



Utrecht University

MASTER THESIS BUSINESS INFORMATICS

**Model-driven engineering of ethical, social and
environmental accounting stakeholder surveys**

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July 31, 2020

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ACKNOWLEDGMENTS

After quite some time of hard work, dedication, overcoming obstacles, and growth this thesis document presents the final work for graduating for the Business Informatics program at Utrecht University. Many people have been supporting me during these challenging times for which much gratitude.

First and foremost, I would like to thank Professor Espana for his patience, support, and faith for and in me. All discussions were exciting, inspiring and gave me enthusiasm, energy and optimism every time again. His dedication to perform ethically, get knowledgeable regarding this, and transferring his wisdom to others in visual and clear ways are inspiring to me. Moreover, being part of his research group and meeting like minded researchers was a pleasure. As such I would like to thank all openESEA workshop participants for their input during discussions, their feedback, and their point of views on solving problems. This reference has helped me to become more and more confident into getting results. In addition, a special thank you to doctoral student Ramautar. We started together with our research and your continuous support, checking up on me, feedback, and problem solving has been such a relieve. In addition, I would also like to thank professor Overbeek, for his feedback and tips for improving the quality of this thesis. Although we have not communicated plenty. I know from the lectures given and critical questions posed that learning from your knowledge on conceptual modelling and method engineering has been a privilege. Last although not least, I owe my friends and family some gratitude for supporting and keeping faith in me during this time. I have not always been easy to be around, although you stayed with me, supported me, and kept faith. Even though the differing background your inputs in have helped me to understand the topic even better.

All with all I hope I have contributed a small piece into making this world a better place with this research and thesis. I do believe supporting organisations to be more ethical responsible to their environment can make change, although I hope to inspire you as a reader as well. So we together can make an impact.

Model-driven engineering of ethical, social and environmental accounting stakeholder surveys

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Abstract—There is variability in the Ethical Social and Environmental Accounting (ESEA) domain, with differing tools and methods used, since an industry standard is lacking. This is an effect of organisations having differing stakeholder demands, company contexts, and priorities. In addition, stakeholder engagement, enlarging accountability and credibility is sometimes lacking in the process of disclosing ethical topics. All together this results in inefficiencies in the ESEA practise, with problems in comparability, redundancy, legitimacy, and administrative burdens impacting the motivation to report.

We therefore propose a Domain Specific Language (DSL), by which a variety of ESEA stakeholder surveys can be defined. This DSL can be used in a tool, so domain experts can configure ESEA methods and features based on common vocabulary. Moreover, this DSL is expressing ESEA methods for 90 percent. At least when considering B Impact Assessment, Global Reporting initiative and Common Good Balance Matrix.

Index Terms—Model-Driven Engineering, Ethical Social Environmental auditing, Ethical Social Environmental accounting, taxonomy mapping, content mapping, Domain Specific Language engineering, openESEA, and Model Transformation

I. INTRODUCTION

Ethical Social and Environmental Accounting (ESEA) is the process of assessing and reporting the social and environmental impacts a company has on various stakeholder groups and society as a whole [3]. ESEA guides companies to become sustainable by encouraging companies to sustain the environment, human resources, and maintain company survival by having income [4]. In other words, companies should take responsibility for the triple P [5]: People, Planet and Profit, also known as the “Triple Bottom Line” [1], [6] as shown in Fig. 1. ESEA allows measuring the performance of an organisation in areas such as Corporate Social Responsibility (CSR) and sustainability [7]–[9], and creates the possibility to benchmark [4]. Synonyms to ESEA are non-financial, sustainable, integrated, or CSR reporting; also social, environmental, impact accounting or assessments; and also Corporate Social Disclosure (CSD) and Social Balance [2], [5], [10].

Among many reasons, SEA is performed either voluntarily, due to economic gains or ethical argument, or mandatory, due to pressures from stakeholders or legislation. Economic gains are reached with good ESEA practices due to which organisations outperform other companies. This is due to the

critical look on business processes, the increase in brand image, the enhanced customer loyalty, the minimised employee turnover, and the more easy recruitment, raising finances and attracting trade partners. [7], [11]. Moreover, a company’s own existence may be endangered when its objectives are relatively for short term in time and of economic nature. In such cases typically overlooking, or at worst ignoring social and environmental impacts. In this case, the time horizon referred to is not measured in years ends, but rather on a larger, humanitarian scale of societal impact. This can result in breakdowns in social harmony and environment, such that cannot sustain human life, and companies can potentially not operate anymore. Consequently, a legislative and social trend is noticeable for assessing those impacts by ESEA, this can be seen as the first steps towards environmental and social sensitivity. [12]

Often organisations disclose the results of their ESEA publicly by means of a report. This contributes to transparency, especially when the organisation is honest about its strengths and weaknesses, and when they establish mechanisms to assure the veracity of the disclosed information, e.g. performing a third-party auditing. A step further in transparency can be achieved by means of stakeholder engagement (SE). Thomsen [13] and Greenwood [14] define SE as: ‘practices that organisations take to involve stakeholders into projects and activities’. Moreover, Standford [15], Unerman et al. [16] and Thomsen [13] agree that stakeholder engagement increases accountability, legitimacy and credibility and therefore strengthens trust, loyalty and advocacy for organisations. Moreover,

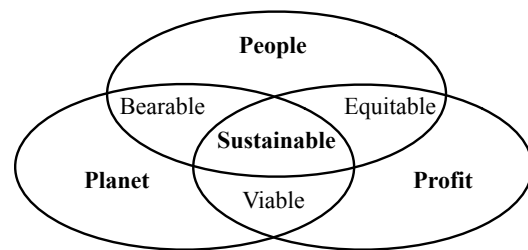


Figure 1. Sustainability, taking care of the triple P, adapted from [1]

Abreu and David [17] advise to incorporate SE outcomes in business goals. Lastly, Reed [18] agrees that SE increases organisational acceptance and stakeholders' awareness, thence positively influencing society's adoption for, in our case, social and environmental topic. Thomson [13] and Stanford [15] discuss for the following steps to increase SE practises:

- 1) Clarifying objectives for engaging stakeholders – this will set scope for prioritisation in the upcoming steps and helps to get people on board in the process.
- 2) Identifying the stakeholders
- 3) Mapping the stakeholders – the identified stakeholders are mapped in a matrix with two axes of influence and impact
- 4) Determining what will engage the stakeholders – multiple methods are available for this such as communication, education, involvement, incentives, and power
- 5) Planning precisely how to engage stakeholders – henceforth a measurable plan is elaborated upon, for example strategic, systematic, and flexible approach to create buy-in, minimising opposition and developing ownership, and continuing commitment.

A common practise to engage with stakeholders is stakeholder surveys, in which a high population of stakeholder's perception and opinion is measured in a small period of time [9], [19], [20]. In essence organisations can measure their impacts on ethical, social and environmental topics, for example an employee satisfaction survey measures the quality of the workplace as experienced by employees. By surveying several advantages can arise, in line with the advantages of stakeholder engagement as discussed by [1], [15], [16]. As such, stakeholder awareness can increase, influencing stakeholders education. Moreover, stakeholders can have a feeling of involvement and power, since they can influence decision making. For stakeholders this can be seen as an incentive and stakeholders can concurrently offer continuing organisational commitment. In addition, SE is not always incorporated in ESEA, for instance Xarxa d'Economia Solidària (XES)'s Social Balance¹ has surveying built in; while B Impact Assessment² requests survey results albeit does not offer the question to do so. Although stakeholder surveys have its advantages for ESEA and SE, there are problems related which will be discussed in the following section.

A. Outline

The outline for enhancing stakeholder engagement practises in the context of ESEA is as followed. We start with a sketch of the problematic phenomena in chapter II. With chapter III we design the research to overcome these problematic phenomena, with research goals and questions. In chapter IV we present the research method used, which can inspire for, verify and justify our approach. Moreover, chapter V depicts the results

of our literature analysis offering a conceptual model which can be re-used by others and supports for our design goal. After the literature study, the practise is explored in VI, where methods are described and a content mapping approach is developed and reported, which can inspire to resolve content overlap. Based on both the literature and practice exploration a Meta-Model and concurrent DSL is designed and requirements deviated in VII, to depict the ESEA domain and inspire others for re-use. This design is implemented in VIII for proof of interoperability and this is validated in IX. In section X the conclusions are presented, to answer to the research questions and therefore achieve contributions stated. Thereafter, the discussion XI poses limitations and recommends future work to overcome these.

II. PROBLEMATIC PHENOMENA

While the existence of many different ESEA and SE methods and standards is understandable and desirable, it brings disadvantages for which we provide rationale, provide examples and explain the consequences.

A. Reasons for differing ESEA practises

Currently no standard ESEA method or tool exists and there are multiple reasons for this. One reason is that ESEA practises are complex due to variable stakeholder demands, company contexts, company priorities and layers of thinking regarding social and environmental topics [21], [22]. The second reason is the differences in information needs across national boundaries and stock ex-changes [21]. The third reason is that environmental and social issues require complex estimations, for which there is no accepted basis for validation, due settle in time for results, uncertainty, and interdependence on other factors such as humans [7], [22]. Another reasons is that standardisation reduces room for individual action and design, thus standards focus more on sector and company specific standards [21], [23]. Due to all the reasons above and possibly others, compression of all sustainability issues into an overall system is difficult and ESEA methods and standards are therefore fragmented targeting other scopes [4]. The fragmentation results in a sheer number of measures and indicators, which further complicates the landscape [21]. In the end there are multiple ESEA methods and there is no universal accepted framework developed by one central accepted authority [21], [22].

B. Examples of ESEA practises

Due to missing ESEA standardisation companies have a multitude of ESEA methods and tools at their disposal, with overlapping aspects, used for specific purposes [24]. Examples of methods used are Global Reporting Initiative (GRI), Common Good Matrix, B Impact Assessment (BIA), ISO 14000 and 26000 series, Social Accountability (SA)8000, Sustainability Accounting Standards Board (SASB), Leadership in Energy and Environmental Design (LEED), Fair Trade certification, World Business Council for Sustainable Development (WBCSD), the Institute of Social and Ethical Account Ability

¹<http://xes.cat/comissions/balanc-social/>

²https://bimpactassessment.net/sites/all/themes/bcorp_impact/pdfs/B%20Resources%20-%20Employee%20Engagement%20and%20Metrics.pdf/

AA1000 standard, XES Social Balance and the Sustainability Integrated Guidelines for Management (SIGMA) Project [5], [25].

C. Consequences

The consequences are topic variability in ESEA methods or standards, issues in comparability between those, and resulting inefficiencies in ESEA practises and tool use. For the first consequence, ethical and sustainability topics can overlap across methods, e.g. the Common Good Matrix addresses impacts on the environment, and the GRI focusses on energy requirements [2]. Moreover, the numbers of variety in ESEA methods are increasing due to the rise of sector specific ESEA methods, e.g. UniSAF³ for universities and Green IT Maturity Assessment⁴ for data centres. This further overwhelms the ESEA methods and standards landscape [2]. The second consequence, also impacts comparability between corporate reports, even within the same areas of industry [3], [10], [21], [26]. Stakeholders can therefore not compare nor benchmark, due to difference in report format, style, evaluation methodology and difference in preparation of accounting results [6], [21]. There can be a case where an organisation is performing well in one ESEA method, although not in the other, for example with the BIA an organisation can perform well, and on GRI they do not. This is due to the fact that BIA is more centred on social topics rather than on the environmental side, according to [27]. For the last consequence, multiple inefficiencies in ESEA practises can arise, such as preparation and presentation of the same or overlapping information multiple times, non-interoperable or -customizable tool use, and comparability issues for company and stakeholders. The preparation and presentation of ESEA results is potentially done multiple times for different requirements and information needs. Accountants therefore design, process and report on similar information in various ways, stakeholders are likely engaged for redundant and repetitive work, and company management has differing results although the content is the same. Regarding the ESEA tool use, often one single method is covered by one single tool without extension capabilities for other ethical, social or environmental topics, indicators and questions, let alone other methods. We expect this to happen due to legitimacy and technology lock-in. If for example users can tweak their results with own defined indicators, this has implications on the trustworthiness of the results, and if tool users can use the tool for different purposes this impacts the truth fullness of ESEA networks. Unfortunately, smaller organisations often lack the resources to apply more than one method [2]. Moreover, the administrative inefficiency can have implications also on larger organisations.

To conclude, the variability in ESEA method and tool use results in inefficiencies in the ESEA practise and issues with comparability. If for example in a fictional ESEA stakeholder surveys scenario, an organisation sends out three surveys

regarding employee treatment, to asses for three separate ESEA methods and certification, e.g. the GRI, BIA, and AA1000. Employees have to respond to multiple redundant questions, impacting their motivation to do so. Concurrently, the organisation has to administer and report on all three, in which results can be differing and in need of more clarifications. Resulting in inefficiency for the accountant, survey administer and participant. Moreover, the results between the three methods cannot be compared with each other, since there are differing data displays, and the organisation can possibly choose to disclose only the positive results.

III. RESEARCH DESIGN

The variability in ESEA method and tool use, due to understandable reasons, results in issues with efficiency and comparability in ESEA practises. To overcome this, research objects are defined and made specific in the research questions, and both help to achieve the contributions to society and research.

A. Research objectives

We aim to develop two artefacts to overcome the variability issue in the ESEA domain, reasons for this, and the expected results are explained next. Firstly, a Domain Specific Language (DSL) is designed, by which a variety of ESEA stakeholder survey methods can be specified. This DSL is derived using a model-driven-engineering (MDE) approach. Secondly, we validate the first artefact by designing a DSL interpretation tool, offering support for stakeholder surveys and as such for stakeholder engagement and data input. With the developed tool we can validate if existing ESEA methods can be expressed completely, which can be showcase to others. Moreover, support for other aspects of ESEA are for example access management, report generation, stakeholder survey implementation, such as posing questions to respondents and retrieving the answers which populate reports. Altogether the tool is versatile for multiple ESEA method specifications.

We aim for DSL development, thence this offers a tailored notation to the domain experts, which can specify relevant concepts and configure features based on their own knowledge [28], doing so with a General Purpose Language requires a developer as well. Moreover, we chose for a MDE approach, since schematic representations of the domain help to clarify and transfer knowledge about the domain for traceability, comparability and validation purposes. Lastly, we chose to develop a DSL interpretation tool, so stakeholders can see the benefit of having one environment for a variety of ESEA methods and to validate expresiveness of the DSL.

With the two artefacts explained before we aim to alleviate problems related to variability in ESEA methods, with multiple advantages for practitioner and stakeholder. We aim to enlarge comparability between ESEA methods and results. This is due to the fact that practitioners can specify ESEA methods which are validated by domain represented DSL constructs, and the output can be standardised with one specification file. We expect to enhance the truthfullness of data underpinning

³<http://rootability.com/green-offices/assessment/>

⁴<http://greenit.s-i.ch/en/dc>

ESEA reports, more specifically regarding stakeholders' perception and opinion, by offering stakeholder survey support. In addition, the survey feature also supports for one respondents surveys, and ESEA data gathering can target stakeholders with access to that data. For example, single respondent surveys can be send to financial, logistics, and management stakeholders for specific data. Regarding the results, we aim to store historical and current data, with possibilities to share with others and contribute to comparability even more. In addition, more contributions are specified in section III-C.

B. Research questions

In order to achieve the above-mentioned objective, we attempt to answer the following research questions:

- 1) What are key concepts to consider in the ESEA stakeholder survey domain? - A conceptual model will depict domain knowledge, a feature model will depict key features, and content is mapped to investigate internal structures of ESEA methods.
- 2) Can the meta-model and DSL rules, constructs and semantics describe all ESEA stakeholder survey methods? - A meta-model will describe key components, requirements will be prioritised, and both will serve as a product backlog to define sprints for the development of a DSL and tool interpreter.
- 3) What are the strengths and weaknesses of the ESEA stakeholder survey method interpreter? - For validation we expose the method and tool to controlled stimuli, depicting real life scenarios, and validate requirements.

C. Contributions

By answering the research questions sketched above we contribute to science and practise. For science, DSL patterns and best practises as discussed by Čeh and Mernik [29], [30] are implemented and validated. In addition, MDE is used for guiding the development process and is used to define sprints for agile development. Secondly, to España et al. [2]'s knowledge, approach and artefacts are validated and extended upon. Therefore, España et al. [2]'s model-driven ESEA tool, called openESEA, is extended upon with survey capabilities, as it was not supported before, and to gather data from single users. In addition, España et al. [2]'s methods and tools specification repository is elaborated on. Thirdly, an approach and the results for requirements elicitation in the context of stakeholder surveys and ESEA are discussed. Additionally, we define domain vocabulary regarding this context. Lastly, we map existing ESEA methods' content into a repository. More specifically, we intensively investigate the content relationships of three ESEA methods.

In regard to practise, we further detail the expectations mentioned in III-A. Firstly, the ESEA domain is represented in a DSL for domain experts to use. Secondly, a tool is developed to interpreted and roll out survey questions automatically for practitioners, covering multiple ESEA methods, so that administrative time is reduced and comparability improved. Moreover, this tool supports multiple ESEA methods by

configuring the tool based on models. Therefore, insights into topics, questions, answer types, and indicator calculations are presented. In addition, the tool can save historical data for benchmarking purposes. Due to the data being stored centrally, this has security implications, solving these implications is not part of our research goal. Ideally, the historical data can be analysed to discover trends and/or patterns, by means of data mining or with Artificial Intelligence algorithms in the future. To conclude, all these contributions result in comparability, interoperability and customisability in the ESEA stakeholder survey domain.

IV. RESEARCH METHOD

In this chapter we discuss the research methods followed, in order to answer the research questions and therefore reach the research objective. The phases to do so are decision, analysis, design, implementation and testing, as explained by Mernik [30]. In addition, these phases have commonality with Wieringa's [31] design science phases, such as problem analysis, treatment design and treatment validation. Design science is applicable for our research goal since we extend the current ESEA space by creating a DSL and interpreter. The intertwining iterative phases, as recommended by Mernik [30], are described next and these are depicted in a Process Deliverable Diagram (PDD) notation in Appendix XII-A. More information regarding PDD notation is presented in section IV-B.

A. Decision

In this section we argue for the five reasons to develop a DSL. Firstly, with DSL engineering less programming expertise is needed for users, due to the expressiveness of DSL, automation of code generation, re-use of existing semantics, and post-development verification [29], [30]. Secondly, in the past DSL was fruitful to facilitate system configuration. This helps for the development of a versatile tool supporting multiple ESEA survey management methods. Thirdly, we extend on España et al. [2]'s openESEA DSL to not re-invent the wheel and to add to their knowledge and repository, as recommended by [29], [30]. Fourthly, an interpreter for implementation is used, since it provides for easier extension and greater control over the execution environment. In addition, DSL interpreters are relatively easy to extend according to Mernik [30], suiting our goal. Lastly, according to Mernik [30] integrating new features into an existing DSL is challenging. We expect to overcome this challenge by peer reviewing conceptual representations with fellow students' and España et al. [2]'s work, and re-design the DSL using another framework, as explained in section IV-D. In addition, we implement new features in sprints according to agile and scrum approach [32], meaning the design and implementation phase will be executed simultaneously.

B. Analysis

We perform analyses based on scientific and practice knowledge, where both iteratively complete each other, in order

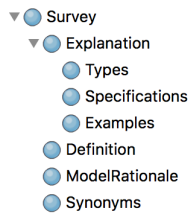


Figure 2. Taxonomy of classified information

to conceptualise the ESEA domain. For conceptualisation we formally explain the domain’s entities, attributes and relationships types using Unified Modelling Language (UML) class diagrams [33]. By conceptually depicting the domain general assumptions are made based on domain knowledge, key concepts are clarified and a vocabulary is established, context and goals are set, and relating actions clarified [30]. Altogether this helps to guide the development process, since requirements are defined and represented in a product backlog, as further explained in IV-C. Most importantly we add up to the openESEA repository [2], since concepts and relationships are tested and improved, with a scope on stakeholder surveys and information subtraction.

1) *Literature review:* We started the analysis with an unstructured literature review by means of snowballing [34], and relevant information was coded using NVivo⁵. While systematic literature reviews are valuable, defining scopes or search queries for this was ineffective, complicated and not offering the appropriate results, due to missing domain knowledge. Moreover, ESEA literature does not treat survey development and measurement theories in detail. For this reason, we focused on three separate areas of research, namely ESEA, survey development and measurement ontologies, to get more specific insights. Consequently, we have made use of forward and backward chaining, such as following through on citations by and for publications [34]. The sources for snowballing are intensively peer reviewed, since we use Scopus and the University library’s database. The first offers abstracts of peer reviewed literature for scientific journals, books and conference proceedings; and the second offers access to sources of books, papers and encyclopaedias. In addition, we administered relevant information in NVivo’s clustering ‘nodes’ for tracability, structuring, and statistical purposes. The taxonomic coding of ‘nodes’ was formed iteratively, based on reappearing and associating concepts in the literature, see Fig. 2 as an example, since domain knowledge was lacking. The main concepts derived and presented in Nvivo are then depicted in a UML Class diagram to formally display our theoretic understanding to support for discussion and validation.

2) *SEA practise exploration:* To analyse the ESEA methods we created PDDs of existing methods, we scraped the content of those methods, we mapped that content, performed graph analysis based on those maps, and analysed survey features.

