

bEquality - Automated tracker for gender equality with blockchain

Creation of an automated and reliable gender equality index

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April 1, 2018

This project has been built in the context of the BIOTS Hackathon 2018
Blockchain and the Internet of Things School

Project repository: <https://github.com/ETHBiots2018/bEquality>

Abstract

Today, most companies' market value is driven by intangible value, such as reputation or brand equity. Thus, thousands of companies now provide detailed extra-financial information. Regulations are mandating increased management disclosure and analysis on sustainability, and investors are analyzing the comprehensive risks and opportunities of issuers in public and private markets. One aspect of this extra-financial information is data on gender equality. And more and more investors take this data into consideration when investing as research suggests that good gender equality practice can serve as an indicator for good corporate governance and decision making and these companies might outperform in the future. To get a structured, concise and comparable overview of this data, investors often rely on established gender-equality certifications. Unfortunately, this process is costly, time intensive and requires multiple revisions to produce reliable data. ¹

Our project aims to simplify and automate the process of obtaining such a gender-equality certification based on an existing Gender-Equality-Framework, and to make its results publicly accessible for everybody.

Our approach focuses on the data capture, data storage, data validation and the display solution of the process.

The data is obtained by the means of a website and an app whereas the storage solution relies on an E-voting system, based on the latest blockchain and cryptographic technology. The solution provides the code of the communication interfaces for the website and the app, as well as the necessary code to handle the data for the E-Voting system via blockchain.

Furthermore, a Radar-Chart is used to present the results in a straightforward manner.

In conclusion the platform ensures a trustful, transparent and cheap way to create a gender-equality-index, which is useful for people to make investment decisions and for companies to further improve their status with respect to gender equality.

¹This paragraph is taken from the challenge description handed to us by the UBS

Introduction

The current situation of the economy is not fully inclusive for every member of the society, women get discriminated, sexually harassed and do not have equal chance of high salaries and or higher positions in companies.

Our Project bEquality aims to punctually recognize inequality by providing a transparent, reliable and efficient gender-equality index for companies. We think that applying and evaluating a gender-equality index should not be expensive and exclusive to companies that can afford it.

We aim to improve today's state of society with respect to gender-equality in the economy.

This document summarizes our approach to solve this problem. Our solution has come up on a hackathon organized by the Blockchain and Internet of Things School (BIOTS) 2018.

We will first present you our whole process systematically and then later dive further into the implementation of the whole process.

The reader should have basic programming understanding or basic logical thinking to understand our approach and implementation, we try to explain it as easy as possible.

- describe structure of report - done
- describe prerequisites - done
- general things - Q: what to add more?

1 Project

1.1 Overview

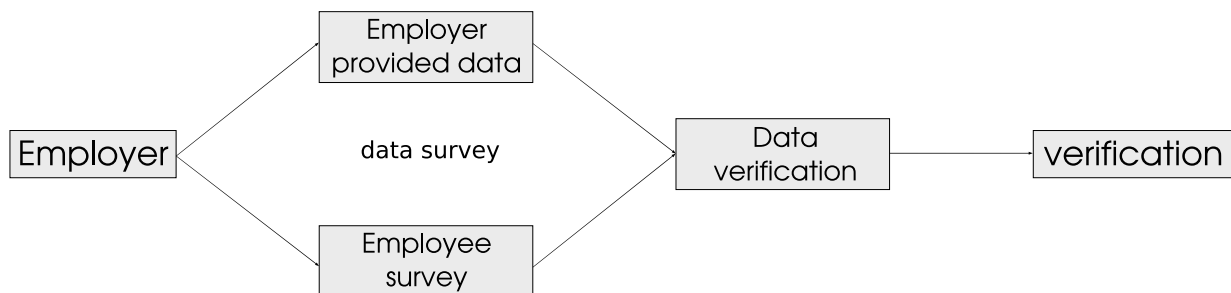


Figure 1: Project flow graph

- I think the project flow should contain a node for DISPLAY SOLUTION, because this is one of the key points (also one of the points they wanted us to focus on). -If possible, the texts in all the nodes should have the same font size

The figure 1 visualizes the high-level structure of our project.

Existing gender-equality indices differ from our project at the points *data survey (employee survey)* and *data verification* in the high-level structure and in the final evaluation.

We will now explain the high-level structure of our project structure.

