities. Some of the studies address general best practices to better gender equality in IT, but in an isolated manner and none of them discuss this in relation to IT processes. Thus, the most prominent result is that there seems to have been no research on using IT processes as such to achieve gender equality (but there are best practices in this regard that can be used and put together), as far as the studies found through this SMS. In further detail the studies show no way to assess or ensure that the artifact from an IT process results in a product that fits the needs of all genders, or that the process itself has any focus on gender equality. For example, the best practices identified could serve as a foundation for the development of a framework or guidelines that help implement gender-friendly IT processes.

Likewise, the studies that have an answer for the RQ4 are also the only studies that correspond to the Target 5.c, which is about enforcing policies for gender equality and empowerment [1]. This suggests that a research or development for promoting gender equality in IT processes has potential to further promote the Target 5.c. However, we must not forget the other Targets of the SDG 5 and these results also demonstrate the opportunity for innovation and the need to develop new research to address these important Targets in and by IT processes.

## **5.2 Limitations**

During the planning and execution of an SMS there are always limitations that can affect the results and findings. To mitigate them, it was decided to conduct 10 searches (1 at general level and 9 in relation to each of the Targets of the SDG 5 [1]). This has helped us to find studies with very specific terminology related to each of the Targets.

However, it was also decided to limit the search to a short period of publication (the last 6 years). Although it is true that the purpose is to perform a first approach on the most recent and updated works and that the area of gender equality is relatively young with the most relevant studies published in recent years, this period could be longer.

Finally, certain studies may have been overlooked for different reasons or certain evidence or advances on the studies found may not have been published at the time of the execution of this SMS. Likewise, the analysis of the results and findings performed in this SMS comes from the perspectives and experiences of the authors, which could not be interpreted in the same way by other stakeholders in this area. That is why, with the aim to mitigate these risks, an attempt has been made to reduce the bias by analyzing the data and results obtained independently by the authors and reaching a consensus.

## **5.3 Implications**

This SMS is highly relevant both for researchers and professionals in the fields in which it is framed. The results obtained demonstrate the lack of research and developments that address gender equality in and by IT processes, as well as the importance of conducting proposals in this regard. That is why this SMS, in addition to identifying the current state of the art, also highlights the gaps and possible future lines of research/work that can be performed.

The findings obtained can be used by both researchers and professionals who are working in areas such as IT management, gender equality, and social sustainability, among others. Therefore, this SMS is a relevant starting point and a demonstration of the importance of the fields it affects, which will attract new researchers and professionals in the search for gender equality in and by IT processes.

## **6 Conclusions and Future Work**

Technology has changed the world as we know it in practically all areas that surround us [3]. However, these changes, far from being perfect, are not always accompanied by positive aspects, as is the case of the gender inequality in IT [4].

That is why this study has focused its goal on analyzing the state of the art on gender equality and IT processes through an SMS. IT processes are the foundations on which all aspects related to IT in organizations are governed and managed [15]. For this reason, it is necessary for them to be sustainable and, in this case, to project exemplary gender equality, diversity, and inclusion towards the entire IT context.

Through the results obtained, the novelty of this study has been evidenced, since, of the 4,206 studies found, only 15 studies are related to the established scope. Likewise, the findings achieved identify a series of opportunities and challenges on which it is necessary and urgent to act due to the importance that these fields have together.

Therefore, following these findings, as future work we are working on an empirically validated proposal through the development and implementation of an IT process framework that considers all the Targets of the SDG 5 [1] and addresses the challenges identified through a set of egalitarian and inclusive best practices. In this way, we intend to help organizations establish socially sustainable foundations, as well as promote research and practice in these fields. In addition, we also intend to conduct a more in-depth evaluation of the results obtained in this study through interviews or surveys with relevant professionals and researchers in the areas of gender equality and IT processes.

It is our duty to ensure that the changes in our present positively affect our future and that this future is balanced, diverse, and inclusive for all.

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## Appendix A. Selected Studies

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## Appendix B. Results Mapping

Table 5 includes a mapping of the answers of the different selected primary studies with respect to the defined research questions (RQs).