⁵<https://www.qsrinternational.com/nvivo/what-is-nvivo>

We do this to explore existing methods’ content and structures to overcome the interoperability issue, and supplementary explored survey features for behavioural requirements specification. These requirements help for the development of a tool capable of stakeholder surveys management. For the analysis of existing ESEA methods we focus on a triplet of ESEA methods, namely the Global Reporting Initiative (GRI), Common Good Matrix (CGM), and B Impact Assessment (BIA). This is done due to the reason that the content mapping is a cognitive and time consuming process. This requires to understand methods thoroughly to interpreted the topics and the ambiguity of language. We chose these three methods since, from the 27 scraped method, these are in our experience best reflecting ESEA, due to the popularity, complete and extensive documentation publicly, and completeness.

Firstly, we wanted to get understanding of existing ESEA method structures, and deliverables from PDDs helps for this cause. PDD notation formally captures the relationships between both the processes and deliverables of ESEA methods [35]. The depiction of both the process and deliverable completes each other, if for example the deliverable cannot be defined, it can be derived from the process. Moreover, the PDD diagrams are peer reviewed and aligned with the openESEA repository [2], and co-researchers.

Secondly, we map the content of multiple ESEA methods, based on a heuristically defined approach, and performed graph analysis on these results. Therefore, we provide proof if ESEA methods’ contents are overlapping. Moreover, we take the first steps to match and merge content, which can be used for computing algorithms in the future. This can be done syntactically and semantically [36]. We focus on the first, since configuration and human interpretation for syntactical matching is more time consuming and less supportive for understanding the ESEA. The matching approach is further treated in VI-B1 since we heuristically defined this approach during analyses.

Thirdly, we performed graph analysis, since the taxonomic concepts, as mentioned at point two, can be represented as nodes, to which another concepts can be related as edges in a network of relationships. This present a graphical overview of the mappings and offers possibilities to perform statistics. Such as:

- Degree (or valence), represents the connectedness to neighbouring nodes [37].
- Graph density, measures the completeness of the graph based on if the graphs edges (or relationships) are close to the maximum number of edges possible [37].
- Modularity, measuring the division strength of a graph into communities [38]
- Number of communities, also known as clusters, modules, or groups, is distinguished by the modularity algorithm above [38].
- Path length, is a distinct sequence of edges joining nodes [37]. Moreover, by calculating the shortest paths average, the connectedness of the networking is further represented. Since we use differing relationship types for

matching, this is not possible to calculate. Therefore, we did not take average path length into consideration, albeit use the overall mapping relationship statistics.

Lastly, we investigate a survey tool implementation by depicting survey components and features in diagrams. This completes for future tool development and to get an understanding of the domain. We chose to scope towards one general purpose survey engine, Limesurvey⁶, since an extensive analysis of the survey domain is not within the research goals, as ESEA is. Moreover, we chose for Limesurvey due to its open-source and free licensing, its wide community support, mature security and scalability options, and the possibility to implement the survey engine on a private database. This offers for better scalability and security possibilities, compared to an self-developed survey tool based on code libraries.

The feature exploration we perform in two steps. Firstly, to get an understanding of Limesurvey we depicted all components of the tool in a Component Diagram (CD), which helps for abstracting features after. This diagram depicts survey aspects present in Limesurvey. Therefore, we created an own diagram notation, to represent abstract components, with detailing components in a tree structure. Moreover, we defined grey components to highlight if a component is later detailed in another diagram. Secondly, features were abstracted from the CD and presented in a Feature Diagram (FD). A feature is defined by van Deursen et al. [28] as a prominent, user-visible characteristic of a software system. We use a FD to structurally depict survey domain from a user perspective [28], [29]. Moreover, the root node of the diagram represents a concept and the remaining nodes represent the features [29]. The feature kinds are mandatory or optional [29]]. In accordance with the scope of future tool development, we see mandatory features as features to be incorporated and optional features as not necessarily to be used. In addition, we added two extra notations for representation purposes namely

- *Partly mandatory, partly optional feature* - a atomic concept, further specified in mandatory and optional features
- *Reference relationship* - duplicate features depicted once and related

C. Design

In this phase we design a Meta-Model, construct a DSL and elicit requirements to represent our findings from literature and practise. The meta-model is formally depicted in UML class diagram notation, which helps for future DSL grammar development, since data structures are modelled and related [29], [30]. A UML class diagram shows static system structures by means of classes, with attributes, and relationships with other classes. These relationships have multiplicities, showing the range of class objects instances associates to the other object, and have roles defined to give more meaning to the relationship. [39] Moreover, to analyse changes and to show contributions to España et al.'s [2] work, we applied a simplified version of the delta method evolution method by

⁶<https://www.limesurvey.org>

Ruiz et al. [40]. This method prescribes to map the initial meta model to the final version. Therefore, the UML classes, attributes, and relationships of the final version are listed and linked to the initial elements. An operator in between the versions indicates whether the element is present in both, an element is added or removed, or the characteristics of the element are changed. Based on these operators, analysis is performed regarding the meta-model evolution.

The DSL is constructed in the Xtext⁷ framework. This increases readability, writability and understandability for authors over a EBNF DSL notation use by Espana et al. [2]. In Xtext the DSL grammar is defined and based on this a parser, serialiser and smart editor are generated for the language [41]. Moreover, validation and content assist limit user input to the required constructs. In addition, the DSL language is offered in an Eclipse instance, which automatically generates a configuration file for the openESEA tool to use.

The key requirements were elicited to guide development of the DSL interpretation survey tool. The key requirements were represented in User Stories, which describe essential elements, by explaining who can execute the action, what is expected and optionally why its important. We use the popular and compact template by Cohn [42] in stead of more thorough linguistics [43], since this is not needed for depicting a overview of what we investigated. The template by Cohn reads as followed:

'As a [type of user], I want [goal], so that [some reason]'

The meta-model elements, the DSL definition and prioritised requirements form product and sprint backlogs enhancing traceability and guidance for developing the openESEA. These backlog elements have the characteristics of agile development [32], although the process was not strictly followed. At first analysis took place, and when software products were distinguished, the implementation was done in sprints and simultaneously tested. See the upcoming section for more information.

D. Implementation

Simultaneously with design a minimum viable product is developed, by modifying and extending the openESEA tool and its infrastructure. The openESEA tool is written in TypeScript, a super-set of JavaScript for styling and HTML development. Moreover, Facebook's REACT framework is implemented for versatile tool configuration. This is because REACT components exist independently from the source code and can be altered during run time. In addition to openESEA, the back-end is deployed in Firebase performing hosting, user authentication and database capabilities. The middle-ware is decoupled as to communicate with back-end technologies in the future. The core structure of openESEA's configuration files is in YAML ("YAML Ain't Markup Language") format, an intend based super-set of JSON for reader friendly configuration files and extensible data types and referencing. This

YAML file is transformed to JSON due to library support. [2]

E. Validation

According to Wieringa [44], the process for validation of the treatment is to justify that it contributes to the stakeholder goals. Therefore, we firstly considered and acted in the roles of stakeholders to consider the problem under investigation and proposed solution. Moreover, we contributed a part to a validation road map, initiated by España et al. [2], and added future opportunities.

To take up a role as stakeholders in the Design Science Research performed, Venable [45] poses a Critical Systems Heuristics (CSH) framework, a philosophically and theoretically grounded framework, to critically consider and represent interests of future stakeholders. The framework poses twelve questions to consider, categorised in four boundary issues representing one kind of stakeholder, their interest and their relevance as stakeholder. Venable [45] considers the Client, Decision Maker, Professional and Witness roles all validating the designed solutions. Firstly, we act as the Client role since we are motivated to solve the variability issue in the ESEA domain. Moreover, we represent the demands of ESEA methods' stakeholders and defined the behavioural requirements for them, based on the analysis performed. We therefore distinguish who can manipulate data, end-users who have insights into the data, and data providers, who provide the data by responding to stakeholder surveys. Secondly, the Decision Maker role is represented by stakeholders from Competa, who validated the research performed and made the decision to further develop and professionalise openESEA and apply the DSL, including the improved version posed in this research. Thirdly, we take up the Professional role, a stakeholder who has the appropriate expertise, is performed by fellow researchers researching the ESEA practise. Together we provided feedback on performed work and supplementing areas we did not consider. Thus, we collaborated with the researcher of the work by Ramautar [46], Derikx [47], Sinaga [48], and España et al. [2]. In addition, by publication of the research in the future, we expect that reviewers and editors provide further expertise in the ESEA, DSL and or MDE domain these can form further validation our work. Lastly, regarding the Witness role we contacted Maatschappelijk Verantwoord Ondernemen (MVO) Netherlands, a non-profit network for enhancing collaboration between organisations for responsible innovation. This organisation has access to a demo of the openESEA tool, pursued to use a mature version of the tool in the future.

Regarding the validation roadmap, España et al. [2] validated the openESEA tool and conceptual model with a prior study as the first step. Due to the expert assessment performed Competa is now professionalizing the proof of concept. Taken together, the ground of validation is established. We however

provide more detailed validity regarding the MDE approach and add up to España et al.'s [2] work as the second step. In this step the conceptual meta-model is the model under consideration. Therefore, both syntactical and semantical quality is investigated. Regarding the first, we want to know if many ESEA methods, including stakeholder surveys can be modelled. For this reason, important variables are versatility of the meta-model and therefore expressiveness of the DSL. We validate both by exposing the DSL to controlled stimuli depicting the ESEA method's practice. As such, fragments of existing ESEA methods are specified using the DSL, and based on the success rate of expressed concepts we calculate the expresability of the proposed solutions. Regarding the semantical quality, we collaborated with fellow researchers, as mentioned before, and with discussions regarding the meaning of the conceptual model, method descriptions and meta-model improved. This however can be further validated by ESEA practitioners in the future. For the final validation step, which is dependent on the maturity of the openESEA tool, we propose to step away from the controlled "laboratory" environment [44] and expose the solution to the practice. Therefore, usability or resource economisation can be investigated, for example by means of an experiment or Technical Action Research [44], [49].

V. LITERATURE STUDY

In this chapter the conceptualisation of the ESEA stakeholder survey domain is described, as common vocabulary is established, the elements for designing and developing an interoperable survey tool is inspired for. Depicting the domain clarifies the key elements and set the context, goal, terminology and actions related [30]. The ESEA stakeholder survey domain model is presented in Appendix XII-B, and is also known as an ontology, due to its conceptual nature [50]. Moreover, the ontology is divided into three sub-ontologies. Each sub-ontology builds upon a different scientific discipline, yet all together confirm our universe of discourse.

- ESEA: An organisation performs ESEA to identify, record, analyse, evaluate, improve and disclose information regarding its interactions with stakeholders. For stakeholders such as the environment, the people or society at large. [4], [6], [12], [17], [22], [51]–[53]. This information is visually and orally disclosed via report elements, by which benchmarking is made possible. This is why negative or positive values can be placed on an

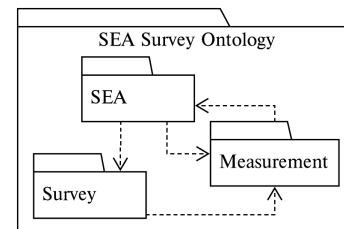


Figure 3. SEA stakeholder survey sub-ontologies

⁷<https://www.iso.org/standard/26153.html>

⁸<https://yaml.org/spec/1.2/spec.html>

⁹<http://eclipse.org/Xtext>

¹⁰<https://www.eclipse.org/Xtext/#platform-comparison>

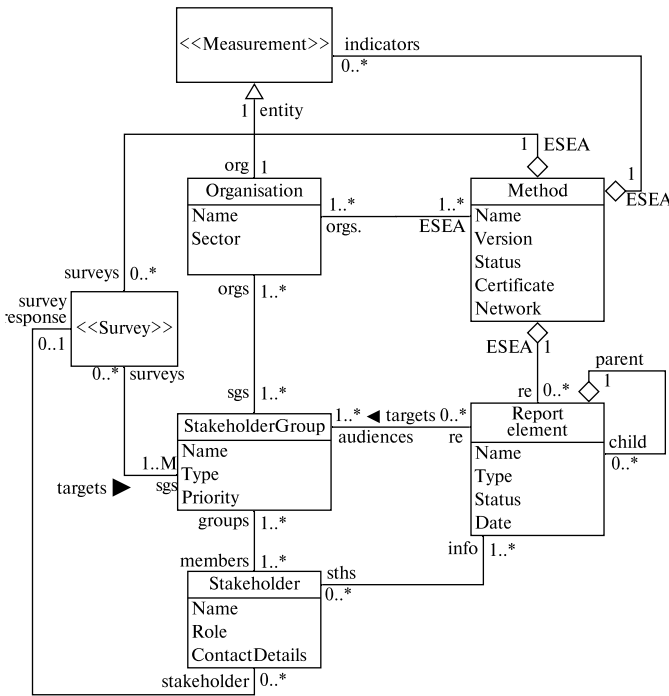


Figure 4. SEA sub-ontology

organisation’s performance, in order to be judged by the stakeholders and therefore the organisation itself [4], [17], [52].

- Survey: Surveys are conducted for collecting information to investigate the opinions or experiences of stakeholder. Based on series of structured and predefined questions, insights are gathered about what the entire population thinks or does. Therefore, a sample representing stakeholders answers to survey questions [19], [54]–[56]
- Measurement: The survey answers provide values and are seen as measures. These measures are displayed a direct indicator or indirect indicator, are reported to stakeholders [17], [51], [53], [57]–[59]

Fig.3 shows a high-level depiction of the ESEA, survey and measurement sub-ontologies, and more details follow in the upcoming paragraphs.

A. SEA ontology

Organisations cannot exist without stakeholders. Stakeholders are vital to the survival and success of an organisation, since they affect or are affected by business decisions, and they can be held accountable for organisational performance [4], [60], [61]. Stakeholders are therefore interested in transparent and publicly disclosed information via report elements, in the context of organisations social and environmental responsibly. To reach results organisations preform ESEA methods. Fig.4, a fragment of Appendix XII-B, depicts more about the ontology.

An *organisation* is an organised group of people with a particular purpose. Due to this the organisation performs ac-

tivities, has behaviours, exploits resources, and makes choices for profits or non-profits [4], [6], [17], [22], [51]–[53], [56]. Consequently, stakeholders, as defined later, are interacted with, resulting in contributions to or impacting to those [4], [6], [12], [17], [22], [51]–[53]. Organisations therefore perform ESEA to know the extent to which their actions are responsible and sustainable. This is, as mentioned before, due to norms, values and beliefs, and/or due to laws and regulations [4], [12], [22], [52]. Examples of organisations are businesses, enterprises, corporations, co-operations, institution or agency, which can be either governmental or non-governmental [4], [12], [22], [51]–[53]. Despite the subtle differences, we use the term “organisation” as common usage and encompassing of all, for our purposes. A stakeholder is a person with an interest or concern in something, especially in an organisation [62]. In the context of ESEA Lauesen [60] and Gray [3] mention a stakeholders to be an individual, group, organisation or spokesperson with interests, claims or stakes at an organisation. As mentioned before, stakeholders are important to organisations due to interaction with and for the survival of an organisation. Organisation therefore categorise stakeholder into stakeholder groups, which is a number of stakeholders that are located, gathered and classed together based on similar and sometimes conflicting needs [17], [56]. These stakeholders are grouped, based on particular shared characteristics [56]. As an example, John, Mary, and Anne are stakeholders, grouped as workers belonging to the category of owners in a co-operation. These classifications are not absolute, since one stakeholder can belong to multiple groups and therefore categories, e.g. Anne can be a worker albeit also a consumer. Moreover, there is a wide variety stakeholder groups per organisation, including workers, suppliers, consumers, regulators, shareholders, and partners [51], [62]. Some organisations even consider the environment and society as a stakeholder group [5]. All these stakeholder classifications differ per organisation, creating a large variety of stakeholder groups. A report element is a document, either on paper or electronically, publicly and transparently disclosing information regarding organisational behaviour in terms of economic environmental and social performance [53], [60]. This is done by organisations voluntarily or compulsory and is typically performed to enhance reliability [60]. Moreover, this report element is normally presented in a standardised format with information, structure, content, indicators and a conclusion, and disclosed at the end of the year. In literature, such as in [17], [21], [25], [51], [53], this concept is referred to as reporting. We however call this a report element, due to the fact that information can be disclosed via different channels apart from reports and for structuring purposes. To elaborate on the latter, reports have sections covering different aspects of the report, and thus has several report elements. Example report elements are corporate social responsibility report, community report, environmental report, sustainability report, corporate responsibility report and more, as discussed in I.

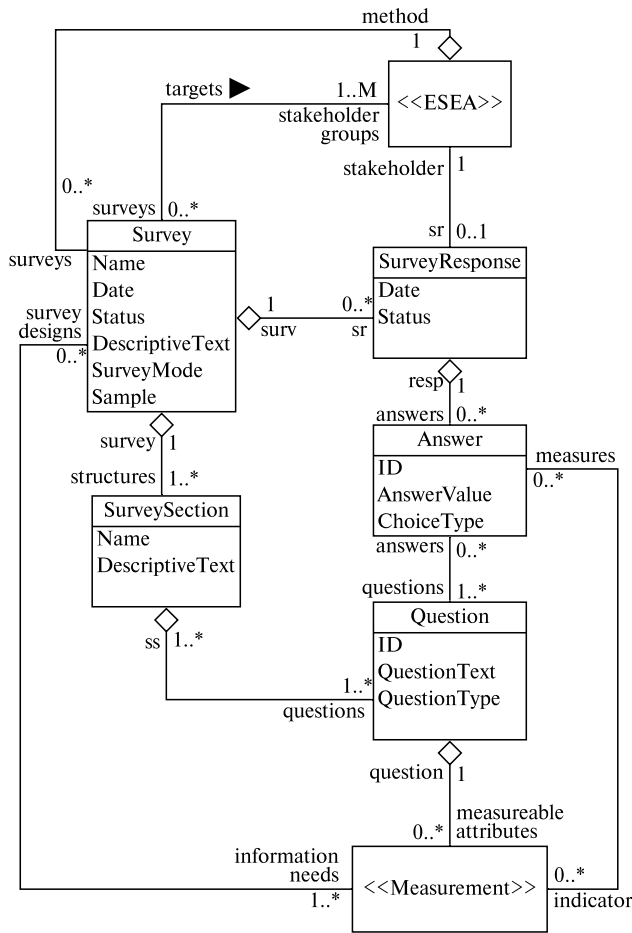


Figure 5. Survey sub-ontology

B. Survey ontology

SEA organisations engage with stakeholders via surveys to gather insights and feedback about an organisation’s performance. Therefore, a survey is sent to a sample of respondents. To a survey question an answer is given by participants, and all survey question answers form the survey response of a participant. The answers provide value to indicators, on which is reported upon. This conceptualisation is depicted in Fig. 5, which is a fragment of the conceptual model in Appendix XII-B, and further explanations follow.

A *survey* is a system or strategy for systematically collecting quantitative and qualitative information to describe, compare or explain the characteristics, actions, opinions, knowledge, attitudes and behaviour of a sample taken from a larger group of people [9], [19], [20]. The aim for conducting a survey is to explore, describe or explain a phenomenon of interests, resulting in a depiction of organisational performance [19], [55]. Therefore, quantitative insights are gathered and described regarding stakeholders’ perspective on the organisation’s impacts on or contributions to the community and environment [6], [9], [17], [19]. An organisation can then place a value to their actions and performances, in which stakeholders have interest

[17], [22], [52], [53]. As an example, think of a resident survey, for organisation to explore community opinion about nuisance. Moreover, there are differing approaches used to contact or obtain data from survey respondents, called survey modes [63]. For instance, face-to face, via paper, via the telephone, via the Internet, computer-assisted, mixtures of modes and more [63]. Due to the mode a survey can be supervised, unsupervised or semi supervised, and can be with or without an interviewer [54], [64]. The mode influences the coverage and response rate, so should be considered carefully [63]. Additionally, costs are balanced against resources available, the survey objectives, desired response rate and survey errors, timeliness, the survey users and even cultural aspects [19], [64]. In Addition, a sample represents a small part or quantity intended to show what the whole is like [56]. For survey purposes a sample is cost effective to represent the target population. There-fore, a subset or a fraction of the population is drawn to which generalisation can statistically be made to represent tot population as a whole [9], [19], [55], [56], [65]. Thus, a sample is not the same as responses obtained from a questionnaire [55]. In addition a sample is used to reduce the costs and time needed to undertake the tasks of surveys, since in some cases the population of interest is too large to be studied in details [65]. However, in other cases this does not apply, since the whole population is included in the sample. Moreover, costs-effectiveness is reached if the smallest sample size can statistically generalise the survey results to the whole population [55], [66]. There are many methods developed for selecting representative samples [65], [67]. For instance, in the probabilistic category, random sampling, stratified random sampling, systematic sampling and cluster-based sampling, or in the non-probabilistic category convenience sampling and snowball sampling [67]. For example, John, Mary, and Anne are stakeholder randomly assigned and asked to participate as the worker stakeholder group, existing out of five persons. Therefore, this sample represent the whole stake-holder group, although the whole population is not participating.

A *question* is a sentence formulated to elicit information [56]. There-fore, concepts or subjects to be measured are translated into questions, which are send to a sample of the population, who’s answers are important to reach the survey objectives [19]. Therefore, questions have to be clear and understandable for respondents in the same way, so answers will be consistent and complete [19], [66]. In addition, questions are phrased using conventional language, relying on grammar, punctuation and spelling, and are using complete sentences to express one single idea [54]. Moreover, terminology, jargon, technical expressions, abbreviations, slang an colloquial expressions are either explained or avoided [54]. Also, the question topics should not be too sensitive, fit respondents’ knowledge, and fit a time frame not too far in the past for respondents to be able and willing to answer the questions [19], [54], [66]. Lastly, there are different formats of questions to be asked, influencing the type of answer to be given. For example, Castillo-Montoya [66] distinguishes two types of question format, namely open- or closed-ended. Open-ended

questions give the respondents the freedom to frame their own answer. Closed-ended questions restrict the respondents choice of reply by offering standardised response formats, such as ratings, categorical, rankings and dichotomous questions, to name a few [63]. The latter question format provides respondents only two options, e.g. true or false, or yes or no [54], [66] and the first asks an open question where respondents can answer what they want.