Employer Survey

There are a few necessary steps for an employer to get a certification. First, the employer has to send the data asked for by the given rating framework via a Website. Additionally the company provides the E-mail-Addresses of

their employees. That's the employer provided data.

Question: do we really take the e-mail addresses?

Or does the employer tells every employee to make an account on our platform and then the employer sends us all generated public keys? (sending of public keys can be done implicitly at the registration of the employee)

Employee Survey

After that, a percentage of employees will be chosen randomly to participate in an employee survey. This survey is used to validate the plausability of the provided data from the employer and to obtain further important private data from employees that cannot be known by the employer.

However, this is an easy task for the employee. To set up an account, the employee gets an invitation link from our program and then gets linked to the app, where he/she can set up his/her account. While setting up the account, a public and a private key get generated in the background and linked to the employee account.

After the account set-up the company sends all the public-keys generated by the employee account set-up to our framework, this then initiates the survey set-up.

When all background work is done, the employee gets a message that the survey is ready. He/she has then just to log into the app, fill out the survey and then submit the data.

Everything technical is handled automatically in the background, such that the user just observes a handy interface, and all data is stored on either the blockchain or the IPFS.

Data Validation

When all data is gathered from all chosen employees, we split the data into different classes. Either the data from the employees intersect the employer provided data, and is therefore in the *intersecting-data category*, or it is data that is just known or provided by the employee (such as number of sexual harassments or similar things).

All data from the *intersecting-data category* gets compared by comparing the provided view of the employer and the view of the employee.

This comparison then provides a validity factor for the employer provided data.

This process of data validation ensures that the data is not corrupted by either humans or bots.

Q: How is validation done exactly?

Display Solution/Evaluation

We would adapt our evaluation to already existing gender-equality indices. But to further improve these evaluations, we would like to evaluate also different indicators for gender-equality and other measures that are important.

I move this phrase into the Further-points-section, it is too much in the overview: And because all the data is digitally available, we could also insert classification via artificial intelligence to even further improve the evaluation process.

The data evaluation then finally not just results in a single index number, but in a multidimensional spider-diagram, that allows the investor or the company to look closer to existing problems or advantages over the requirement:

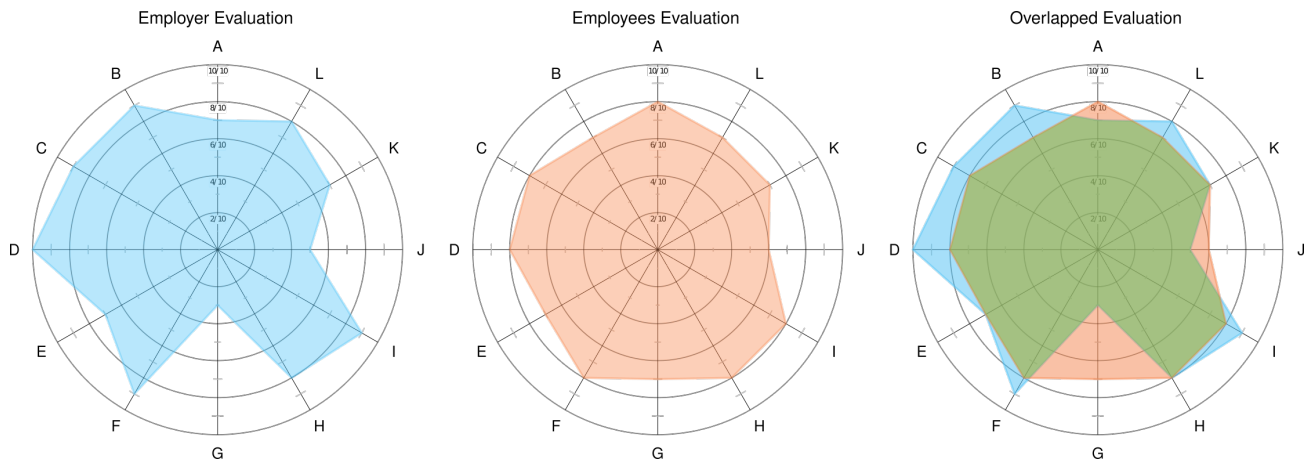


Figure 2: Spider-diagram evaluation example

The figure 5 provides a flexible evaluation system with detailed feedback.

This detailed feedback is useful for company management and also useful for investment decisions by investors that may want to invest in this company. It also implies a feedback system for the company to rate, such that the company knows what to improve in it's employee environment to further improve it's index.