**Table 5.** Data extraction results from the primary studies.

ID	Type (RQ1)	Targets (RQ2)	Challenges (RQ3)	Best Practices (RQ4)
S01	Others	<ul style="list-style-type: none"> <li>Target 5.1</li> <li>Target 5.5</li> </ul>	<ul style="list-style-type: none"> <li>Implicit bias</li> </ul>	
S02	Others	<ul style="list-style-type: none"> <li>Target 5.1</li> <li>Target 5.5</li> </ul>	<ul style="list-style-type: none"> <li>Gender bias</li> <li>Code acceptance</li> <li>Disengagement</li> <li>Imposter syndrome</li> </ul>	
S03	Others	<ul style="list-style-type: none"> <li>Target 5.5</li> </ul>	<ul style="list-style-type: none"> <li>Gender bias</li> </ul>	



ID	Type (RQ1)	Targets (RQ2)	Challenges (RQ3)	Best Practices (RQ4)
S04	Validation	<ul style="list-style-type: none"> <li>• Target 5.1</li> <li>• Target 5.4</li> <li>• Target 5.5</li> <li>• Target 5.c</li> </ul>	<ul style="list-style-type: none"> <li>• Few women</li> <li>• Gender bias</li> <li>• Retention problems</li> <li>• Imposter syndrome</li> <li>• Motherhood penalty</li> </ul>	<ul style="list-style-type: none"> <li>• Women workshops</li> </ul>
S05	Proposal	<ul style="list-style-type: none"> <li>• Target 5.1</li> <li>• Target 5.4</li> <li>• Target 5.5</li> <li>• Target 5.c</li> </ul>	<ul style="list-style-type: none"> <li>• Recruitment</li> <li>• Poor management</li> <li>• Retention problems</li> <li>• Gender bias</li> </ul>	<ul style="list-style-type: none"> <li>• Nudging</li> </ul>
S06	State of the art	<ul style="list-style-type: none"> <li>• Target 5.1</li> <li>• Target 5.4</li> <li>• Target 5.5</li> <li>• Target 5.c</li> </ul>	<ul style="list-style-type: none"> <li>• Gender bias</li> <li>• Gender preferences</li> <li>• Pay gap</li> </ul>	<ul style="list-style-type: none"> <li>• Habit-breaking</li> </ul>
S07	State of the art	<ul style="list-style-type: none"> <li>• Target 5.5</li> </ul>	<ul style="list-style-type: none"> <li>• Gender bias</li> <li>• Pay gap</li> <li>• Retention problems</li> <li>• Implicit bias</li> </ul>	
S08	Validation	<ul style="list-style-type: none"> <li>• Target 5.5</li> <li>• Target 5.b</li> <li>• Target 5.c</li> </ul>	<ul style="list-style-type: none"> <li>• Gender bias</li> <li>• Imposter syndrome</li> <li>• Stereotype threat</li> </ul>	<ul style="list-style-type: none"> <li>• Goal congruity model</li> </ul>
S09	Validation	<ul style="list-style-type: none"> <li>• Target 5.5</li> </ul>	<ul style="list-style-type: none"> <li>• Imposter syndrome</li> </ul>	
S10	State of the art	<ul style="list-style-type: none"> <li>• Target 5.4</li> <li>• Target 5.5</li> <li>• Target 5.c</li> </ul>	<ul style="list-style-type: none"> <li>• Gender preferences</li> <li>• Stereotype threat</li> </ul>	<ul style="list-style-type: none"> <li>• Anti-bias training</li> <li>• Gender blind training</li> </ul>
S11	Others	<ul style="list-style-type: none"> <li>• Target 5.1</li> <li>• Target 5.5</li> </ul>	<ul style="list-style-type: none"> <li>• Symbolic violence</li> <li>• Queen bee syndrome</li> <li>• Motherhood penalty</li> <li>• Imposter syndrome</li> </ul>	
S12	State of the art	<ul style="list-style-type: none"> <li>• Target 5.1</li> <li>• Target 5.5</li> </ul>	<ul style="list-style-type: none"> <li>• Pay gap</li> <li>• Gender-based discrimination</li> <li>• Motherhood penalty</li> <li>• Imposter syndrome</li> </ul>	
S13	Validation	<ul style="list-style-type: none"> <li>• Target 5.1</li> <li>• Target 5.4</li> <li>• Target 5.5</li> </ul>	<ul style="list-style-type: none"> <li>• Implicit Bias</li> <li>• Self-efficacy</li> <li>• Imposter syndrome</li> </ul>	
S14	Others	<ul style="list-style-type: none"> <li>• Target 5.1</li> <li>• Target 5.5</li> </ul>	<ul style="list-style-type: none"> <li>• Gender bias</li> <li>• Stereotype bias</li> <li>• Negative environment</li> <li>• Stereotype threat</li> </ul>	
S15	State of the art	<ul style="list-style-type: none"> <li>• Target 5.1</li> <li>• Target 5.5</li> </ul>	<ul style="list-style-type: none"> <li>• Implicit bias</li> </ul>	