An *answer* is a written or spoken reply as a reaction to a question [56]. An answer is given to a question which refers to the respondents themselves or other units of analysis, e.g. characteristics, opinions, and knowledge [9]. As mentioned before, the answer given highly dependent on a question type, e.g. whether framed open or close ended. For the latter, standardised response formats are used and therefore less time is needed for respondents to answer [64]. For answers formats to be consistent and complete the same rules apply as with questions [66]. Normally answer values are transferred to numerical values for analysis purposes [66]. This transformation highly depends on the question design and answer format. With open ended questions human expertise is required to identify an answer, meaning more time needed for analysis. With closed- ended questions sometimes, a transformation is needed towards numerical values, e.g. categorical answer formats are translated to a numerical value which represents the different categories. Moreover, if there are three response categories, such as agree, disagree, and do not know, then these categories are translated into a number. Based on this number calculations can be done to depict the mean, median or mode, to name a few.

A *survey response* is all verbal or written answers to all questions posed in a survey [56]. Responses adhere to a response rate, meaning the percental proportion of participants who responded in comparison to the number of persons who were approached [19], [55], [63]. In addition, this rate is an important survey quality indicator, since it shows that result are generalisable to the population as a whole [19], [66]. Therefore, explanations about high or low response rates has to be reported upon, since the first can indicate if the results are biased and the second if the population is underrepresented [19], [55], [63]. Two examples explanations for having a low response rates are item non-response and unit non-response. The first, a measurement error, means respondents' answer are intentionally or unintentionally inaccurate and untrue. The last means a sample of participants fails to respond or participate in the survey. Many factors influence the response rate, e.g. the survey topic, survey length, survey organisation, number of reminders, or survey design and data collection method [64]. Another factor is that the question and answer formats should be, as explained before, expressed in understandable and clear language and should not be too sensitive. Moreover, respondents should be motivated to provide complete and accurate responses by communicating that the results are benefiting them [68]. Other ways of improvements are to reduce the number of refusals by sending reminders or statistically adjusting the non-response after the data collection [19].

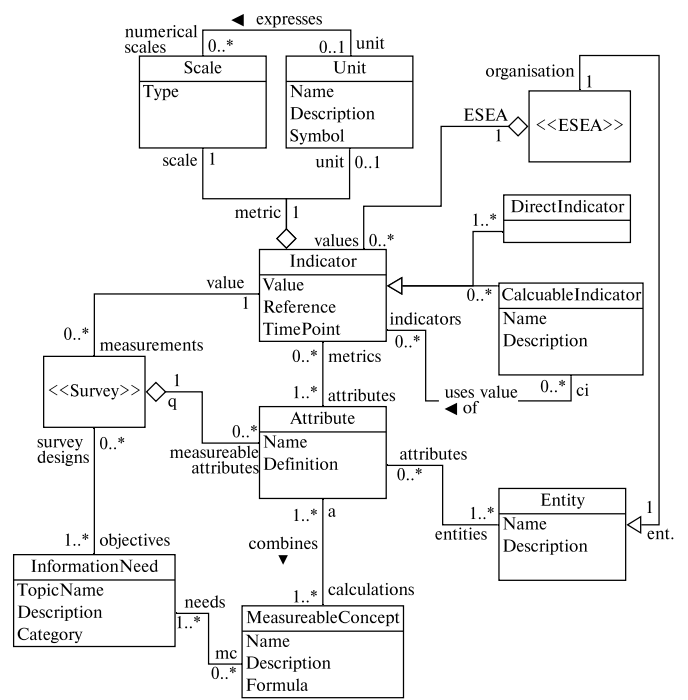


Figure 6. Measurement sub-ontology

C. Measurement ontology

Measurement, the very reason for which surveys are performed, starts with an information need by an organisation. This information need is processed into a measurable concept, which combines the attributes of an Entity. These attributes are the subject of questions to which an answer is given. The answer, the actual measure, provides values for a metric. The metric, which is reported upon, is normally represented in a scale and unit, and can be a direct metric, indirect metric or an indicator. In the following we provide explanatory descriptions of the concepts depicted in Fig. 6, which is a fragment of the conceptual model in Appendix XII-B.

The *information need* describes necessary information required by measurement and therefore driving the measurement process. The insights in general reflect objects to manage ESEA objectives, goals, risks and problems [57]–[59]. For example, an organisation wants to disclose that they consider the area residents and therefore ask questions regarding noise and smell. In this case the objective is to concern about residential opinions. Lastly, the information need reflects entities with elementary attributes.

An *entity* is an object that can be measured and characterised by measuring its attributes [57]–[59], [69]. Examples of those objects are projects, processes, products and services [59], [69]. Moreover, an *attribute* is a measurable physical or abstract property of an entity’s element that can measure objects qualitatively and quantitatively [57]–[59]. For example, time needed to complete a task in a process. Lastly, a *measurable concept* is an idea which establishes an abstract relationship

between attributes of entities and the information need, to identify objects to be measured, and making it calculable [57]–[59]. For example, actions on climate change, sensible use of man’s natural resources, waste management, or gender diversity [1], [51]. A measurable concept can also be defined as a ESEA, as done by España et al [2]. Next to this, the measurable concept combines the attributes, which are quantified by values for indicators.

A *indicator* is a number or category quantifying an attribute of an entity by per-formed measurements [57]–[59], [69]. A synonym for indicator is measure, which can be both a noun and a verb showing the action and the result [58]. In ESEA practise measures are less used to represent the quantification, as such we call this indicators. The indicator provides support for estimating and evaluating the measurable concept and its measurable attributes, due to a quantitative or qualitative values as indication [57], [59]. This indication can be used to support business decisions or show a level of confidence on the measurement results [58]. As such indicators are used to manage measurable objects [59]. As an example indicator, think of gender equity, pollution or illness ratios. Scales and measurement units help to represent indicators, and indicators can be further specialised into indirect or direct indicator.

A *scale* is a set of values with defined properties for which a metric is associated with an attribute [57]–[59]. As such, a scale multiplies a measurement results, positively or negatively, for representation purposes, e.g. from metre to kilometre the metres are multiplied with 1000. There are scale types related with scales, which is another level of detail and not used for our purposes [57]–[59], [69]. Moreover, the scale can be categorical and numerical, in the latter the scale is expressed with a measurement unit. A measurement unit is particular quantity, defined and adopted by convention, with which other quantities of the same kind are compared in order to express their magnitude relative to that quantity [57]–[59]. Two examples of a measurement unit in the context of ESEA is micro-grams per cubic metre ($\mu\text{g}/\text{m}^3$) for air quality, or square metres (m^2) to represent factory space.

A *direct indicator* is a measure obtained from direct measurements [57]–[59]. For example, the total numbers of employees, or number of women.

An *indirect indicator* is derived from values or attributes of other indirect indicators using a calculus or mathematical formulas [57]–[59]. Therefore, the calculation method combines one or more indirect indicators with associated decision criteria, such as thresholds, targets or patterns, supporting the information need [58]. For example, dividing the total female workers by the total number of employees gives a gender equity ratio.

VI. STATE OF THE PRACTISE

To express the practise we scope to three methods and based on those we perform content analysis to express multiple and single respondent(s) surveys. In addition, we perform a survey feature analysis. Both are treated in the next sections.

A. ESEA Methods description

The content, including topics and indicators, of ESEA methods is mapped to each other to get understanding of interoperability and to investigate topic clusters. Therefore, we start with method descriptions, in combination with content depiction

1) *Global Reporting Initiative*: The GRI standard is divided into four series; 100 series (Universal standards), 200 series (Economic topics), 300 series (Environmental topics), and 400 series (Social topics). The 100 series describes GRI’s reporting principles (Foundations), organisational context information regarding reporting practises (General Disclosure), and organisational information regarding sustainability management (Management Approach). The other three series, report per topic area the following:

- Requirements - required information organisations need to disclose in reports and instructions on how to prepare this information.
- Recommendations - encouraged and voluntary actions an organisation can perform.
- Guidance - providing organisations background information, explanations and examples.

In XII-C, the content structure is further specified in a PDD. In which the series, disclosures and topic specific disclosures are depicted.

2) *Common Good Matrix*: CGM is split into two axes, aimed at stakeholders and values, and themes (topics) represent those two. We mapped from the direction of values, since stakeholders are in GRI(VI-A1) and BIA(VI-A3) not separated. To specify the values, CGM considers the following:

- Human Dignity (HD)- regards the ethical aspects, in which humans have the right to exist, and to get respect, appreciation and attention.
- Solidarity and social justice (SJ) - both terms in this value are closely related, where both regards the social aspect of empathy, appreciation, compassion and equal opportunities to reduce unfairness and to take responsibility.
- Environmental sustainability (ES) - regards the ecology, the interaction between organisations and the environment, to decrease organisational impact on the environment.
- Transparency and co-determination (TC) - both terms are connected, where the first offers information the latter involves participation of each stakeholders.

Moreover, the themes are further detailed into aspects (sub-topics). These aspects give instructions to the accounting process and ask for mandatory data in the form of populated indicators. In XII-C these content structures are depicted in a PDD.

3) *B Impact Assessment*: BIA is focused around impact areas (category) and impact topics for which questions are asked and multiple choice answers provide potential values. The impact areas are

- Community - regards community engagement and impact such as diversity, job creation, supplier relations, community service and involvement
- Customers - regards customer impact apart from what is normally provided by products, such as differing impact business models, customer stewardship, and managing of product impact
- Environment - regards environmental management, such as facilities, resource use, emissions and supply chain channels
- Governance - regards company evaluation on topics such as mission, ethics, accountability and transparency
- Workers - regards employee well-being, such as compensation, training, health and safety and job flexibility

For more details on the impact topics, consider XII-D. In XII-C the topic structure is further depicted in a PDD. Compared to the other two ESEA methods, BIA does not ask for indicators. Moreover, BIA's topic disclosure is steward based on contextual information answers given. As distinction criteria think of; Organisation size in number of employees; Organisation location, being in a developed or undeveloped country; Sector and industry, split into manufacturing, wholesale or retail, services with minor or major environmental footprint, and agricultural growers. For the latter, consider follow up questions based on an answer given, such as if a best practise is performed what the details are of the best practise approach. Consequently, the total number of questions BIA considers are 25,418. Due to this number we scoped to BIA's quick assessment for an manufacturing organisation in an emerging market with more than 1,000 employees, resulting in 114 question to be mapped in the following section.

B. Content mapping

1) *Approach*: The matching approach is shown in Fig. 7. This approach is heuristically formed, as mentioned in chapter IV-B2. For the first step, we started with scraping the

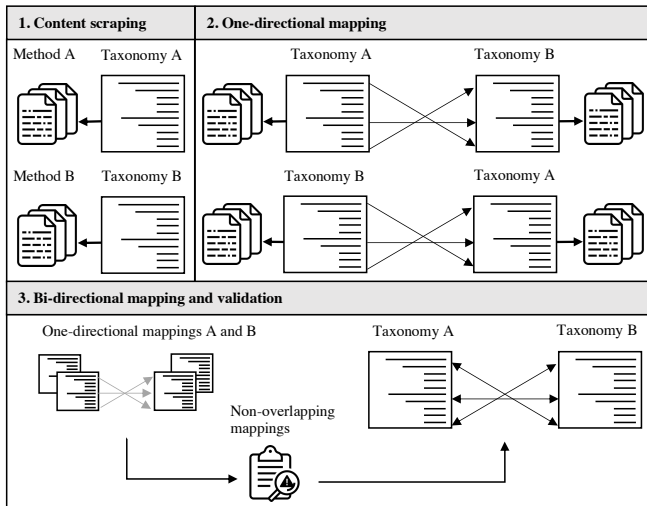


Figure 7. Semantic Analysis Process

contents of ESEA methods' documentations and heuristically created internal content structures based on logical thinking and iterations. Moreover, based on the method analysis performed in VI-A, we saw that ESEA methods have structures, also known as taxonomies, with the abstraction levels of *category*, *topic*, and *indicator*. In more detail indicators can be decomposed into *direct indicators* as mention in chapter V-B. To exemplify, the B impact assessment method has a *category* of 'Environment', a *topic* called 'Absolute impact and management strategy', assesses with the *indicator* 'Greenhouse gas emissions', and decomposing *direct indicators* emissions of carbon dioxide, nitrous oxide, methane, and others.

For the second step, we mapped the taxonomies of one method (method A) to another (method B) based on commonality of topics, since categories were too broad with too many differing topics, and indicators were of too many to map in the research's time frame. Therefore, we made use of method's documentations' categorisations, topics, contextual explanations, and indicators. Unfortunately, the methods do not always have an absolute match, although have commonalities and certain aspects. Therefore, we needed mapping relationships to express the commonalities as such the following relationships labels, as inspired by [36], are developed;

- *Exact match* (=): Both mapping topics have the same semantics.
- *Source is greater than match* (>): The sourcing topic has a broader semantic than the matching topic. This implies that one topic has more subtopics, consisting of more indicators compared to the other matching topic.
- *Source is smaller than match* (<): The sourcing topic has a narrower semantic than the matching topic. This implies that the sourcing topic has less subtopics compared to the broader match, in means of indicator numbers.
- *Source and match are overlapping* ({}): Both the source and matching topics have broad semantic, although some subtopics are matching, for example indicators are the same between the methods although others are provided on both ends.
- *Obsolete* (-): There are multiple cases where a concept is obsolete:

- 1) *Within the same method one topic is covered by more specific topics*, e.g. percentage of company focus on the environment, split into ranges (0-25%, 25%-50%, 50%-25%, 75%-100%) where every range is covered by the topic.
- 2) *Within the same method specifics cover a broader redundant topic*, e.g. diversity training and hiring practices cover practices to promote a diverse and inclusive workforce.
- 3) *Broad term is too broad and can be mapped with too many concepts*, e.g. list others
- 4) *Topics or option has no meaning*, e.g. none of the above or don't know

- *No match found* (?): There is no match to be found, after saturation of the above.

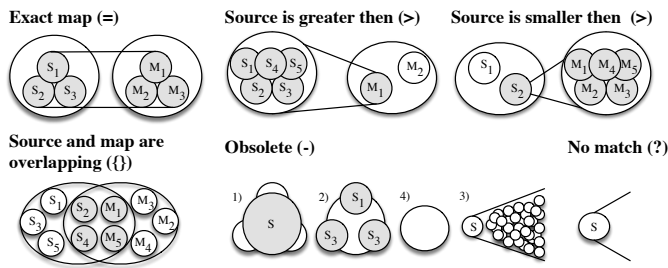


Figure 8. Mapping relationships exemplified, where S_n and M_n are source and match topic, and small and large circles are topics and sub-topics.

To illustrate the map relationships see Fig. 8, in which ESEA methods topics and subtopics or indicators are depicted as atom and sub-atom particles belonging to method A, the sourcing method (S), and method B, the matching method (M). In addition, the search is performed based on drilling down in the scraped contents' taxonomy abstraction levels, and searching for terms and synonyms and indexes of ESEA methods' documentations, until saturation arises. To conclude, with this approach fine grained mappings arise, although remaining interpretation sensitive and open for personal bias. Reasons for this are the ambiguity of words and sentences in the methods' documentation, the gain in method understanding over time, and tunnel vision to find a match.

For the final step we validated the mappings. The mappings are performed in one direction (from method A to B). Consequently, we mapped the other direction (method B to A), without considering the previous mappings (from method A to B) into account. We therefore increase validity, since differing point of views, due to the personal interpretation, are compared and the best match is chosen for taking gain in method knowledge into account. Therefore, checking consistency between the two mappings helps increase validity.

2) **Result:** GRI's topics are connected with the other ESEA methods, although not directly, albeit the difference is distributed. To specify, Table I. reveals that, on average, each GRI topic is connected to at least two other topics per method, in graph theory known as degree. Unfortunately, the table shows that GRI's topics differ compared to the other two, since on average there is a direct match of 4%. Moreover, in

Table I
GRI TOPICS AND MAP RELATIONS

Relation/ Topic	<	>	=	{}	Edges	Nodes
G.100	#	20	68	4	34	126
	%	0.16	0.54	0.03	0.27	1.00
G.200	#	15	28	1	8	52
	%	0.29	0.54	0.02	0.15	1.00
G.300	#	51	12	6	29	98
	%	0.52	0.12	0.06	0.30	1.00
G.400	#	42	25	3	29	99
	%	0.42	0.25	0.03	0.29	1.00
Total	#	128	133	14	100	375
	%	0.34	0.35	0.04	0.30	1.00

Table II
CGM TOPICS AND MAP RELATIONS

Relation/ Topic	<	>	=	{}	Edges	Nodes
CF	#	19	0	3	7	29
	%	0.66	0.00	0.10	0.24	1.0
ES	#	6	45	1	24	76
	%	0.08	0.59	0.01	0.32	1.0
HD	#	9	41	3	11	64
	%	0.14	0.64	0.05	0.17	1.0
SJ	#	13	39	3	20	75
	%	0.17	0.52	0.04	0.27	1.0
TC	#	18	27	1	13	59
	%	0.31	0.46	0.02	0.22	1.0
Total	#	65	152	11	75	303
	%	0.21	0.50	0.04	0.25	1.00

general there can not be distinguish if GRI's topics are broader, smaller or overlapping compared to the other ESEA methods, respectively 34%, 35% and %30. Detailing these statistics per topic series; the environmental and social topics are mostly smaller than the ones of CGM and BIA; the contextual and economic asks for more; and all topics have some overlap between the others except for the economic series.

CGM's topics are connected twice as many times as GRI is, again not directly, albeit mostly having more concepts covered per topic than the other ESEA methods do, as Table II shows. More specifically, the average degree of total nodes is 3.99, meaning that on average four nodes of GRI and BIA are connected with a CGM topic. This implies that CGM's topics are more concise compared to GRI and BIA. The 4% exact match shows that there are not many well connected topics. Moreover, around 50% of CGM's topics consists of more concepts (greater than relationship). Around 21% of CGM topics cover less concepts (smaller than relationship) and 25% topics are overlapping. On the topic level we see that company facts are mostly smaller than (66%), environmental topics mostly greater than (59%), ethical topic mostly greater than (52%), and social topic mostly greater than (combined 49%).

The 4% exact match shows that there are not many direct connecting topics. Moreover, around 50% of CGM's topics have broader semantics (greater than relationship), compared to the others. Around 21% of CGM topics have smaller semantics (smaller than relationship) and 25% topics are overlapping. On the topic level we see that company facts have mostly narrower semantic (66%), and environmental (59%), ethical (52%) and social topics (combined 49%) have mostly broader semantic.

On the topic level we see that company facts are mostly smaller than (66%), environmental topics mostly greater than (59%), ethical topic mostly greater than (52%), and social topic mostly greater than (combined 49%).

BIA covers more topics then in the chosen quick assessment which has implications on comprehensiveness of BIA compared to the other methods, as explained in IV-B2. Therefore, we see that BIA has more targeted and precise topics compared to the others, since from the 114 topics, 50% are smaller

Table III
BIA TOPICS AND MAP RELATIONS

Relation/ Topic	<	>	=	{}	Edges	Nodes	
B.C	#	35	4	3	5	47	20
	%	0.74	0.09	0.06	0.11	1.00	2.35
B.D	#	3.0		2.00	5.00	10	4
	%	0.30	0.00	0.20	0.50	1.00	2.50
B.E	#	23	20	4	18	65	25
	%	0.35	0.31	0.06	0.28	1.00	2.60
B.G	#	14.0	6	2.00	5.00	27	13
	%	0.52	0.22	0.07	0.19	1.00	2.08
B.IB	#	35	20	2	16	73	24
	%	0.48	0.27	0.03	0.22	1.00	3.04
B.W	#	39	7	4	24	74	28
	%	0.53	0.09	0.05	0.32	1.00	2.64
Total	#	149	57	17	73	296	114
	%	0.50	0.19	0.06	0.25	1.00	2.60

than the other, as can be seen in Table III. This trend also stands out per topic, where the community topic has the biggest amount of 74% and demographics the smallest of 30%. Per topic level there are slight differences; environmental topics are relatively in balanced (greater and smaller than); demographics topics are mostly overlapping, although it only entails 4 nodes; and governance, impact business models and workers are overlapping with the topics of the other methods. Moreover, around the same number is an exact and overlapping match as with the mappings in discussed at the GRI VI-A1 and CGM VI-A2 sections.

C. Topic clusters

1) *Topic clusters*: Based on all mappings a total of 14 clusters, also known as communities, are derived based on a modularity of 0.765, as shown in Table IV. To elaborate, modularity shows the strength of the division into groups, and the closer to 1 the stronger strength is [38]. This implies that the upcoming defined topic clusters are of a high modality. Meaning that the defined topic clusters are small although strongly related. The 14 communities can be grouped into 8 larger communities based on whether they are intensively connected to other communities. This is graphically represented in XII-E. In this representation the number of connected edges, degree, show the size of each node, and the colours show the 8 larger communities. The representation in XII-E is based on the openord algorithm. This algorithm clusters nodes together based on how edges are related [70].