1.2 Challenges to Solve

There are still some challenges to solve for this project.

One major challenge is to provide a secure way of implementing a system equivalent to E-voting, i.e. to find a system where a user applies to a survey or evaluation and the data provided by him cannot be traced back to this user, even when the user can verify that the data provided by him is used and not some modified version of his data.

A way of solving this problem for this use-case (of a gender-equality index) it may be a solution to implement the system in such a way, that cheating for companies are too expensive to be profitable and the company therefore acts cooperatively and provides true data.

challenges for implementation

- Finding a secure way of implementing a system equivalent to E-voting.
- Making cheating for companies too hard to be profitable.
- privacy for gathering data, boss should not have possibility to see results from its employees
- costs

done???

2 Technical Implementation

2.1 Data Capture and Storage

As already mentioned earlier, the *data capture* process is split into two parts.

The first part is the evaluation of a survey handed to the management of the company, i.e. the *company provided data*. This first part can be implemented via a survey that is being transmitted to us.

The second part of *data capture*, the *employee survey*, is a special point of interest. Because it is important to guarantee

anonymity to the employee and at the same time ensure validity and transparency of the data that is provided. We implemented this second part with a protocol that is equivalent to an *E-voting system* that is explained in detail below.

E-voting protocol

A company that wants to be part of our rating applies and sends their unverified data via smart contract (contract `SurveyFactory`) to the blockchain. This initiates the whole process of survey generation.

```
1 // https://github.com/EriCreator/bEquality/blob/master/Survey.sol
2 /* SurveyFactory serves as a hub
3    (deployed on the blockchain upon the launching of bEquality)
4    Company can create their own survey by providing a list of permitted user address. */
5
6 contract SurveyFactory {
7
8     //address owner;
9     mapping(uint => address) public SurveyContracts;
10
11     // function SurveyFactory(address adr) public
12     // {
13     //     owner = adr;
14     // }
15
16     function createNewSurvey(uint companyID, address[] addressessOfEmployees, string
17         _hashToaddressessOfEmployees) public returns(address newContract)
18     {
19         // require(msg.sender == owner);
20         require(SurveyContracts[companyID] == 0x0);
21         Survey c = new Survey(addressessOfEmployees, _hashToaddressessOfEmployees);
22         SurveyContracts[companyID] = c;
23         return c;
24     }
25
26     function getContractAddress(uint companyID) public constant returns (address)
27     {
28         return SurveyContracts[companyID];
29     }
30 }
```

They also send bEquality the email addresses of all employees, as observable in the function `createNewSurvey`), which we store in a secure and private data base.

We do not store the password of the employee explicitly, we instead store the hashed password linked to the corresponding username. To further link the private key to the account, we also store the hashed private key on our database.

This account stored on our database does not allow us to login to the user-account, but we can verify validity of the account, when a user wants to log in.

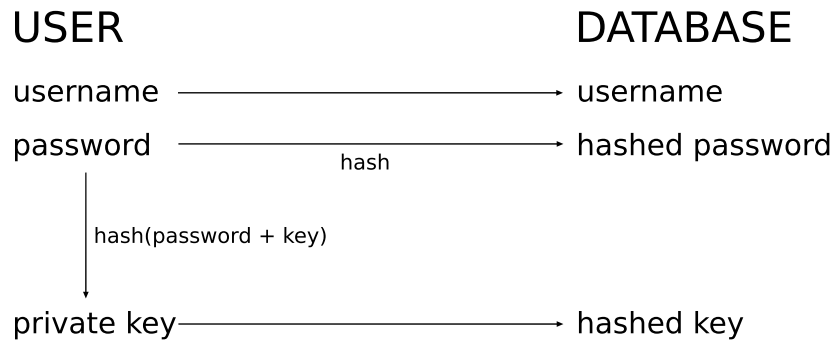


Figure 3: Secure login data storage

Is this correct?

When all accounts are set up and put money on them to pay for the transaction costs, the employee gets notified that he has to log into his account and fill out the survey.