Table IV
MAPPING STATISTICS

Map	Nodes	Edges	Degree	Density	Modularity	Communities
GRI-BIA	172	184	2,140	0.013	0.85	23
BIA-CGM	131	112	1,171	0.013	0.907	27
CGM-GRI	173	191	2,208	0.013	0.825	15
Total	305	487	3,193	0.011	0.765	14

Table V
TOPIC CLUSTERS

Community 1			Community 2			Community 3			Community 4		
ID	#	%	ID	#	%	ID	#	%	ID	#	%
300	26	35.1	IB	12	18.2	W	24	24.2	400	5	23.8
E	24	32.4	400	12	18.2	100	16	16.2	100	4	19.0
ES	12	16.2	C	9	13.6	400	15	15.2	W	3	14.3
IB	5	6.8	SJ	6	9.1	G	7	7.1	200	3	14.3
100	2	2.7	HD	5	7.6	CF	7	7.1	G	2	9.5
G	2	2.7	100	5	7.6	TC	7	7.1	C	1	4.8
200	1	1.4	CF	4	6.1	C	6	6.1	HD	1	4.8
CF	1	1.4	200	4	6.1	HD	5	5.1	SJ	1	4.8
W	1	1.4	TC	3	4.5	SJ	4	4.0	TC	1	4.8
			G	2	3.0	IB	3	3.0			
			300	2	3.0	200	3	3.0			
			E	1	1.5	D	1	1.0			
			ES	1	1.5	ES	1	1.0			

In Table V the first four communities are treated (87% of occurring topics), since latter four show to be outliers (13%) and no patterns can be distinguished. The patterns distinguished of the first four are:

- Cluster one's major topics are environmental
- Cluster two's major topics are community, impact business models and socially focused
- Cluster three's major topics are worker, management and socially focused
- Cluster four's topics are a mixture of related social, management, worker, economic, and governance topics.

There is noticeable cluster present regarding the environmental topics, although the ethical, social and economic topics are more intertwining with each other.

D. Feature exploration

We identified key and mandatory features which we implement in Limesurvey, and optional features which will be implemented by openESEA or not be used at all. Moreover, we identified four feature pillars, namely user management, participant management, survey engine, and statistics. OpenESEA has user management, such as user access, incorporated and statistics is a predefined set of statistics and layout which is not customisable and therefore optional. Moreover, every other feature pillar offers table like overviews and editing actions, such as adding, removing, exporting, importing or copying features. Please consult XII-H for a depiction of the FD. This FD is an abstraction from the component diagram in XII-G.

The *Participant management* feature, which differs from openESEA's user management feature, is used for handling survey participants, such as email contact, authentication via token registration, and survey response handling. For invitations it requires name, email, and offers invitation statuses. In addition, batch edit can be performed, such as sending reminders, invitations or token generation, although this is not taken into account due to time constrains. Moreover, Limesurvey initialises a Central Participants Database (CPDB), which needs to be activated to make use of all participant management features.

The *Survey engine* feature treats all survey related tasks, such as general survey settings, question management and

question grouping. The survey settings are attributes or descriptions, activate or test the survey, survey layout (questions grouped or questions as a list), and overview of initialised surveys and editing actions. Examples of survey attributes are title, expiry and creation date, statuses, and privacy settings. Examples of descriptions are survey explanations and welcoming and closing messages.

For question management answer options, sub questions, and question attributes are offered to be defined by users. Answer options regards the following answer types:

- Choice - single, multiple and/or including with comments answers, where participants can select from, e.g. agree, disagree and neutral.
- Array - with sub questions defining the rows and numbers, textual, choice or custom variables defining the columns.
- Mask - limiting user input to for example date or time, numerical, gender or ranking.
- Textual, asking for short, long, huge or multiple short textual input by participants.

Moreover, sub questions are presented in arrays, or when a user can selecting multiple choices, where every choice answers to a sub question. In addition to question management, users can categorise questions in question groups. To support this, Limesurvey asks for group attributes for tractability purposes, and has overview and editing incorporated. Examples of group attributes are group ID, title, description and order.

VII. DESIGN OF ESEA META-MODEL AND DSL

In accordance to the MDE approach a meta-model is designed and DSL constructs are defined based on those. In addition, the DSL is implemented in a tool for which requirements are needed. The meta-model summarises the analyses as explained before, and depicts data structures for the openESEA tool. This tool is developed for validation purposes and therefore requires the description of mandatory features in User Stories. The meta-model is presented in Fig. 9, and explanations and rationale is provided in the upcoming sections. As such, the meta-model is described first and more details are presented after.

A. ESEA Meta-Model

Organisations asses and report on the impacts to their environments by performing a ESEA. Therefore, organisations are required to provide data for assessing and reporting on topics that have impact. In ESEA methods topics are presented in sections, having instructions and descriptions to illustrate what the topic means, and having 'questions' to specify and guide the information need. These questions are not always in a question format, with a question mark, however provide sentences to elicit information. Moreover, the 'answers' to questions are data inputs for indicators, summarising results so benchmarking is possible. The indicator can be direct, meaning one data point, or indirect, meaning calculated based on several data points. Lastly, a survey bundles and poses a cluster of questions to a specified stakeholder group, with

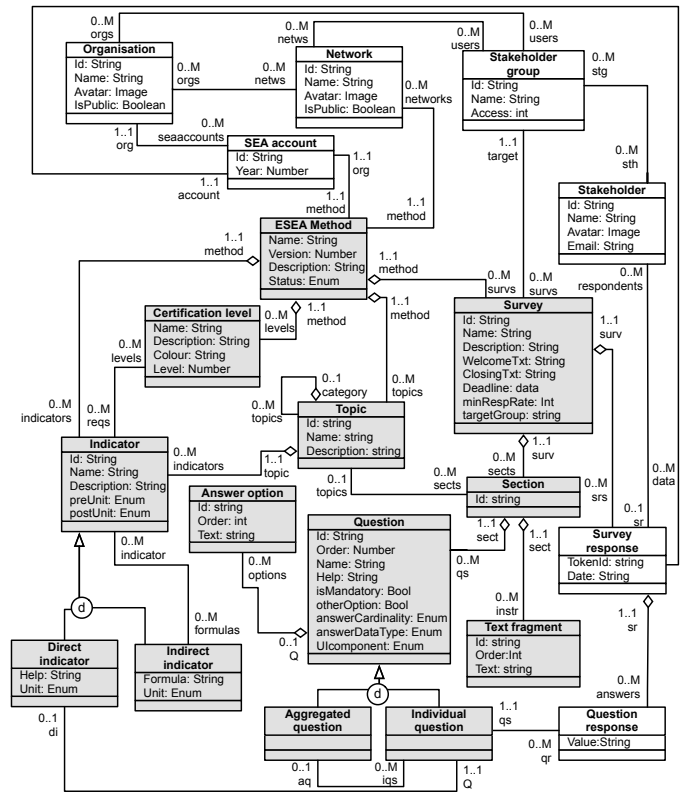


Figure 9. openESEA meta-model, where grey is represented by the DSL and white by openESEA

stakeholders. The question formats can vary from a simple text input, to single or multiple choice, or to array form. Therefore, participant input is limited what helps for answer analysis and less time to answer for participants. For this limitation cause, answer options or sub questions are presented. All answers to all questions from all participants are represented in survey responses. In this manner survey statistics about the response rates are calculated. Based on the survey response answers to questions are summarised to one data input for the indicators, e.g. with mean, mode, or median statistics. Moreover, with these data points calculations are performed with defined formulas in indirect indicators. Apart from surveying, requirements for certification purposes can also be defined in these indirect indicators, for example *if* a threshold is met *then* provide an certification level. See List 1 and 2 as an example between the two types of indirect indicators.

There are four key concepts in the meta-model which is further explained, namely topic section, indicator, survey and stakeholder. Moreover, as mentioned in the contributions III-C, we improve Espana et al.'s [2] work and therefore have evolved their meta-model, which is described next.

1) *Topic section*: In the ESEA methods, investigated in VI-B1, text had a taxonomic structure with multiple categories clustering topics, instructions and indicators, see Fig. 10. This figure exemplifies the alternating topics, contextual information, questions and data input. As mentioned in the content

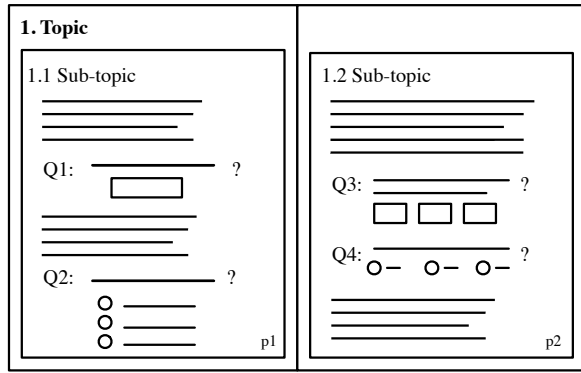


Figure 10. ESEA Methods section pattern

analysis VI-B1 the taxonomy of topics have different levels of granularity, e.g. chapter, category, topic, sub topic. This means that a 'parent and child' topic implementation is more suitable for supporting the definitions of the topic taxonomy, with unlimited levels of granularity. Moreover, multiple contextual descriptions are presented in ESEA methods, for instance best practises, requirements and guidelines. As such a separate description class is given. See Table VII-A1 for proof from practise, where the method fragments of GRI XII-C, CGM XII-C and BIA XII-C are used.

2) *Indicator*: Indicators can be of two differing types, direct indicators or data entry points, and indirect indicators or formulas. This type of measurement ontology is explained by [57]–[59] as direct and indirect measures or indicators. In practise, the term indicator is used more often, where we saw a common depiction of indirect and direct indicators. See List. 1 as an example indicator specification. In Table VII-A1 for proof, where both ANSWER and CONTRIBUTION STATEMENT are data points. In addition, in this table

Table VI
METHOD COMPARISON FOR META-MODEL CLASSIFICATION

Meta-model	BIA	GRI	CGM
Topic	TOPIC	SERIES	VALUE
	TOPIC	DISCLOSURE	THEME
Context	EXAMPLE	RECOMMEN- DATION	INSTRUCT- ION
	EXPLANTION	GUIDANCE	
	INSTRUCTION		
	DOMAIN EXAMPLE		
Question	QUESTION	TOPIC SPECIFIC DISCLOSURE	ASPECT
Indicator	ANSWER	INDICATOR	CONTRIBU- TION STATEMENT
	DIRECT SCORE	-	SCORE

DIRECT SCORE and SCORE are part of the audit and verification of BIA and CGM. Moreover, GRI has a focus on assessment and reporting and uses another method for verification, e.g. AA1000SE. Espana et al. [2] described this 'scoring' as requirements for certification levels. This is not investigated thoroughly, since this is a step post ESEA. There is commonality between (indirect) indicator and scoring. Both are presentable in formulas, see List. 1 and 2 as an example. For this reason the indirect indicator defines formulas for assessment and scoring for the certification.

```

1 average_salary_women: number (euro)
2 average_salary_man: number (euro)
3
4 gender_ratio: women_staff / (total_staff)

```

Listing 1. Indicator specification for assessment

```

1 gender_ratio_score:
2 IF gender_ratio < 0.15 THEN gender_ratio_score = 0
3 ELSE IF gender_ratio < 0.85 THEN gender_ratio_score
   = 10* (gender_ratio - 0.15 ) / (0.85 - 0.15)
4 ELSE gender_ratio_score = 10

```

Listing 2. Scoring specification for verification and auditing

3) *Survey*: A survey poses a bundle of questions targeting a topic, to which one or multiple participant responds. Therefore, topic sections and surveys have multiple questions intertwined with explanatory text and indicators, see Fig. 10. The investigated ESEA methods (BIA, GRI and CGM) perform one person surveys, albeit target not multiple persons in their methods. An exception exists for BIA, which externalises the multiple respondents survey, and asks for that results, however does not offer the content. The same accounts for Social Accounting and Audit (SAA) and CGM [27]. Other methods which do not advise a survey, focus more on stakeholder treatment by a company rather than their opinions, e.g. what the employee benefits are rather than how benefits are experienced by employees. Due to those reasons, we cannot meta construct the survey domain based on the ESEA. However, based on Limesurvey and survey literature, key classes are defined as explained next.

Firstly, a survey incorporates welcome and closing messages for survey participants, the status represents an active, expired or in development survey, and minimum response rate is needed to accurately represent the population. Unfortunately, due to time constrains sampling methods are not further specified, and a minimum response rate is seen as sufficient. Secondly, questions can pose differing answer data type formats, limiting input and time needed for response and therefore analysis. As format classifiers we distinguish answer options and cardinality, and both influence the answer User Interface (UI) component. Answer options can be predefined enumerations or self defined enumerations, e.g. five-point scaled, agree-disagree, man or woman choice. With answer cardinality we see two types:

- single cardinality, one option can be selected and one answer provided

- multiple cardinality, multiple options can be selected and providing multiple answers

Both the answer options and cardinality influence the visual representation of these question types, e.g. a date requires a date field, a five-point scale requires radio button selection, and multiple cardinality answer requires a checkbox. See Appendix XII-I. for a table representing the considered closed questions. Apart from answer types, questions can be aggregated or individual. Aggregated questions are categorical head questions, which pose individual sub questions to which is responded. As an example, the main question is 'rate the following office conditions from one to five', with sub-questions 'office environment', 'noise distraction', 'management involvement'. In this example, the question is presented in an 'Array' representation where the rows hold the sub-questions and the columns the numbers from one to five.

Lastly, a survey targets a stakeholder group, with stakeholders who respond to the survey. This survey response holds all question responses from all stakeholders in the group. Evidence for this is the API response object from Limesurvey see List. 3, where all responding participants are represented as tokens. Based on this response, question response is populated with all the corresponding answers. Based on the indirect indicator formula, where question response statistics are defined, the mean mode, maximum, minimum, median, and sum are calculated based on the question response.

```

1 "responses":
2 [
3   1:
4     {
5       "id": "1",
6       "submitdate": "2020-05-17 11:51:00",
7       "lastpage": null,
8       "startlanguage": "en",
9       "seed": null,
10      "token": "tWkt9o8LO7PBbir",
11      "Q4": "Very satisfied",
12      "Q5": "Very satisfied"
13    },
14   2:
15     {
16       "id": "2",
17       "submitdate": "2020-05-17 11:52:00",
18       "lastpage": null,
19       "startlanguage": "en",
20       "seed": null,
21       "token": "7afZygWzCYw9F8c",
22       "Q4": "I am satisfied, although it can be
23       better. ",
24       "Q5": "My work is challenging "
25     }
26 ]

```

Listing 3. Limesurvey survey response API result object

4) *Stakeholders*: There are two types of stakeholders, stakeholders for the openESEA tool and stakeholders to an organisation performing ESEA and survey. Firstly, we distinguish two types of tool users; an administrator to alter data, and a survey participant to provide data. Moreover, the administrators can have access to all data present (root admin), network and all member organisation data (network admin),

Table VII
EVOLUTION OF META-MODEL ELEMENTS

Element	Operator			
	-	+	=	~
Class	2	10	4	6
Attribute	8	33	26	3
Association	5	16	10	4
Specialisation		4		
Total	15	63	40	13

- and + denotes a deleted or added element
= indicates elements remained the same, and
~ shows elements with changed characteristics

organisation data (organisation or accounting admin), the method specification design (method designer). Lastly, survey participants provide information to which they have access. For example, a manager from the finance department providing financial statements (single response survey) or customers providing their opinion regarding company ethics (multiple response survey). The survey respondent, and stakeholder to an organisation performing ESEA, can be clustered in stakeholder groups, e.g. as consumers, staff, suppliers, government or even the environment represented by activists or the government. There is not a standard set of stakeholder groups in the ESEA domain, since these differ based on organisation context and ethical, social and environmental impact. Moreover, the identification of stakeholders is not part of ESEA, and is beyond the scope of this research.

5) *Meta-Model evolution*: The meta-model has evolved from 67 initial elements to 116 final elements, not only survey concepts are added, also the initial meta-model's structure has changed. See Appendix XII-F and Fig.9 for the corresponding initial and final meta-models. Between the two meta-models there are 15 elements deleted, 63 elements added, 40 remained the same and 13 elements changed with differing characteristics. See Fig. VII-A5 for more details, and Appendix XII-N for the data supporting this table.

B. ESEA DSL

The DSL is designed based on the meta-model classes and attributes, and acts as support for ESEA domain experts to configure the openESEA tool based on common domain vocabulary, content assist and validation. See Appendix XII-O for the DSL specification. Moreover, based on a workflow every meta-model's class is handled in a chronological order. The number of instances of classes are limited based on cardinality syntax elements, such as

- no operator - exactly one class instance
- ? operator - zero or one class instance
- * operator - zero or more class instances
- + operator - one or more class instances

The workflow and cardinality elements requires one class to be instantiated before another can be, for instance an indicator cannot be present without an topic to link to. Based on the chronological order the DSL is explained next.


```

1 Topic:
2   'newTopic:'
3   'id:' name=ID
4   'title:' title=STRING
5   ('superTopic:' superType=[Topic])?
6   ('description:' description=STRING)?
7   (indicator+=Indicator)*
8   (survey+=Survey)*
9   (back+=Topic)?
10  ;

```

Listing 4. Topic DSL grammar

To start the DSL requires to define at least one new topic, and subsequently and optionally an indicator or survey have to be defined. If this is not the case, another topic class can be defined. Moreover, classes can be related based on the superTopic syntax, e.g. a topic can be part of a category. This means that a topic can be abstracted into super topics, replicating a taxonomy structure. Advise List.4 for the start of the DSL workflow with assignments to other meta-model class instances. This listing is a fragment of the whole DSL in Appendix XII-O. Reading from line one to ten depicts the chronological order presented in the content assist. In the following subsections the instances of indicator, survey, question and answer type are explained.

```

1 Indicator:
2   'newIndicator:'
3   'id:' name=ID
4   ('name:' title=STRING)
5   ('description:' description=STRING)?
6   'topic:' referenceTopic=[Topic]
7   'Unit:' unit+=UNIT
8   'indicatorType:' indicatortype= IndicatorType
9   ;
10
11 IndicatorType:
12   directindicator=DirectIndicator |
13   indirectindicator=IndirectIndicator
14   ;
15
16 enum UNIT: text='text' | number='number' | list='
17   list' | likert='likert' | percentage='percentage'
18   ;

```

Listing 5. Indicator DSL grammar

C. Indicator syntax

An indicator, linked with a topic, can have a description, has an measurement unit, and is either a direct or an indirect indicator. A direct indicator can have a description, to explain context for the measure needed, and an indirect indicator has a formula represented. This formula uses direct indicators, operators and numbers, and the direct indicator is linked to question response. The operators can be arithmetic, statistical, and functional. The first operator is used to define the calculation based on direct indicators, namely multiplying, dividing, counting, subtracting on direct indicator to another. The second is used to specify the calculation of one single value based on question response, for example the mean of all responses obtained. The latter is used for requirement specifications for certification levels, for example *if and then* statements specifying a condition to be met in order to meet a certification

threshold. See List.5 where the indicator syntax is defined, and in List. 6 the specification of direct and indirect indicator are specified. Both listings are fragments of the complete DSL. Due to time constrains requirement specification are not designed. The in List. 6, a fragment of the DSL, indirect indicator's formula has multiple components from which can be selected. Therefore, there can be chosen from an arithmetic operator, a number or an direct indicator. The latter, is glued to a statistic to handle the question and provide for a data in the direct indicator. In other words the average of a question response is used for data in the direct indicator.

```

1 DirectIndicator:
2   directindicator='directindicator'
3   ('help:' description=STRING)?
4   ;
5
6 IndirectIndicator:
7   indirectindicator='indirectindicator'
8   ('formula:' (formula+=Formula)*)
9   ;
10
11 Formula:
12   operator=OPERATOR | number=INT | indicatorhandler
13   = IndicatorHandler
14   ;
15
16 IndicatorHandler:
17   statistic=STATISTICS
18   ' ('
19   superIndicator=[Indicator]
20   ') '
21
22 enum OPERATOR: nothing = ' ' | multiply='*' | divide
23   = '/' | add = '+' | subtract = '-' | openBracket
24   = '(' | closingBracket = ')';
25
26 enum STATISTICS: min='minimum' | max='maximum' | sum
27   ='sum' | mean='mean' | mode='mode' | median='
28   median';
29 ;

```

Listing 6. Direct and indirect indicator DSL grammar

D. Survey syntax

The survey has, as in accordance with the meta-model, optionally a textual description and messages, mandatory response threshold and clusters questions in sections, see List. 7, a subsection of the complete DSL. The response rate is limited from zero to 100 percent and the DSL enforces this, by limiting the numeral input. The percentage is furthermore translated to decimal numbers, for computation purposes. Moreover, questions are clustered based on sections with similar topics. By defining questions in sections, the topic reference has to be done only once and all topics are linked. Questions can also be posed without a topic reference. For example, when an organisation wants to add custom questions apart from an ESEA method.

```

1 Survey:
2   'newSurvey:'
3   'id:' name=ID
4   'title:' title=STRING
5   ('description:' description=STRING)?
6   ('welcomeText:' welcometxt=STRING)?

```

```

7 ('closingText:' closetxt=STRING)?
8 'minResponseRate:' rate=Rate
9 section+=Section+
10 ;
11
12 Rate:
13 (one='1') | (zero='0' poin='.' decimal=FULLNUM)
14 ;
15
16 Section:
17 'newSection:'
18 'topic:' linkTopic=[Topic]
19 question+=Question+
20 ;
21
22 enum FULLNUM: zero='0' | one='1' | two='2' | three
    ='3' | four='4' | five='5' | six='6' | seven='7'
    | aight='8' | nine='9';

```

Listing 7. Survey DSL grammar

E. Question syntax

A question posed to a participant can be mandatory or, when limiting options are presented (e.g. multiple choice), have an 'others' options to provide a text input box, as for participants to provide a remark or another option, see List.8, which is a subsection of the whole DSL. In addition, questions and instructions are intertwining, as such the DSL offers to define a question or an instruction, and based on which is defined first the order is set. Moreover, a question is of an answer type to limit answer input, as explained in VII-A3. For the answer type we distinguish answer type, answer cardinality, and UI component. The answer types can be of single input, enumerated predefined option input, or enumerated input with options customary defined. The user can select one of the three options and therefore the answer cardinality and UI component options are limited to the possible options, in accordance with Appendix XII-I. The answer type is defined in accordance to the distinguished classification in Fig ???. The classification presented as options as treated in the upcoming section.

```

1 Question:
2 ('newQuestion:'
3 'id:' name=ID
4 'question:' qtitle=STRING
5 ('help:' qdescription=STRING)?
6 'mandatory:' mandatory=YESNO
7 ('referenceTo:' linkIndicator=[Indicator])?
8 'answerDataType:' answerType=AnswerType )
9 |
10 ('newInstruction:'
11 'id:' name=ID
12 'instruction:' instruction=STRING)
13 ;
14
15 AnswerType:
16 singleinput=SingleInput | enuminput=EnumInput |
    enumuserdef = EnumUserDefined
17 ;

```

Listing 8. Question DSL grammar

F. Answer type syntax

The answer types are classified as single choice with set answer options, single choice with custom options, multiple

choice with custom answers, array with set options to chose from, and array with custom options, see List 9. The single choice provides an enumerator with set options to chose from, for instance a date format or a text input, and additionally custom options can be defined. The multiple choice offers only custom options, since there can not be a set option to chose from, e.g. a five point scale cannot have multiple options selected. Lastly, an array question, has multiple sub questions as rows and a list of set or custom choices. Consider List 9. for the predefined options when there is chosen between the single, enumerated or user defined answers type. In addition, options are presented with a comma sign in between the differing textual options.

```

1 SingleInput:
2 sinput=SINPUT
3 'answerCardinality:' cardinality='single'
4 'UIcomponent:' uicomponent='field'
5 ;
6
7 EnumInput:
8 enuminput=EINPUT
9 'answerCardinality:' cardinality='single'
10 'UIcomponent:' radio='radio'
11 ;
12
13 EnumUserDefined:
14 enumuserdef='enumUserDefined'
15 'answerCardinality:' (singlecardinality=
    SingleCardinality | multiplecardinality=
    MultipleCardinality)
16 'othersOption:' others=YESNO
17 ;
18
19 SingleCardinality:
20 'single'
21 'UIcomponent:' (dropdown='dropdown' | radio='radio'
    ')
22 'options:' (option+=STRING (',' option+=STRING)*)
23 ;
24
25 MultipleCardinality:
26 'multiple'
27 'UIcomponent:' checkbox='checkbox'
28 'options:' (subq+=STRING (',' subq+=STRING)*)
29 ;

```

Listing 9. Answer type DSL grammar

G. Requirement User Stories

There are two requirements types, namely static and behaviour requirements. The static, data structural, requirements are depicted in the previous meta-model VII-A section, and the behavioural requirements are explained here. For this we use User Stories, as explained in IV-C. The User Stories are categorised as report, survey, stakeholder and DSL User stories. The first category explains Survey behaviour, see Appendix XII-J, such as management, overview, exporting, data population, structure, unit representation, and merging behaviour. The second category explains survey behaviour, see Appendix XII-J, actions, overview, participant communication, participant targeting, answer anonymity, and structural behaviour. Stakeholder behaviour, as explained in Appendix

XII-L., regards behaviour to perform stakeholder management, such as users and participants creation, grouping and deletion. The last, DSL behavioural requirements presented in Appendix XII-M, explain behaviour regarding configuration file specification, including the order of specification, validation and file generation behaviour. In the upcoming section we explain the implementation of these requirements for validation purposes.

VIII. IMPLEMENTATION OF DSL INTERPRETER

To prove that the defined meta-model and DSL are correct, the openESEA tool's [2] DSL and interpreter are redefined and survey capabilities added. The DSL is defined in Xtext to validate, present code assist and generate a YAML file for users specifying ESEA methods. Lastly, Limesurvey performs the survey capabilities, such as participant management, survey definition, and response management. Therefore, openESEA connects to API data points by sending requests and getting responses which are used as data input in openESEA. Fig. 11 represents the infrastructure schematically, where the numbers indicate the upcoming subsections.

```

1 class ESEADslGenerator extends AbstractGenerator {
2
3   override void doGenerate(Resource resource,
4     IFileSystemAccess2 fsa, IGeneratorContext
5     context) {
6     fsa.generateFile('model.yaml', '''
7     <<TopicGenerator(resource)>>
8     <<IndicatorGenerator(resource)>>
9     <<SurveyGenerator(resource)>>''' )
10  }

```

Listing 10. Limesurvey survey response API result object

A. Xtext and DSL

ESEA methods specifications can be defined by the DSL, as designed in VII-B, providing backing for versatile tool configuration. The specification is performed in an Eclipse instance, offering the DSL and providing validation and content assist. When an ESEA method is specified completely by a user a YAML file will generate. This file is used to configure openESEA for method and survey capabilities. The YAML file generator is defined in the Xtend language, which interpreters the DSL and generates Java code, and therefore generates instances of the classes of the meta-model. Therefore, Eclipse

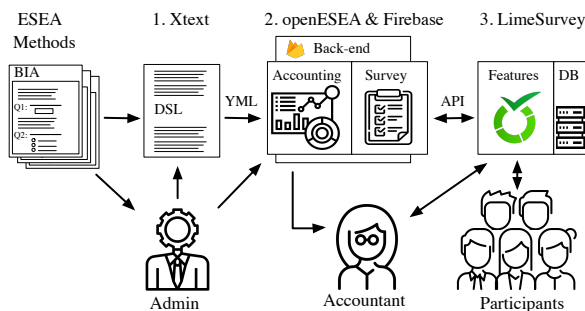


Figure 11. Implementation infrastructure

and Xtend treat every class, e.g. topic or indicator, as an array object, and based on *for loops* instances are made available in the YAML file. Moreover, using string literals in the YAML file generator, all instance prints are space and tab sensitive and a YAML format is maintained. See List. 10 where doGenerate generates a YAMLfile, based on later defined functions. Moreover, see List. 11 for a preview of the TopicGenerator function, where class and attributes are generated. Moreover, in Appendix XII-P the whole generator specification is presented.

```

1 def TopicGenerator(Resource resource)
2 {
3   var txt = 'topics:'
4   return txt = txt + '''
5   <<FOR topic :resource.allContents.filter(Topic).
6     toIterable>>
7     <<topic.name>>:
8     name:<<topic.title>>
9     <<IF (topic.description != null)>>
10    description:<<topic.description>>
11    <<ENDIF>>
12    <<IF (topic.superType != null)>>
13    topic:<<topic.superType.name>>
14    <<ENDIF>>
15  <<ENDFOR>>'''

```

Listing 11. Limesurvey survey response API result object

Moreover, the for the YAML file to generate properly constraints are defined, please see Appendix XII-Q.

B. openESEA

The openESEA tool interpreter is altered to support a new version of the meta-model, see section VII-A3. Therefore, the structure of category, topic, indicator, and metric is changed, and stakeholder management added. The category and topic structure support for unlimited granularity levels. A 'parent and child' topic implementation in openESEA support to specify topics with unlimited levels of granularity. Additionally, the indicator and metric presentation did not co-respond to our findings. The indicator can be either an input (direct indicator) or calculated (indirect indicator). Moreover, the data input page is removed from openESEA and data input is given via Limesurvey's features. In other words, the single respondent survey is supported by Limesurvey rather than by openESEA. In addition, the multiple respondent surveys is also supported, e.g. for an employee satisfaction survey. The next section VIII-C explains about the survey implementation. Lastly, support for the participant management, stakeholder management is added to the tool apart from user management. Stakeholder groups can be created and stakeholders can be added or uploaded by a Comma Separated Value (CSV) file format.

C. Limesurvey

Survey capabilities are performed in real time by API requests to Limesurvey, catching the response, and storing data in the Firebase, and presenting survey statistics. In this manner, the survey implementation is done automatically when

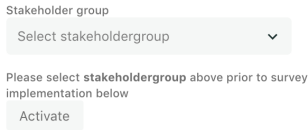


Figure 12. openESEA survey initialisation

Survey statistics

13% of the responses obtained, 20% is required

- 24 invites send
- 2 valid response(s) obtained
- 3 total survey participants(s)
- 1 incomplete response(s)

Figure 13. Survey statistics

a method is specified and survey initialised. This initialisation is done manually in openESEA, since DSL independent stakeholder management, e.g. uploading participants and creating stakeholder groups, is performed in openESEA and therefore need to be linked to the survey in openESEA, see Fig. 12. The API requests are done in chronological order to create surveys, question groups, questions, participants, and activate surveys. Firstly, a survey can be added with a name, description, and opening and closing message. Secondly, a question group is added, with references to an ESEA topic, and questions as well. Therefore, the question types are defined, with concurrently the sub questions or options, as mentioned in the DSL answer type specification VII-F. Moreover, an instruction can be after or before questions, to guide and provide context for the survey. Thirdly, a participants database is initialised, all participants are imported, and tokens per participant generated. At last, the survey is activated and participants receive an invite. The database has the same structure as the meta-model in VII-A3, e.g. when survey responses are requested they are stored in the survey response collection. This implies that there can be a mismatch with Limesurvey and Firebase, when new responses are present. Unfortunately, when rendering a page in React, an API request can not be send, since this has security implications. Therefore, a user can refresh to get the latest responses. Moreover, the direct indicator is calculated in run-time when a page gets rendered, so no data redundancy is present. This has no implications on security, since the data is loaded in the same Firebase environment. In addition, the direct indicators are populated with the statistics of the responses, for instance the mean of all responses from one question. These statistics are used to calculate the direct indicator in real time. Moreover, the percentage completion to the required response rate is also shown. Lastly, information about the total responses, the complete responses and incomplete responses are presented, see Fig. 13.

IX. VALIDATION

Validation is done based on two aspects, the static and behavioural requirements. The first is exposed to existing

ESEA methods and proof provided whether they are expressive enough. For the second, proof is provided if the User Stories, as defined in Appendix XII-J, XII-L, and XII-M, are met.

A. Static requirements

The method deliverable fragments, as result of method process fragments, from CGM (XII-C), BIA (XII-C), and GRI (XII-C) are implemented as DSL specifications to provide proof that the openESEA tool has the capabilities to interpret the Meta-Model and react accordingly. In total 71.1% of the 45 method fragments is expressed using the DSL, see Tab. IX-A. For rationale behind these statistics see Appendix XII-R. Moreover, the percentage above is skewed, since CGM and BIA have certification and therefore scoring incorporated. Excluding those results, a total of 91.4% of DSL expressiveness. This means that 32 of the 35 method fragments can be expressed using the meta-model and DSL, when expressed only on ESEA and excluding certification. More details are presented next.

1) *CGM*: CGM includes reporting and certification, and 72.2% of 18 method fragments can be expressed using the DSL. Excluding the certification fragments, 13 method fragments are expressed for 100%. See Appendix XII-S for the CGM method specification using the DSL. In this specification the CONTRIBUTION STATEMENTS and EVIDENCE, which are normally in free text answer format, are translated into closed answer formats saving time for analysis, benchmarking and survey response. These statements could be implemented as free and open text and have no influence on the statistics. In addition, we see the meta-models aggregated and individual questions as respectively REPORT QUESTION and COMPULSORY INDICATOR. Unfortunately, both aggregated questions and individual questions are not supported in the DSL and therefore separate questions are specified. Lastly, all INSTRUCTIONS are representable as TOPIC descriptions, although gives no room for structuring purposes. Therefore, a separate INSTRUCTION class can be present in the Meta-model and as DSL construct. Due to time constraints this is not implemented.

2) *BIA*: BIA has ESEA, scoring and certification method fragments and 64.3% of all the 14 method fragments are expressed using the DSL. Excluding scoring and certification 100% of the 9 method fragments are expressed. See Appendix XII-T for the method specification using the DSL. In addition, a question pattern was present. All questions are of the enumeration format with user defined options. There is

Table VIII
METHOD FRAGMENTS EXPRESSED BY DSL

ESEA Method	All method fragments			Accounting method fragments		
	# expr.	# not expr.	Total	# expr.	# not expr.	Total
CGM	13	5	18	13	0	13
BIA	9	5	14	9	0	9
GRI	10	3	13	10	3	13
Total	32	13	45	32	3	35

a distinction between answer response cardinalities, offering multiple choice and single choice options for users. Moreover, the multiple choice options are accompanied with participants defined other options.

3) *GRI*: GRI is focused on performing and reporting on ESEA only, therefore 76% of the 13 method fragments is expressible using the DSL. See Appendix XII-U for the DSL specification. In addition, the implemented GRI section refers to the management approach section. This section was not specified, due to time constraints and only a sub section of the GRI is implemented and not all. If a future GRI specification holds all information, then this reference is conditional, meaning if the answers are already given in the management approach section then this question is not presented to the user again. Unfortunately, this conditional statement cannot be expressed in the current DSL. Apart from that, GRI distinguishes reporting requirements and recommendation. This distinction is implemented as mandatory and non mandatory questions.

B. Behavioural requirements

The User Stories, as defined in VII-G, are implemented in the DSL and openESEA tool interpreter. In total 76.9% of the requirements are met. This means that of the 39 requirements, 30 are implemented and 9 are not. Appendix XII-V lists all requirements with status indication and proof by referring to the requirement in question.

X. CONCLUSION

Organisations ethically, socially and environmental responsible want to disclose this to stakeholders as transparent as possible for economic and ethical gains. We enhance assurance of the veracity of the disclosed information, with offering features for stakeholder surveys tailored to the ESEA domain. These surveys can be specified for single respondents, targeting data acquirement based on participant's access to data, and multiple respondent, to gather perceptions and opinion of a high stakeholders population. In addition, the interoperability between ESEA methods is tackled with a MDE approach to express the variable ESEA domain. The main concepts of the domain are extracted in order to answer the first research question.

1) *What are key concepts to consider in the ESEA stakeholder survey domain?*: The conceptual model and more concrete Meta-Modal both show that the key concepts are topic sections to provide structure and context, indicators to represent data, survey to bundle questions for response, stakeholders and groups to provide the response. In topic sections a topic taxonomy is present with unlimited level of granularity and information is intertwined with textual information and indicators. A survey targets stakeholders, a minimum response threshold is required, questions posted are of differing formats, survey response regards all answers to all questions by all participants, and question response is all the response to a single question. This question response is used to calculate the indicator, which discloses information regarding ESEA topics. Stakeholders are grouped based on common

characteristics and as such a survey can be targeted. Apart from survey participants and organisational stakeholders, there are tool administrators needed. All these key concepts are implemented for answering the next question.

2) *Can the meta-model and DSL rules, constructs and semantics describe all ESEA stakeholder survey methods?*:

The meta-model and DSL can express CGM, BIA and GRI for around 90 percent, if certification in ESEA is not taken into account. The last 10 percent is not reached, due to GRI offering post ESEA steps in their method, such as material assessment, stakeholder analysis and impact significance. Therefore we can conclude that the designed artefacts can cover the three methods for ESEA. In addition, this only implies for single respondent surveys, since all three methods have no multiple respondents surveys specified. Unfortunately, this expressiveness does not imply that the variability issue and more specifically the redundant presence of information in the ESEA domain is solved. Based on the content matching between the three investigated methods there were not many direct topic matches, although there were partly matches present. We did see information being clustered around the same ethical, social and environmental topics. Where the environmental cluster was strongest. To overall conclude the latest question is answered.

3) *What are the strengths and weaknesses of the ESEA stakeholder survey method interpreter?*: The biggest strength of the developed DSL and interpreter are the possibility to specify and interpret CGM, BIA and GRI almost completely, when excluding post and prior ESEA steps. This means that if the method is specified, organisations and accountants can use multiple ESEA method in one environment to disclose their sustainable accounting, by uploading the method specification file. In this sense stakeholder surveys are enrolled with one click, without having to perform many survey actions, such as defining questions, choosing a survey engine, sending out the survey, and administering the data for ESEA reports, since this is all done automatically. The inefficiencies in ESEA practises are therefore improved, since data preparation and presentation is automated by an interoperable and customisable tool. Also, comparability between reports can increase, since the report style, evaluation methodology and preparation of accounting results can be defined and shared. Therefore, we have implemented survey sections with closed answer formats, e.g. for CGM's open text formats. Overall, stakeholders opinions transparency, stakeholders awareness, stakeholders' feeling of involvement and influence, and stakeholder commitment to an organisation increases.

The biggest weakness of the ESEA stakeholder survey method interpreter is the absence of merging topics and survey question. Moreover, due to time constrains around 23 percent of the requirements is not implemented, e.g. the export of reports, a dump of all data for auditing purposes, data units and conversion of those, the send of survey reminders to participants, targeting a survey to multiple stakeholder groups, and a method specification marketplace where users can download specifications. Other short comings of the research

are presented in the limitations section [XI-A](#)

XI. DISCUSSION

A. Limitations

The biggest limitation, as explained in the section before, is that redundant ESEA and survey content between ESEA methods cannot be merged, since the content is not explicitly matching. In line with this, model management is also not implemented, e.g. the updating from one uploaded model to another, or the upload of malicious method specifications by tool users to show that they are performing well. Moreover, chances are missed to automate question answer types based on the question semantics. Based on the question constructions the tool could have predicted which answer type was needed, although this was not possible in the current time frame. Also, comparability between the definition of answer options by differing ESEA methods is lacking. If for example an ESEA method ask for a numerical input and the other offers options to represent number ranges, then this cannot be automatically compared. The survey support for bi-language is missing, so a survey can only be send in one language.

With regards to the DSL, the ESEA method specification is a time consuming process. We implemented a small section from GRI, CGM and BIA, as shown in Appendix [XII-U](#), [XII-S](#) and [XII-T](#), which requires a multitude of code lines, for example the names of direct and indirect indicators needed to be given, which are used only for traceability purposes. Moreover, instructions provided for surveys are based on one format, plain text, and misses titles for example. This also applies for descriptions in reports. Also, conditional questions can not be defined, if for example on one question yes is answered then an explain more question is presented. In addition, the distinction between aggregated and individual questions, and the requirement specification for certification and scoring purposes is not implemented in the DSL and interpreter. Another point is that certification level and requirement is not supported in the current version of openESEA.

In regards to openESEA the storage of question response needs to be done in order to display indicators when a page is loaded. This offers for data conflicts, if for example a response is present then this is not shown in the report. Also, for auditing purposes a data dump holding all data and responses is missing.

Regarding the validation, due to the corona pandemic, time constraints, and not mature enough tool stakeholders from practise are not well represented. Although, we did specify some role representatives, there could have been more interaction with the ESEA practise to get better validity.

Regarding these limitations please regard the next section on how to overcome these challenges in the future.

B. Future work

Hopefully and ideally, these efficiency benefits in ESEA inspires more organisations to become sustainable and take stakeholder awareness into account. Large corporations and organisations have a big impact on and can influence society

to become more aware of our ethical, social, and environmental impacts. In addition, we hope to have inspired other researcher with our work. Therefore, we see the following future challenges.

Firstly and most importantly, model management is interesting to incorporate in our proof of concepts. This will overcome data redundancy between multiple methods. For example, based on ontology matching, the semantic meaning of topics and indicators can be distinguished and both can be combined into one data point.

Secondly, access to the data for auditors is important. The eXtensible Business Reporting Language (XBRL) a global framework for exchanging business and accounting informations can be an interesting. By labeling the data in openESEA with the specified taxonomy, this will offer advantages for interoperability with other business data. Moreover, based on APIs an auditor can get access to the data. Data security is an important thing to consider.

Thirdly and regarding the prior limitations, the DSL currently requires Eclipse and Xtext to function. This can be overcome by implementing the DSL using an UI to let users specify each content class. This helps to overcome the time consuming process of defining redundant information. In addition to the DSL, certifications, requirements, scoring, aggregated questions, and explanation types should be incorporated for a more holistic ESEA approach. Regarding the surveys features, question logic and bi-language support should is interesting. Lastly, when a page is rendered the latest data should be presented.

Fourthly, Question target classification based on Natural Language processing is another thing to consider. The semantic meaning of a question when defined, and the starting word, e.g. who, what and when, can have implications on the answer data type chosen. If this is linked to a knowledge base, the inputs and therefore accuracy can increase. is one of the essential research topics in question answering

Fifthly, content scraping of existing ESEA methods can be interesting to incorporate during specification. Then based on labels, text fragments can selected representing for example a topic, description, indicator or question.

Lastly, when the openESEA tool is matured experiments and Technical Action Research is recommended to be performed. Variables under study are stakeholder perceptions, stakeholder goals and improvements to and economic gains due to the proposed solution.