The employee then acts on the following smart contract **Survey**, that only he can modify, but not the contract-creator. When the employee has filled out his survey, he submits his data via a user-friendly interface and the data gets stored anonymously on the blockchain. The user therefore can verify that his data is not altered, but at the same time there is guaranteed that the employer cannot prosecute the employee for telling the truth about the company.

```

1  // https://github.com/EriCreator/bEquality/blob/master/Survey.sol
2  /*
3   Survey is the child contract created by the SurveyFactory where only the permitted user
4   can modify.
5  */
6  contract Survey {
7      mapping (address => string) public hashes;
8      mapping (address => bool) public isAllowedToSumbitSurvey;
9      string hashToaddressessOfEmployees;
10
11     function Survey(address[] addressessOfEmployees, string _hashToaddressessOfEmployees)
12         public {
13         hashToaddressessOfEmployees = _hashToaddressessOfEmployees;
14         for (uint256 index = 0; index < addressessOfEmployees.length; index++) {
15             isAllowedToSumbitSurvey[addressessOfEmployees[index]] = true;
16         }
17     }
18
19     function submitResults(string myHash) public {
20         require(bytes(hashes[msg.sender]).length == 0);
21         require(isAllowedToSumbitSurvey[msg.sender]);
22         hashes[msg.sender] = myHash;
23     }
  
```

Because all data is stored on the blockchain, everyone can verify the integrity of our analysis, and can even make his own analysis of the given data. This allows full transparency towards the shareholders and future investors in the company.

Yet there are still challenges ahead of us, for example the possibility of storing the Ethereum addresses on the blockchain instead of a private database for further transparency and automation of the process.

Below is shown the full protocol in a schematic way, to give the reader an overview of our E-voting protocol.

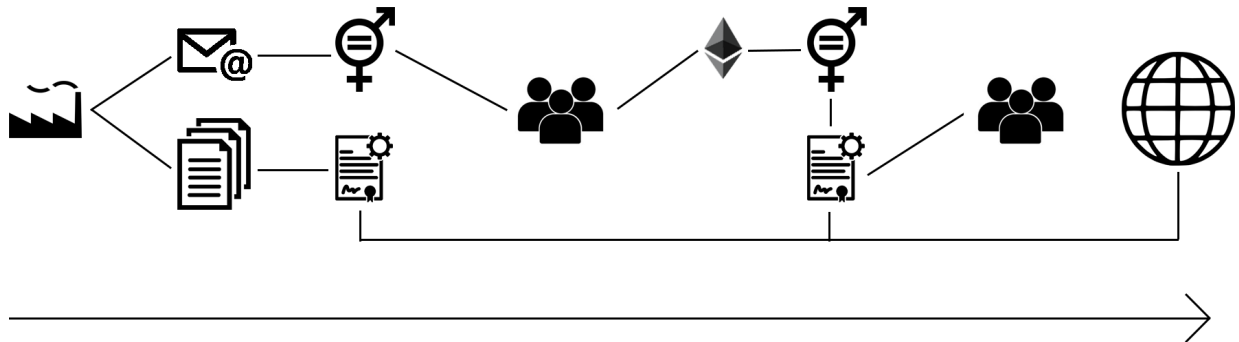


Figure 4: technical flow representation of the data capture and storage process

CANCEL THAT?? (below):

Survey for Employer

The survey handed to the employer, that applies to our gender-equality index, is based on already existing frameworks such as the Bloomberg gender-equality index or the gender-equality index of Equileap.

- based on existing frameworks such as Bloomberg, Equileap
- capturing data with app or web -delivers e-mail addresses from employees
- addresses stored on private database
- survey stored on IPFS
- explain interaction with web/App

We now dive deeper into details of the implementation of the employee survey.

Survey for Employees

The survey for the employees presents the employee with gender specific questions and also with questions applicable for both men and women. These questions guarantee further insight into the microclimate of the employees that cannot be obtained by just consulting the company management.

We earlier explained that we hand our survey to just a randomly chosen percentage of all employees. This is done to increase efficiency of the gender-equality index while cutting costs of applying to that index. The random sample provides us with a hopefully real view of the microclimate of employees. Unfortunately this random sample could lead to a completely wrong picture of the company, we therefore have the option to increase this sample, when there is too

much variation from the employer provided data.

capturing data with app

To make the survey as easy as possible for the employees, we came up with providing an app for this task. We build an example app for android smartphones with the android studio IDE. Our app is only a placeholder for an actual implementation. That means, that our example app consists of a sample survey and dummy buttons (app can't submit survey). Because of the limited time, we couldn't build a working app. Besides the time factor, we didn't know how to link the app with the Blockchain/IPFS and if there is even a java Interface to accomplish this task. Nevertheless our app is just an example, how a survey app can look like.