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A. Process Deliverable Diagram Research Method

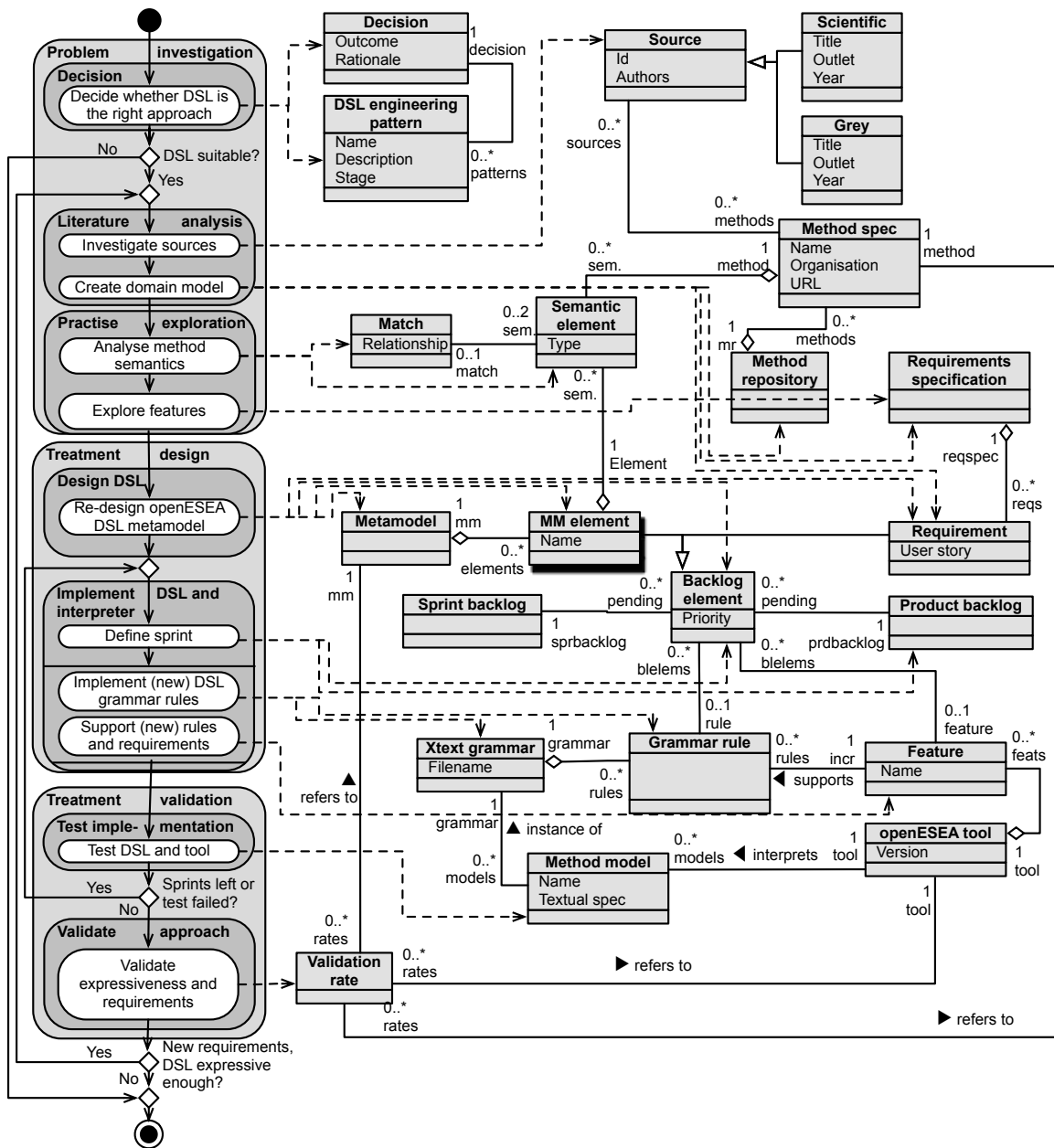


Figure 14. Process deliverable diagram, adapted from [2]

B. Conceptual model

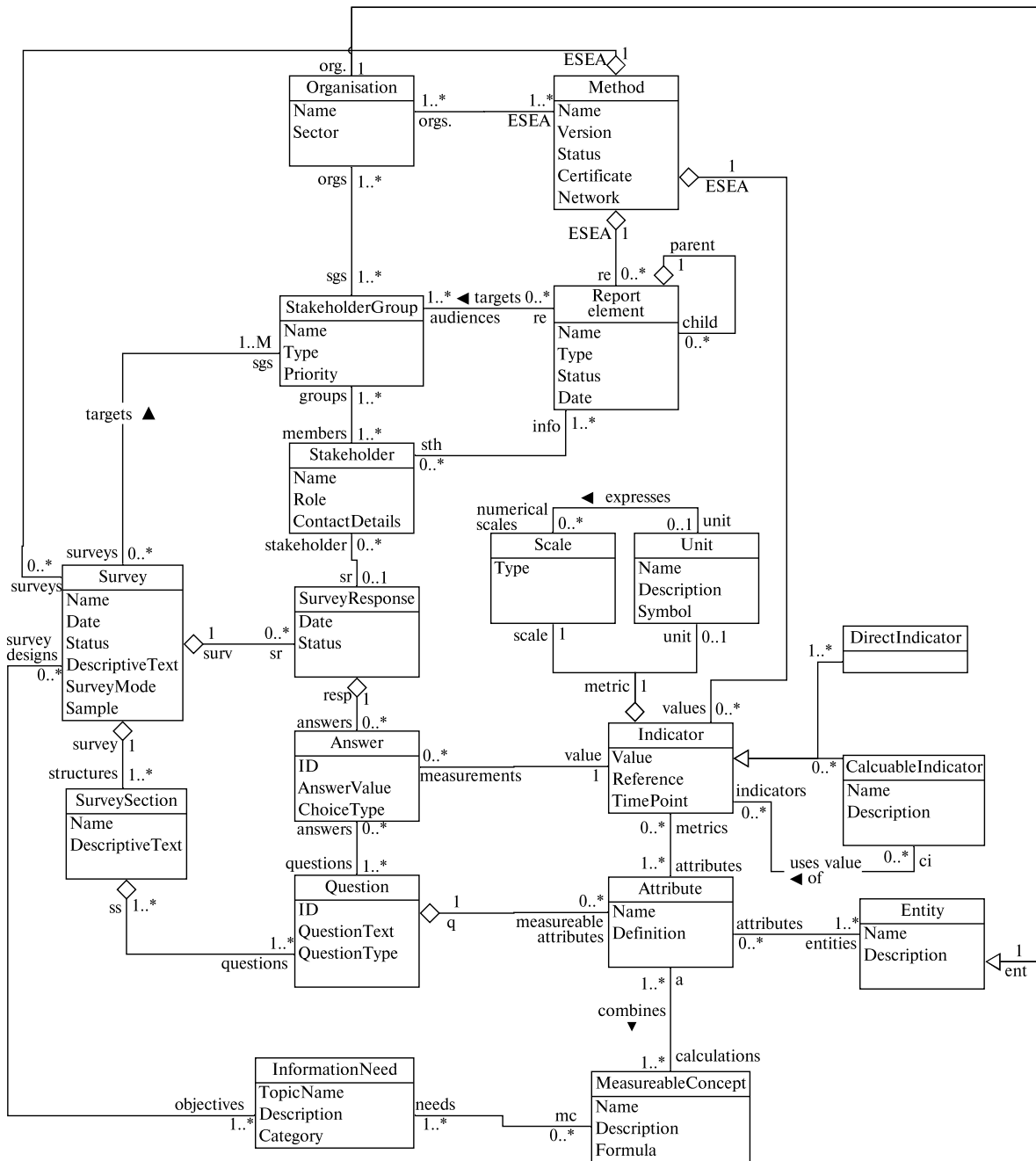


Figure 15. Conceptual model ESEA stakeholder survey domain

C. Process Deliverable Diagrams

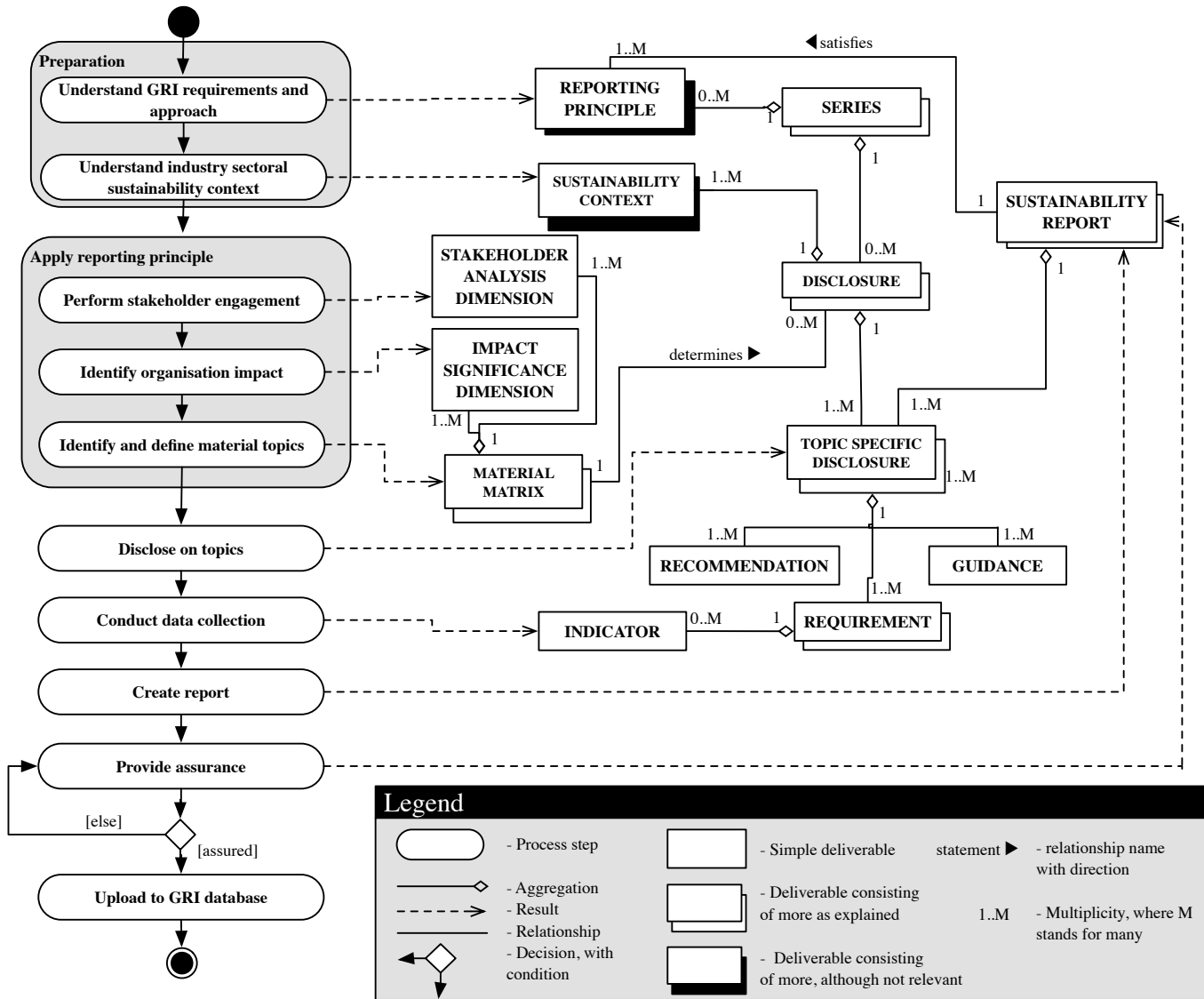


Figure 16. Process Deliverable Diagram Global Reporting Initiative

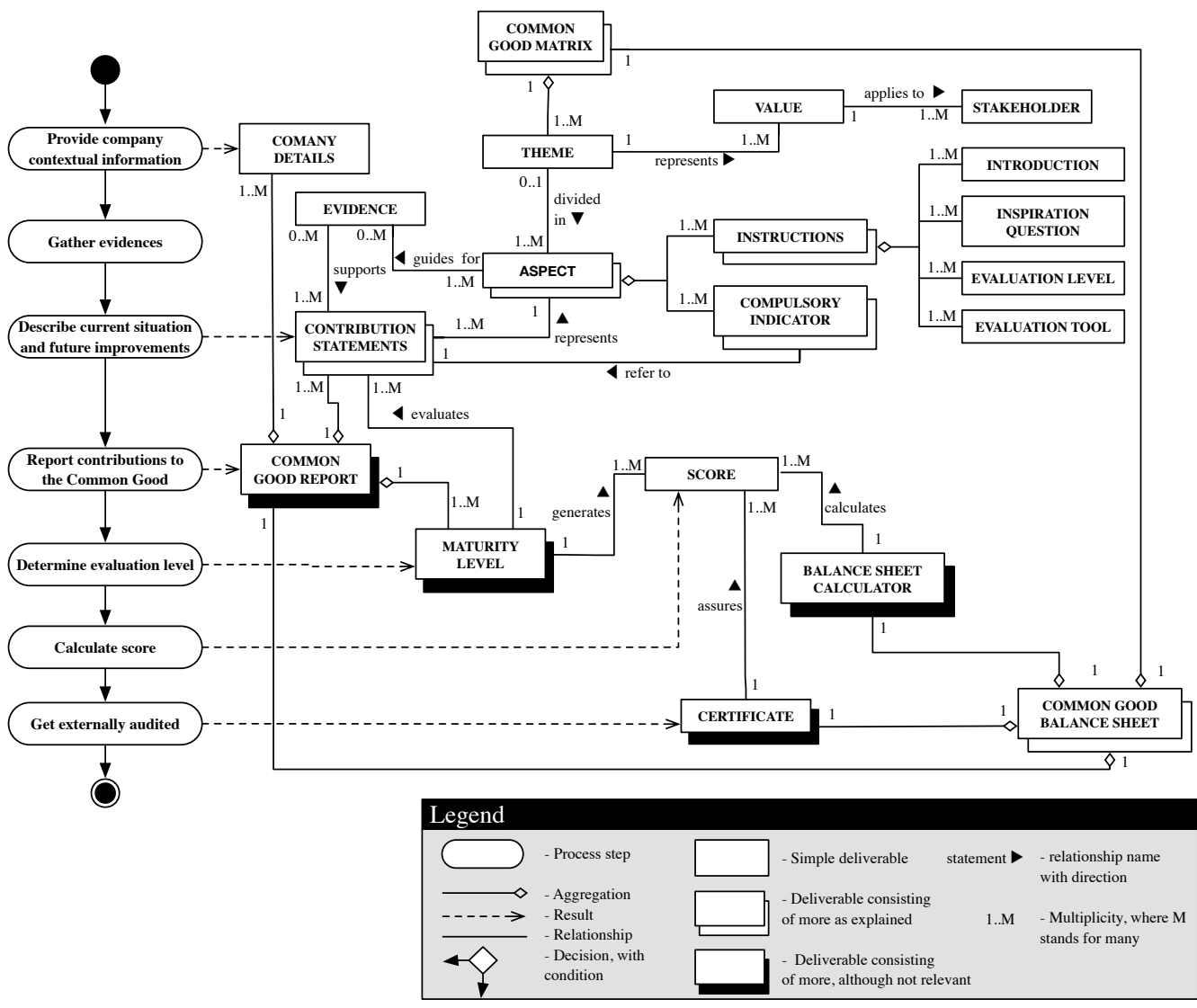


Figure 17. Process Deliverable Diagram Common Good Matrix

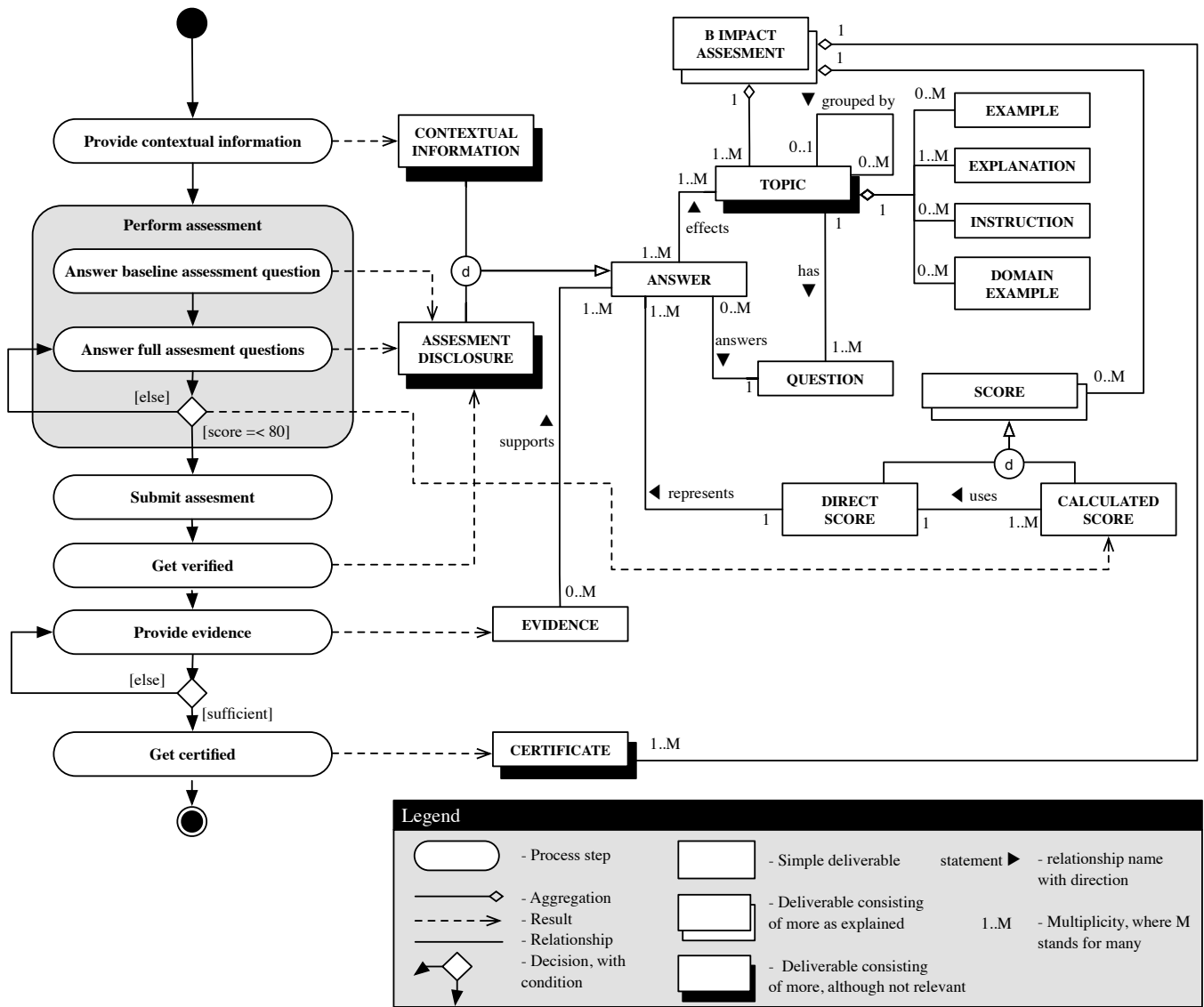


Figure 18. Process Deliverable Diagram B Impact Assessment

D. Impact topics B Impact Assessment

Impact Area	Impact Topic
Community	Civic Engagement & Giving
	Community Impact Area Introduction
	Designed to Give
	Diversity, Equity, & Inclusion
	Economic Impact
	Local Economic Development
	Microdistribution Poverty Alleviation
	Microfranchise Poverty Alleviation
	National Economic Development
	Producer Cooperative
	Supply Chain Management
	Supply Chain Poverty Alleviation
	Customers
Basic Services for the Underserved	
Customer Stewardship	
Customers Impact Area Introduction	
Economic Empowerment for the Underserved	
Education	
Educational Models and Engagement	
Financial Services Addendum	
Health & Wellness Improvement	
Higher Education/Education Services Addendum	
Impact Improvement	
Infrastructure/Market Access Building	
Serving in Need Populations (Outcomes)	
Serving in Need Populations (Quality and Continuous Improvement)	
Serving Underserved Populations (Direct)	
Serving Underserved Populations (Indirect)	
Support for Underserved/Purpose Driven Enterprises	
Disclosure Questionnaire	Disclosure Industries
	Disclosure Outcomes & Penalties
	Disclosure Practices
	Supply Chain Disclosure
Environment	Air & Climate
	Environment Impact Area Introduction
	Environmental Education & Information
	Environmental Management
	Environmentally Innovative Agricultural Process
	Environmentally Innovative Manufacturing Process
	Environmentally Innovative Wholesale Process
	Green Building Addendum
	Land & Life
	Land/wildlife Conservation
	Renewable or Cleaner-burning Energy
	Resource Conservation
	Toxin Reduction / Remediation
Water	
Governance	Ethics & Transparency
	Governance Metrics
	Mission & Engagement
	Mission Locked
Workers	Career Development
	Career Development (Hourly)
	Career Development (Salaried)
	Engagement & Satisfaction
	Engagement & Satisfaction (Hourly)
	Engagement & Satisfaction (Salaried)
	Financial Security
	Health, Wellness, & Safety
	Worker Ownership
	Workers Impact Area Introduction
Workforce Development	

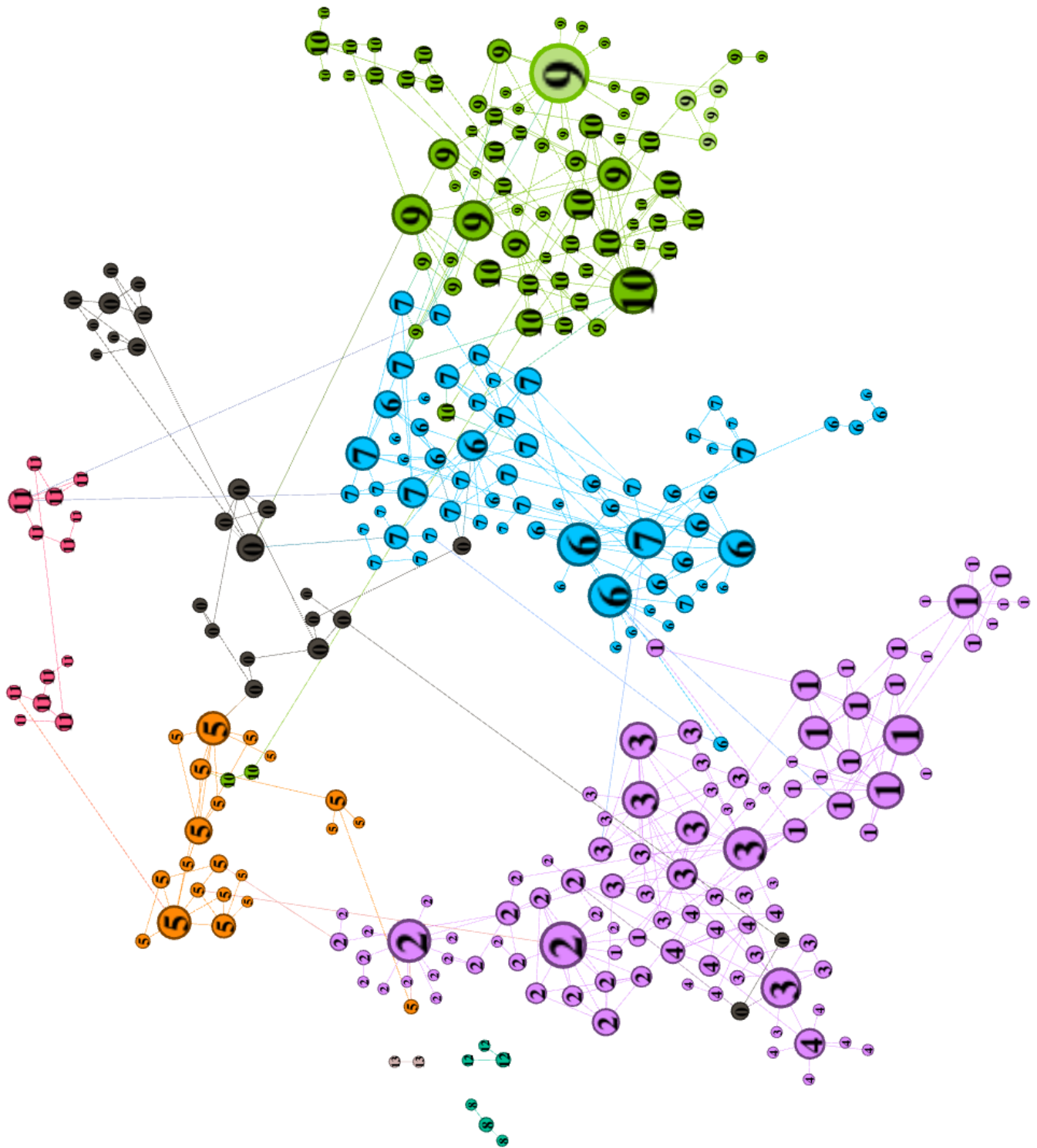


Figure 19. Modularity group and clustering

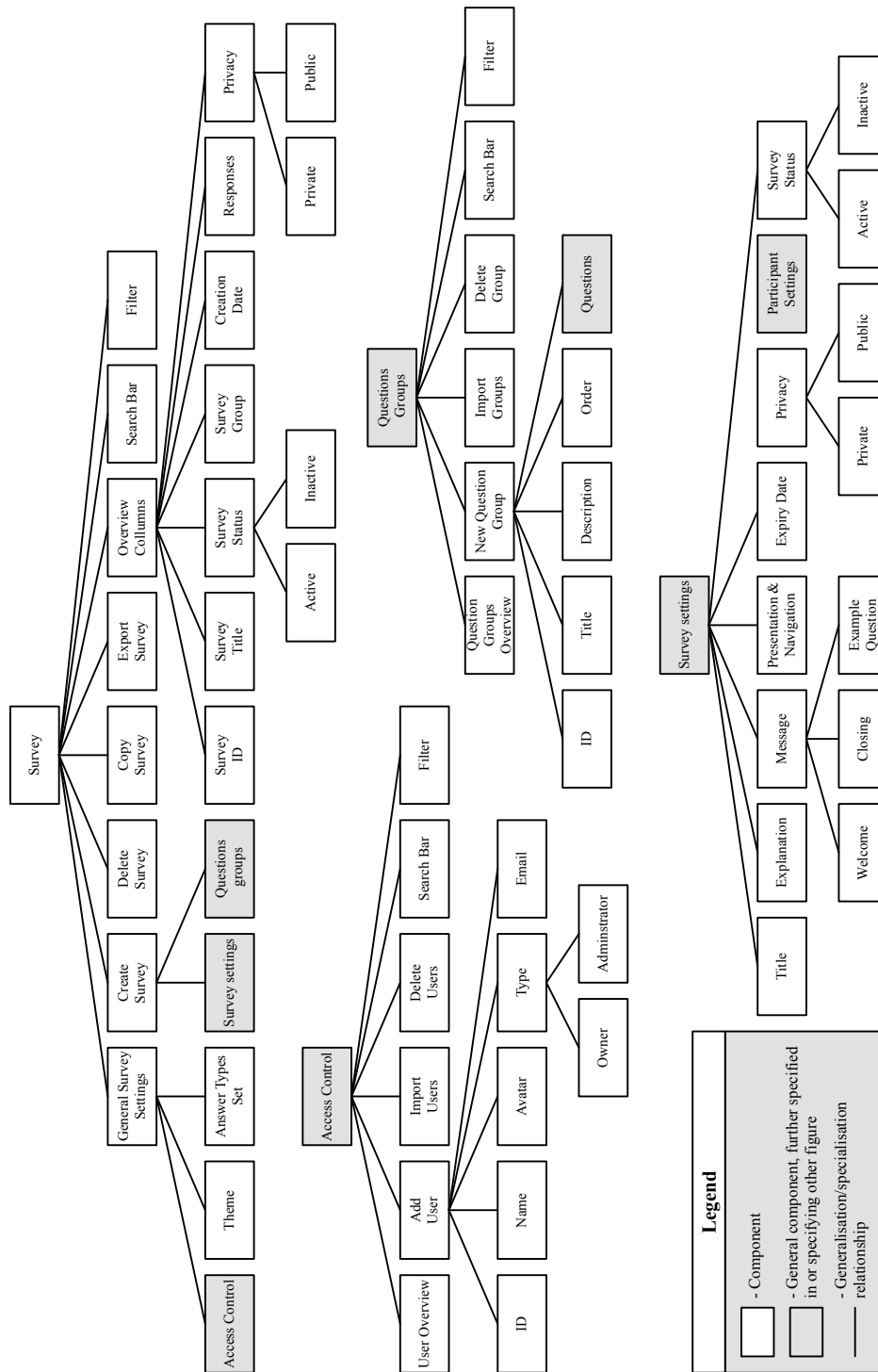


Figure 20. Caption

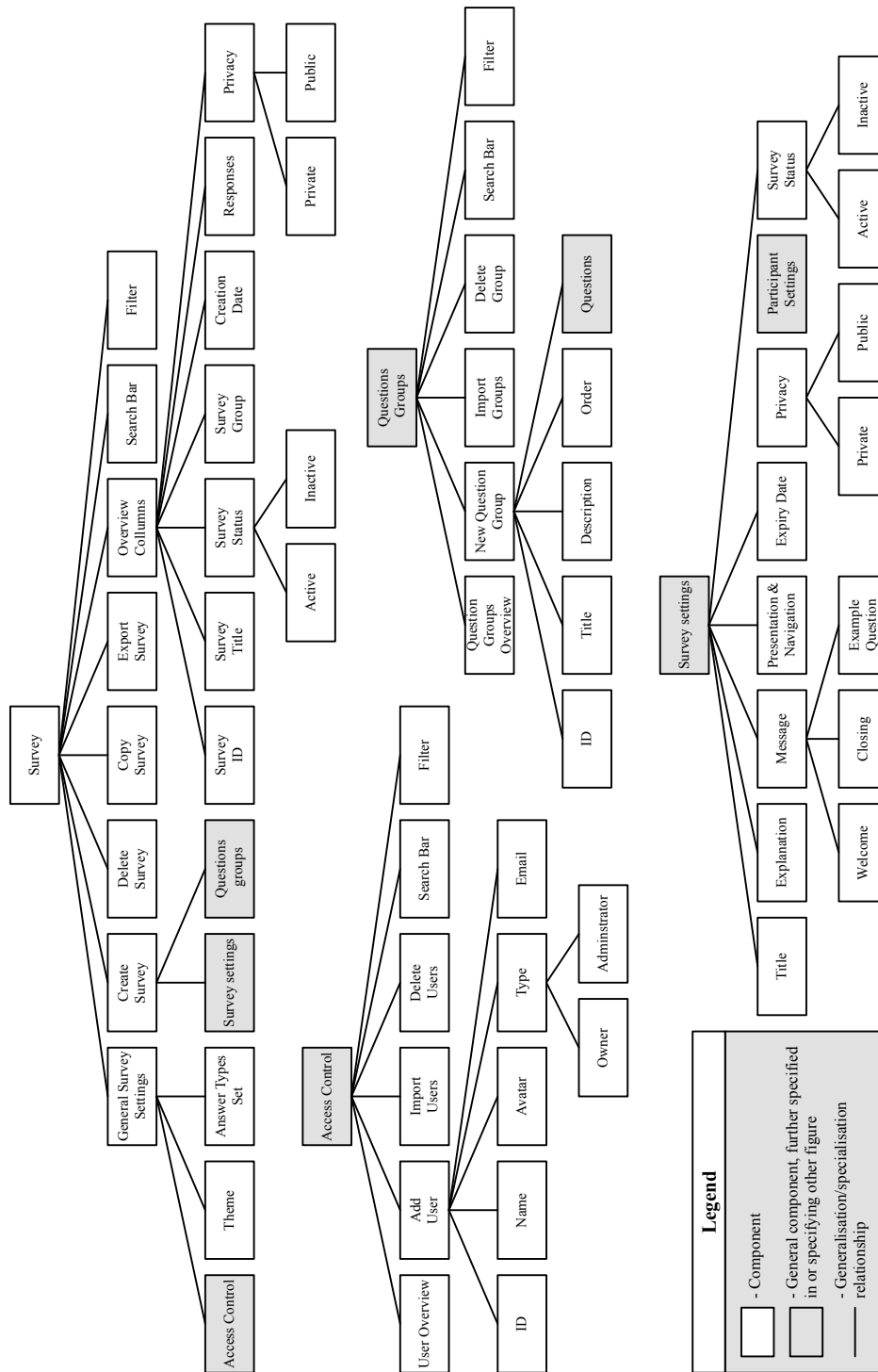


Figure 21. Component Diagram: Complete overview and specifications

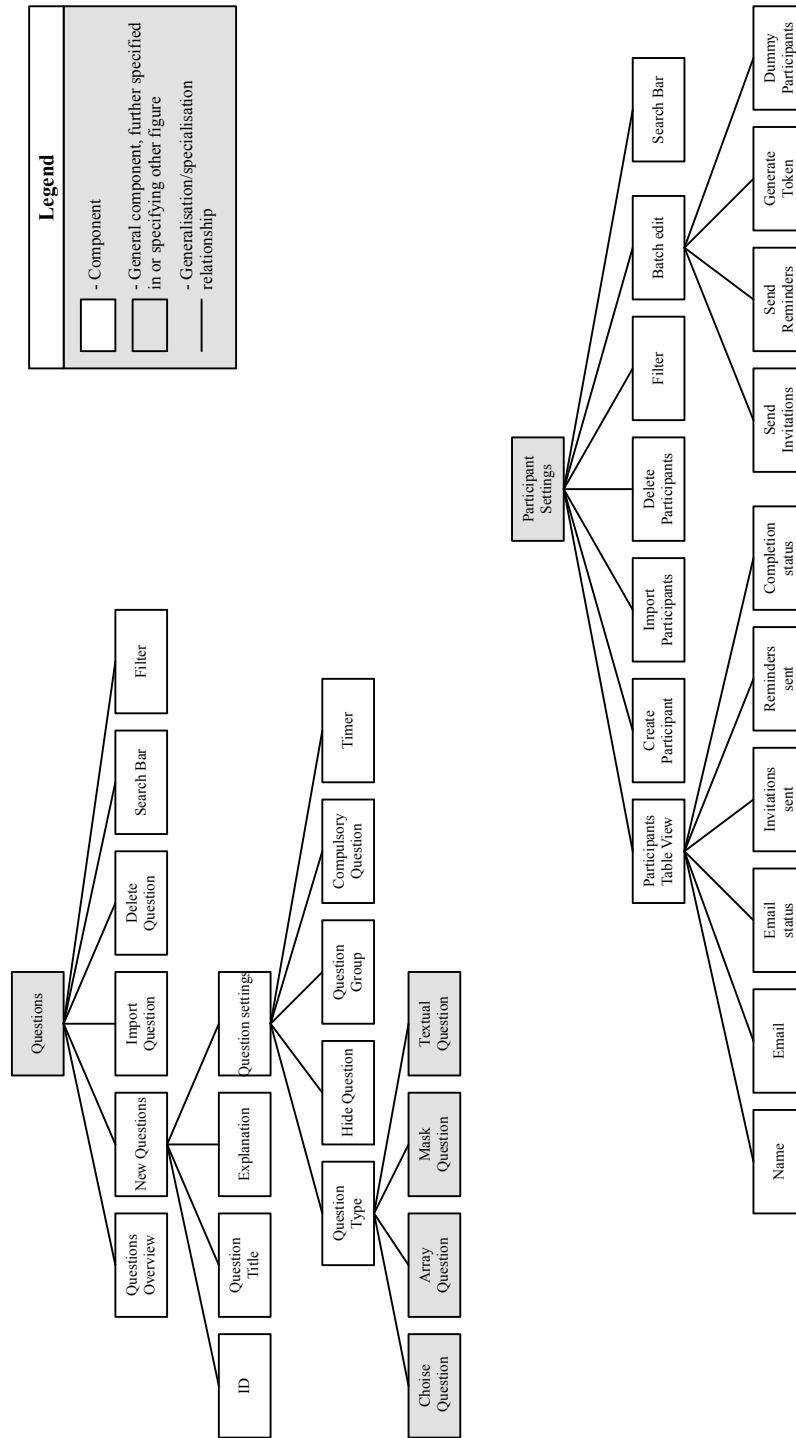


Figure 22. Component Diagram: Questions and Participant settings

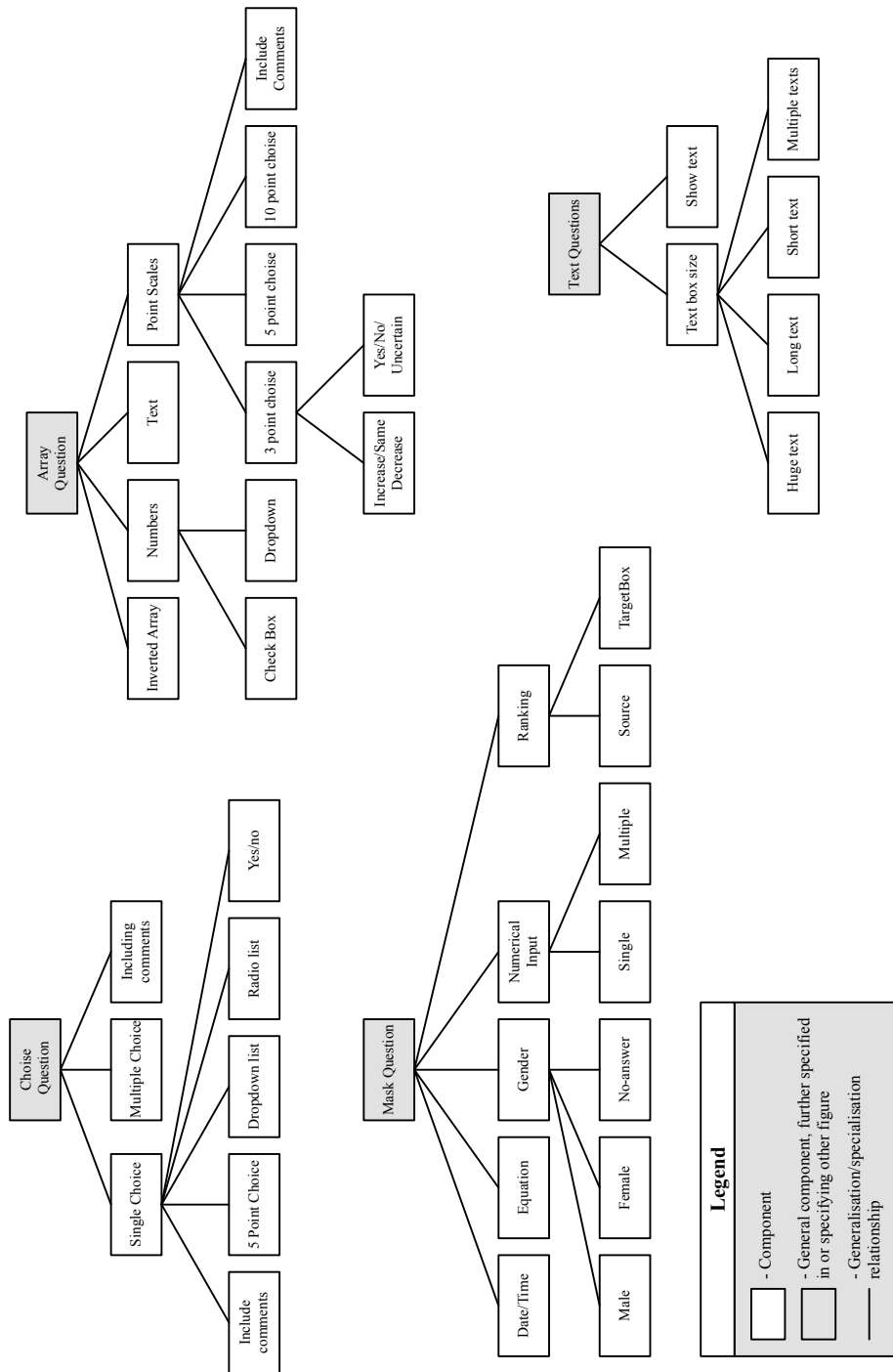


Figure 23. Component Diagram: Question types

H. Feature Diagram Limesurvey

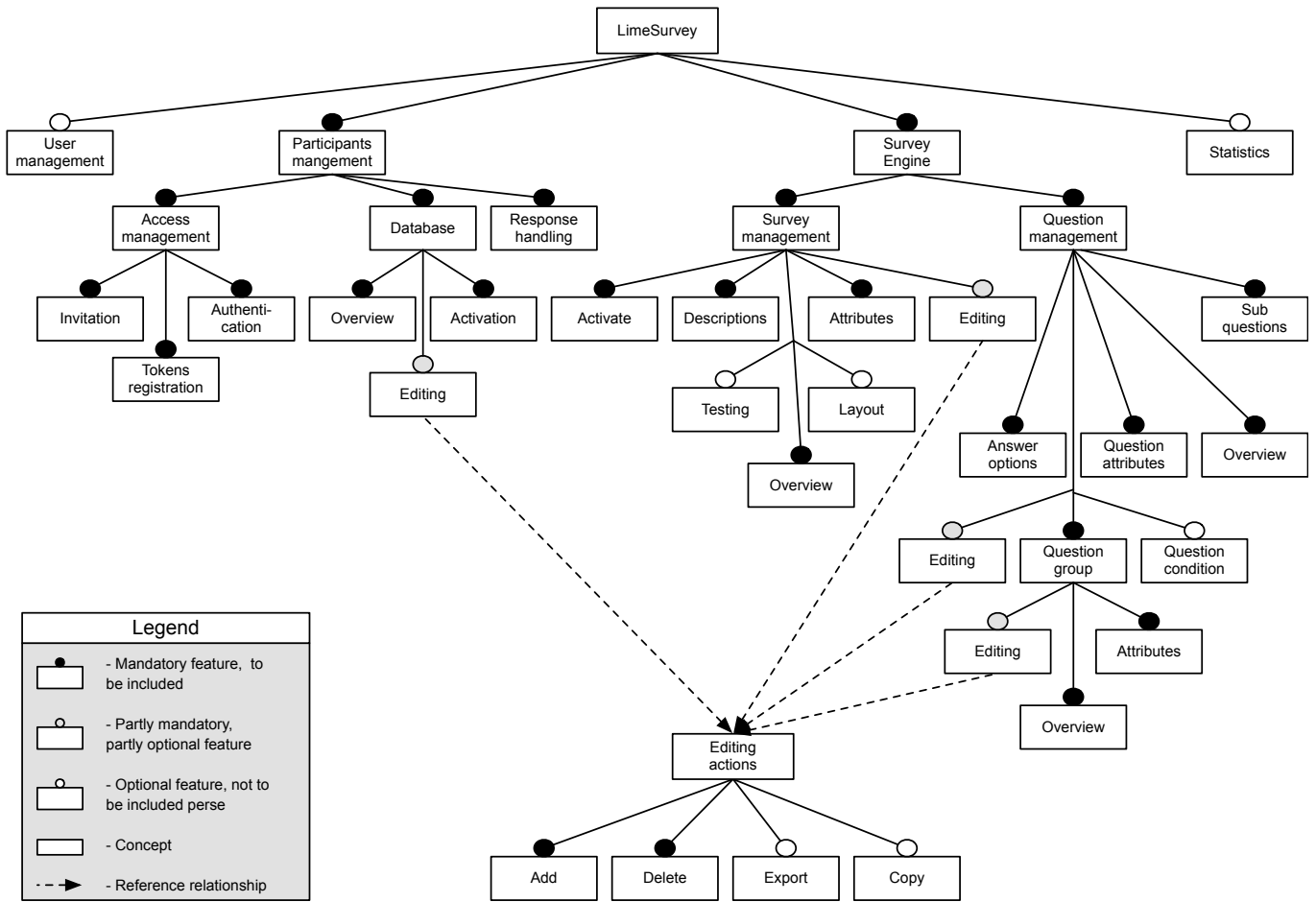


Figure 24. Feature Diagram Limesurvey

I. Closed question types

Table IX
CLOSED ANSWER TYPES, INCL CARDINALITY, USER INTERFACE AND ANSWER STATISTICS

AnswerDataType		answerCardinality		UIcomponent				Answer statistics					
		Single	Multiple	Field	Dropdown	Radio	Checkbox	Min	Max	Sum	Mean	Mode	Median
SingleInput	date	x		x				x	x			x	
	number	x		x				x	x	x	x	x	x
	textHuge	x		x						x			
	textLong	x		x						x			
	textShort	x		x						x			
EnumInput	enumYesNo	x			x	x						x	
	enumFivePoint	x			x	x						x	
	enumGender	x			x	x						x	
EnumUserDefined	enumUserDefined	x			x	x						x	
			x				x					x	

J. Report User stories

- US-R-1:* As a Network, Organisation or Accountant I want to have an overview of all disclosed reports, so I can benchmark and guide improvements.
- US-R-2:* As an Organisation or Accountant I want to export reports, so I can disclose my findings with a set template.
- US-R-3:* As an Auditor I want to have access to all data underpinning reports, so I can audit if the data provided by organisations is valid.
- US-R-4:* As an Organisation or Accountant I want to summarise data points in indicators, so I can represent my information in a compact manner and benchmarking is possible.
- US-R-5:* As an Organisation or Accountant I want the indicators to be populated with the latest question response, so I can report on those.
- US-R-6:* As an Organisation or Accountant I want to have direct indicators linked with questions, so I can have answer to the question as data population for the direct indicator
- US-R-7:* As an Organisation or Accountant I want to have my reports intertwining information with indicators and descriptions , so I can share this without having to provide those.
- US-R-8:* As an Organisation or Accountant I want to have indicators linked with topics, so the indicators are grouped based on common characteristics.
- US-R-9:* As an Organisation or Accountant I want to have data units present for indirect and direct indicators, so I there is context about the required information.
- US-R-10:* As a Network, Organisation or Accountant I want to have the conversion of one unit to another done automatically, so indirect indicators are populated with the right data.
- US-R-11:* As a Network, Organisation or Accountant I want to have topics merged when they are overlapping, so I can overcome data redundancy when I disclose for multiple ESEA methods.