(–insert pictures of the app–)

The fully implemented app could then work as follows: 1. The employee sees a login screen and is asked to fill in his e-mail address and his password. 2. After the login was successful, the app shows it's user the questions to answer. The interface to answer the questions is straightforward and self explanatory. 3. After the user submits the survey, the app sends the Survey to the Blockchain/IPFS and reports that the submission was successfull. The big advantage of an app is the self explanatory user interface. But there are also disadvantages of an app. Some of them are: 1. even for one survey, the app needs to be installed. 2. Survey questions are hardcoded in the current app.

The second problem can be solved, such that the app downloads the survey questions, after the user is logged in. With this approach the app serves as a framework for all kinds of surveys.

To conclude, we can say, that the app can exploit it's advantages, if the employee needs to answer more than one query in shorter periods. For a gender equality survey, this might not be the case, but we can easily deduce other use cases which needs several queries.

capturing data with app or web

- explain, that process automated in the background
- what does the employee has to do
- what is done behind the scenes

storing data: blockchain, IPFS, (some on server)

- how is privacy of data secured
- explain process, what does this mean for different data
- sensible data – server
- insensible data – ipfs
- non-fakeable – blockchain
- explain cost aspect of storing stuff on blockchain or on IPFS (storing on blockchain costly)

how can anonymity/privacy be ensured

- because data on blockchain, IPFS, it is visible for everybody, but boss should not be able to track the results of employees (how do we solve that)

state technical problems

2.2 Data Verification

why 2 surveys?:

-gives company less chances to actually deliver wrong information

-how is the verification done

-After the data verification and evaluation, the evaluated data is stored on IPFS:

2.3 Display Solution/Evaluation

Currently, gender equality barometers, as the Bloomberg Gender Equality Index or the Equileap Ranking, display the result of each company as a single number, score or grade. With this information, a consumer (e.g. an investor) can see which company performs cares about gender equality or which company is "more" gender equal than another one. But this one-dimensional approach does not offer a lot more insight.

A consumer of such a ranking (e.g. an investor) is probably not only interested that a company makes effort in gender equality, but also **how** they do. Moreover, to see how a single number (e.g. the rating result)-which includes a lot of different factors- is composed, it requires quite a bit of investigation. To address these points, our display solution focuses on a multidimensional approach by means of spider diagrams.

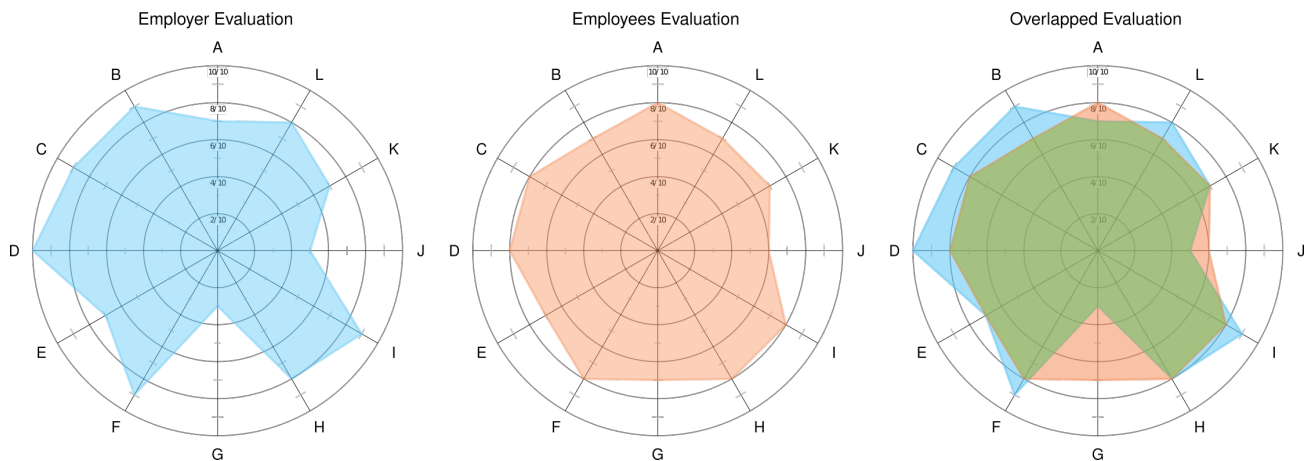


Figure 5: Spider-diagram evaluation example

With the spider diagram it is possible to show multiple factors at the same time. On each branch of the diagram a different factor can be displayed (in the figure, the labels 'A - L' represent each one factor).

An important in the survey evaluation is to identify the relevant factors which should be included into the spider diagram. These factors could rely on the existing frameworks (e.g. from Bloomberg or Equileap) or one could come up with new factors based on the surveys. An obvious factor is for sure the difference of salaries between men and women for equal performances.

Due to the settings of the surveys, there will be data from the employer survey which can not be captured by the employee survey and vice versa. For example, the employer can deliver factual data, whereas the employee can express his personal impressions and experiences of the daily work life. This data can be bounded in the *non-intersecting-data category*. Nevertheless, concerns, which are addressed in both surveys can be compared. This data can be bounded in the *intersecting-data category*.

As shown schematically in the figure above, these two categories can be in a straightforward manner with spider diagrams. On the one hand, the *non-intersecting-data category*, there could be a spider diagram for the employer

survey as well as the employee survey. On the other hand, a spider diagram with the *intersecting-data category* could present the factors, where data from both sides is displayed.

The overlapping in the spider diagram of the *intersecting-data category* can serve as an indicator of data-validity. When a company provides wrong data, then this would result in a smaller overlap. One has to take into account, that people could be forced by the company to give certain answers to gain a competitive advantage. As this problem is too extensive, we consider it as a further point to investigate on.

Since spider diagrams are widely known, and the display solution is easy to read. Due to the fact that the diagram displays more than a number as the other ratings, it is a nice tool to gain additional, comprehensible insight into the efforts a company does in the field of gender equality.

Because the data from the evaluations is open accessible on IPFS, the diagrams can easily be generated and fetched from these places and be displayed via a website or an app.

2.4 OTHER THINGS TO ADD HERE

todo

2.5 Further Points Worth to Consider

-write about problems that we think that are important, but we didn't have time to consider, or which were to complicated to solve in such a short time

-example: which indicators are best to display in Radar-Chart-Diagram, when is a company considered as a Gender-Equal-Company. How should this be measured, how should different companies best be compared...

One problem we encounterd and couldn't solve, was the login process for the employees. Our current implementation depends on, that each employee has to create his own account before taking the survey. The obvious disadvantage of this solution is, that each employee needs to remember his personal password. A better approach would be an automated login process, such that the blockchain account is set up in the background. With this approach the password may be created randomly, without the users knowing about.

An other problem we had was to determine which questions we should take for the survey in the application. The application on the mobile phone should actually be a small survey for the employee to fill in with around 5 minutes. But there are a lot of questions we have to ask in order to get useful data which can be compared with the data we got from the head of the companies.

Also because of the lack of time we couldn't finish our implementation completely. The Mobile Applications needs to collect the data and put the collected data onto the block-chain.

A

nd because all the data is digitally available, we could also insert classification via artificial intelligence to even further improve the evaluation process.

3 Conclusion

Strengths

-Our solution provides a reliable, transparent and automatic way of creating a gender-equality index. Compared to other already existing indexes we offer an index where the reliability and correctness can be verified by each and every person. This is done by implementing our strategy on the block-chain. -Our approach allows everybody to classify companies according to the latest law regulatory for gender-equality in companies.

-Our solution is multidimensional, where multidimensional stands for two different things. First of all our index contains different categories where the result is weighted and then demonstrated as a graph [graph bild]. The other multidimensionality of our project is that we collect data from two different sources. We collect it from the managers and we collect the data from a casual worker as well. -public

-cheap

Nowadays these indexes require a lot of work e.g. to collect the data, to evaluate the data, to present the data in a meaningful way and so on. In our solution we are trying to do as much as possible in an automatic approach.

Weaknesses

- Each participant needs to create his own blockchain account before taking the survey
- One has to handle a large chunk of data.

Open Challenges

There are several ways to expand our project. Examples would be -to achieve a full working automatic way of indexing gender-equality. This is our main idea but we haven't completed the implementation. The application we use to do the survey has just an interface. This means that we should collect the data on the application and try to put the collected data onto the block-chain for further calculation processes. -E-voting system should be improved

Disruptional Potential

-transparency

-further enhance gender equality

4 Sources and Literature

Sources In order to develop the app we used:

- <https://developer.android.com>
- <https://stackoverflow.com>

Dateiname - Author - Jahr - Link/Buch