K. Survey User stories

- US-S-1:* As an Organisation or Accountant I want to have different actions available per survey status, so I can know what action can be performed, which are kept to a minimum. For example, change survey statuses so I can test, activate or expire implemented surveys
- US-S-2:* As an Organisation or Accountant I want to have overview of responses to my survey and to all individual question, so I can conclude if these are valid and what that means.
- US-S-3:* As an Organisation or Accountant I want to automate participant communication, so I can send invites and receive responses automatically.
- US-S-4:* As an Organisation or Accountant I want to send out reminders to respondents, so I can get a higher response rate on my surveys.
- US-S-5:* As a Network, Organisation or Accountant I want to have a minimum survey response rate, so I know when the threshold of number of participants for a valid survey is reached.
- US-S-6:* As a Network, Organisation or Accountant I want to target a group of respondents, so I can send my survey to all participants with the same characteristics.
- US-S-7:* As a Survey participant I want to my survey response to be anonymous, so I can provide a truth-full response.
- US-S-8:* As a Network, Organisation, Accountant or Method designer I want to limit question response to predefined formats, so I can perform analysis on the data gathered.
- US-S-9:* As a Survey participant I want to have differing answer types presented to me, so I can save time responding.
- US-S-10:* As a Survey participant I want to have surveys intertwined with information and questions, so I can get contextual information with questions.

L. Stakeholder User stories

- US-STH-1:* As a Root administrator, Network, or Organisation I want to perform stakeholder management, so I can define, import and delete admins,users and respondents
- US-STH-2:* As a Network or Organisation I want to define stakeholder groups, so I can cluster stakeholders to perform management on and can target one or multiple response surveys.
- US-STH-3:* As a Survey participant, I want to be part of multiple stakeholder groups, so I can respond to surveys targeted to me based on my contact details

M. DSL User stories

- US-DSL-1:* As a Method designer I want to use arithmetic, statistical, and functional operators for indirect indicator formulas, so I can specify indirect indicators calculation, the treatment of question responses, and requirements for certifications.
- US-DSL-2:* As a Method designer I want to automatically generate method specification files, so I can know the DSL specification can be interpreted in openESEA.
- US-DSL-3:* As a Method designer I want to validate my method specification, so I can know that the openESEA tool will work and be used correctly.
- US-DSL-4:* As a Network, Organisation or Accountant I want to browse by others defined method specification files, so I can use more ESEA methods.
- US-DSL-5:* As a Method engineer I want to define topic structures with unlimited granularity, so I can recreate ESEA methods topic taxonomies
- US-DSL-6:* As a Method engineer I want to provide a survey description, so I can inform others who use the survey
- US-DSL-7:* As a Method engineer I want to provide messages with surveys, so I can welcome and thank participants for answering to questions.
- US-DSL-8:* As a Method engineer I want to define answer types and cardinality, so I have the corresponding UI question component to select from presented to me.
- US-DSL-9:* As a Method engineer I want to cluster questions per section, so I can group questions and link them all with a topic at once.
- US-DSL-10:* As a Network, Organisation or Accountant I want to define questions apart from ESEA method specifications, so I can ask for more information.
- US-DSL-11:* As a Method engineer I want to define an ESEA method in chronological order, so I am guided which specification needs to be done first for others to work.
- US-DSL-12:* As a Method engineer I want to be informed when I define conflicting data unit types, so indirect indicators calculation is done correctly.
- US-DSL-13:* As a Method engineer I want to be informed when an indicator is defined without a question, so I can know that this data is not provided.
- US-DSL-14:* As a Method engineer I want to be informed when ids are overlapping, so I can know that there will be no conflicts.
- US-DSL-15:* As a Method engineer I want to be informed if a statistical test cannot be used at a specific question type, e.g. not the average of plain text, so I can ensure faultless compilation.

N. Delta analysis

Type	Final element	Operator	Initial element
Class	Organisation	=	Organisation
Attribute	Organisation.Id	=	Organisation.Id
Attribute	Organisation.Name	=	Organisation.Name
Attribute	Organisation.Avatar	=	Organisation.Avatar
Attribute	Organisation.IsPublic	=	Organisation.IsPublic
Association	Organisation.org.users	=	Organisation.org.users
Association	Organisation.orgs.netws	=	Organisation.orgs.netws
Association	Organisation.org.seaaccounts	=	Organisation.org.seaaccounts
Class	Network	=	Network
Attribute	Network.Id	=	Network.Id
Attribute	Network.Name	=	Network.Name
Attribute	Network.Avatar	=	Network.Avatar
Attribute	Network.IsPublic	=	Network.IsPublic
Association	Network.netws.users	=	Network.netws.users
Association	Network.networks.method	=	Network.networks.method
Class	Stakeholder group	+	
Attribute	Stakeholder group.Id	+	
Attribute	Stakeholder group.Name	+	
Attribute	Stakeholder group.Access	+	
Association	Stakeholder group.stg.sth	+	
Association	Stakeholder group.target.survs	+	
Class	ESEA account	~	SEA account
Attribute	ESEA account.Id	=	SEA account.Id
Attribute	ESEA account.Year	=	SEA account.Year
Association	ESEA account.org.method	=	SEA account.org.method
Association	ESEA account.account.data	=	SEA account.account.data
Class	Stakeholder	~	User
Attribute	Stakeholder.Id	=	User.Id
Attribute	Stakeholder.Name	=	User.Name
Attribute	Stakeholder.Avatar	=	User.Avatar
Attribute	Stakeholder.Email	=	User.Email
Association	Stakeholder.respondents.sr	+	
Class	ESEA Method	~	SEA Method
Attribute	ESEA Method.Name	=	SEA Method.Name
Attribute	ESEA Method.Version	=	SEA Method.Version
Attribute	ESEA Method.Description	=	SEA Method.Description
Attribute	ESEA Method.Status	+	
Association	ESEA Method.method.survs	+	
Association	ESEA Method.method.topics	~	ESEA Method.method.categories
Association	ESEA Method.method.levels	=	SEA Method.method.levels
Association	ESEA Method.method.indicators	=	SEA Method.method.indicators
Class	Surveys	+	
Attribute	Surveys.Id	+	
Attribute	Surveys.Name	+	
Attribute	Surveys.Description	+	
Attribute	Surveys.WelcomeTxt	+	
Attribute	Surveys.ClosingTxt	+	
Attribute	Surveys.Deadline	+	
Attribute	Surveys.minRespRate	+	
Attribute	Surveys.targetGroup	+	
Association	Surveys.surv.srs	+	
Association	Surveys.surv.sects	+	
Class	Certification level	=	Certification level
Attribute	Certification level.Name	=	Certification level.Name
Attribute	Certification level.Description	=	Certification level.Description
Attribute	Certification level.Colour	=	Certification level.Colour
Association	Certification level.Level	=	Certification level.Level
Association	Certification level.levels.reqs	~	Certification level.levels.requirements
Class	Topic	~	Category
Attribute	Topic.Id	+	
Attribute	Topic.Name	=	Category.Name
Attribute	Topic.Description	=	Category.Description
Association	Topic.topics.category	+	
Association	Topic.topics.indicators	~	Category.category.indicators
Association	Topic.topics.sects	+	
Class	Section	+	

Type	Final element	Operator	Initial element
Attribute	Section.Id	+	
Association	Section.sect.qs	+	
Association	Section.sect.instr	+	
Class	Indicator	=	Indicator
Attribute	Indicator.Id	=	Indicator.Id
Attribute	Indicator.Name	=	Indicator.Name
Attribute	Indicator.Description	=	Indicator.Description
Attribute	Indicator.preUnit	+	
Attribute	Indicator.postUnit	+	
Attribute		-	Indicator.Type
Association	Indicator.indicator.formulas	+	
Specialisation	Indicator.Direct indicator	+	
Specialisation	Indicator.Indirect indicator	+	
Class	Direct indicator	~	Metric
Attribute		-	Metric.Id
Attribute		-	Metric.Name
Attribute	Direct indicator.Help	=	Metric.Help
Attribute	Direct indicator.Unit	~	Metric.Type
Association	Direct indicator.di.Q	+	
Class	Indirect indicator	+	
Attribute	Indirect indicator.Formula	~	Indicator.Formula
Attribute	Indirect indicator.Unit	~	
Class	Answer option	+	
Attribute	Answer option.Id	+	
Attribute	Answer option.Order	+	
Attribute	Answer option.Text	+	
Association	Answer option.options.Q	+	
Class	Question	+	
Attribute	Question.Id	+	
Attribute	Question.Order	+	
Attribute	Question.Name	+	
Attribute	Question.Help	+	
Attribute	Question.isMandatory	+	
Attribute	Question.otherOption	+	
Attribute	Question.answerCardinality	+	
Attribute	Question.answerDataType	+	
Attribute	Question.Uicomponent	+	
Specialisation	Question.Aggregated question	+	
Specialisation	Question.Individual question	+	
Class	Aggregated question	+	
Association	Aggregated question.aq.iqs	+	
Class	Individual question	+	
Association	Individual questionqs.qr	+	
Class	Text fragment	+	
Attribute	Text fragment.Id	+	
Attribute	Text fragment.Order	+	
Attribute	Text fragment.Text	+	
Class	Survey response	+	
Attribute	Survey response.TokenId	+	
Attribute	Survey response.Date	+	
Association	Survey response.sr.answers	+	
Class	Question response	~	Data
Association	Question response.Value	~	Data.Value
Class		-	Report item
Attribute		-	Report item.Title
Attribute		-	Report item.Width
Attribute		-	Report item.Chart
Association		-	Report item.reportItems.method
Association		-	Report item.regularItems.value
Association		-	Report item.chartItems.data
Class		-	Requirement
Attribute		-	Requirement.Operator
Attribute		-	Requirement.Value
Association		-	Requirement.requirements.level
Association		-	Requirement.requirements.indicator

O. DSL ESEA domain

```
1 grammar org.xtext.example.eseadsl.ESEADsl with org.eclipse.xtext.common.Terminals
2
3 generate eSEADsl "http://www.xtext.org/example/eseadsl/ESEADsl"
4
5
6 Topic:
7   'newTopic:'
8   'id:' name=ID
9   'title:' title=STRING
10  ('superTopic:' superType=[Topic])?
11  ('description:' description=STRING)?
12  (indicator+=Indicator)*
13  (survey+=Survey)*
14  (back+=Topic)?
15  ;
16
17 Indicator:
18   'newIndicator:'
19   'id:' name=ID
20   ('name:' title=STRING)?
21   ('description:' description=STRING)?
22   'topic:' linkTopic=[Topic] // automate
23   'Unit:' unit+=UNIT
24   'indicatorType:' indicatorType= IndicatorType
25  ;
26
27 IndicatorType:
28   directindicator=DirectIndicator | indirectindicator=IndirectIndicator
29  ;
30
31 DirectIndicator:
32   directindicator='directindicator'
33   ('help:' description=STRING)?
34  ;
35
36 IndirectIndicator:
37   indirectindicator='indirectindicator'
38   ('formula:' (formula+=Formula)*)
39  ;
40
41 Formula:
42   operator=OPERATOR | indicatorhandler = IndicatorHandler | number=INT
43  ;
44
45 IndicatorHandler:
46   statistic=STATISTICS
47   '('
48   superIndicator=[Indicator]
49   ')'
50  ;
51
52 Survey:
53   'newSurvey:'
54   'id:' name=ID
55   'title:' title=STRING
56   ('description:' description=STRING)?
57   'minResponseRate:' rate=Rate
58   ('welcomeText:' welcometxt=STRING)?
59   ('closingText:' closetxt=STRING)?
60   section+=Section+
61  ;
62
63 Rate:
64   (one='1') | (zero='0' poin='.' decimal=FULLNUM)
65  ;
66
67 Section:
68   'newSection:'
69   'topic:' linkTopic=[Topic]
70   question+=Question+
71  ;
```



```

72
73 /*
74 *** single choice & single set answer
75 If answerType = textHuge, textLong, textShort,number,instruction,date,gender,yesno
76 {don't show options, nor subQs)
77
78 ** single choice & single custom answer
79 If answerType = radio, 5pointScale, dropdown, ranking
80 {display options}
81
82 single choice & multiple answers thus sub questions
83 if answerType = MultipleChoice
84 {display subQs}
85
86 multiple questions & single set answers
87 If answerType = 5pointArray yesno increaseDecrease text number
88 Display subQs
89 Display setOptions
90
91 Multiple questions & multiple custom answers
92 If answerType = customArray
93 Display custom options + custom subqs
94 */
95
96
97
98 Question:
99   ('newQuestion:'
100    'id:' name=ID
101    'question:' qtitle=STRING
102    ('help:' qdescription=STRING)?
103    'mandatory:' mandatory=YESNO
104    ('referenceTo:' linkIndicator=[Indicator])?
105    'answerDataType:' answertype=Answertype )
106    |
107    ('newInstruction:'
108     'id:' name=ID
109     'instruction:' instruction=STRING)
110    ;
111
112 //We distinguis 2 answer data types; single input and enumInputs, whereas the user can define their own
113 //The structure below forces a user for the answer cardinality and UIcomponent suiting with the answer data
114 //type.
115 Answertype:
116   singleinput=SingleInput | enuminput=EnumInput | enumuserdef = EnumUserDefined
117 ;
118
119
120 // in order for answerCardinality and UIcomponent to show an enum is made in capital letters
121 SingleInput:
122   sinput=SINPUT
123   'answerCardinality:' cardinality='single'
124   'UIcomponent:' uicomponent='field'
125 ;
126
127 EnumInput:
128   enuminput=EINPUT
129   'answerCardinality:' cardinality='single'
130   'UIcomponent:' radio='radio'
131 ;
132
133 EnumUserDefined:
134   enumuserdef='enumUserDefined'
135   // if a user selects one choice then singeCardinality if a user wants multiple choice, then
136   // multiplecardinality
137   'answerCardinality:' (singlecardinality=SingleCardinality | multiplecardinality=MultipleCardinality)
138   'othersOption:' others=YESNO
139 ;
140
141 SingleCardinality:
142   'single'

```

```

143 'UIcomponent:' uisinglecomponent=UISINGLE
144 'options:' (option+=STRING (',' option+=STRING)*)
145 ;
146
147
148 MultipleCardinality:
149 'multiple'
150 'UIcomponent:' checkbox='checkbox'
151 'options:' (subq+=STRING (',' subq+=STRING)*) // since every answer responds to a sub questio of the main
    , the options are written as subquestions
152 ;
153
154 enum STATISTICS: min='minimum' | max='maximum' | sum='sum' | mean='mean' | mode='mode' | median='median';
155 enum UISINGLE: dropdown='dropdown' | radio='radio';
156 enum YESNO: Y='yes' | N='no';
157 enum FULLNUM: zero='0' | one='1' | two='2' | three='3' | four='4' | five='5' | six='6' | seven='7' | aight
    ='8' | nine='9';
158 enum UNIT: text='text' | number='number' | percentage='percentage' | date='date';
159 enum OPERATOR: nothing = ' ' |multiply='*' | divide='/' | add = '+' | subtract = '-' | openBracket = '(' |
    closingBracket = ')';
160 enum EINPUT: enumyesno='enumYesNo' | enumfivepoint = 'enumFivePoint' | enumgender = 'enumGender';
161 enum SINPUT: date='date' | number='number' | textHuge='textHuge' | textLong='textLong' | textShort='
    textShort';
162 //enum OPERATOR_REQ: greater='>' | greaterEqual=">=" | smaller="<" | smallerEqual="<=" | equal="==" ;

```

P. YAML file generator

```
1 package org.xtext.example.eseadsl.generator
2
3
4 import org.eclipse.emf.ecore.resource.Resource
5 import org.eclipse.xtext.generator.AbstractGenerator
6 import org.eclipse.xtext.generator.IFileSystemAccess2
7 import org.eclipse.xtext.generator.IGeneratorContext
8 import org.xtext.example.eseadsl.eSEADsl.Topic
9 import org.xtext.example.eseadsl.eSEADsl.Indicator
10 import org.xtext.example.eseadsl.eSEADsl.Question
11 import org.xtext.example.eseadsl.eSEADsl.Survey
12 import org.xtext.example.eseadsl.eSEADsl.Section
13 import org.xtext.example.eseadsl.eSEADsl.Formula
14
15
16 class ESEADslGenerator extends AbstractGenerator {
17
18     override void doGenerate(Resource resource, IFileSystemAccess2 fsa, IGeneratorContext context) {
19         fsa.generateFile("model.yaml", '''
20             <<TopicGenerator(resource)>>
21             <<IndicatorGenerator(resource)>>
22             <<SurveyGenerator(resource)>>'''
23     }
24
25     def TopicGenerator(Resource resource)
26     {
27         var txt = 'topics: '
28         return txt = txt + '''
29             <<FOR topic : resource.allContents.filter(Topic).toIterable>>
30
31             <<topic.name>>:
32                 name: >-
33                     <<topic.title>>
34                     <<IF (topic.description != null)>>
35                     description: >-
36                         <<topic.description>><<ENDIF>>
37                     <<IF (topic.superType != null)>>
38                     topic: <<topic.superType.name>><<ENDIF>><<ENDFOR>>'''
39     }
40
41     def IndicatorGenerator(Resource resource)
42     {
43         if (Indicator.name == null) {
44             return ''
45         }
46         var txt = 'indicators: '
47         return txt = txt + '''
48             <<FOR indicator : resource.allContents.filter(Indicator).toIterable>>
49
50             <<indicator.name>>:
51                 <<IF (indicator.name != null)>>
52                 name: >-
53                     <<indicator.title>><<ENDIF>>
54                 <<IF (indicator.description != null)>>
55                 description: >-
56                     <<indicator.description>><<ENDIF>>
57                 topic: <<indicator.linkTopic.name>>
58                 unit: <<FOR i: indicator.unit>><<i.getName>><<ENDFOR>>
59                 <<IF (indicator.indicatorType.directIndicator != null)>>
60                 type: <<indicator.indicatorType.directIndicator.directIndicator>>
61                 <<IF (indicator.indicatorType.directIndicator.description != null)>>
62                 help: <<indicator.indicatorType.directIndicator.description>><<ENDIF>><<ENDIF>>
63                 <<IF (indicator.indicatorType.indirectIndicator != null)>>
64                 type: <<indicator.indicatorType.indirectIndicator.indirectIndicator>>
65                 formula: <<FOR f: indicator.indicatorType.indirectIndicator.formula>><<FormulaCalculator(f).join
66                 >><<ENDFOR>>
67                 formulameta: <<FOR fm: indicator.indicatorType.indirectIndicator.formula>>
68                 <<IF (fm.indicatorHandler != null)>> <<fm.indicatorHandler.superIndicator.name>>:
69                     statistic: <<fm.indicatorHandler.statistic>>
70                     name: <<fm.indicatorHandler.statistic>>~<<fm.indicatorHandler.superIndicator.name>><<ENDIF
71                 >><<ENDFOR>><<ENDIF>><<ENDFOR>>'''

```

```

70 }
71
72 def SurveyGenerator(Resource resource)
73 {
74   var txt = 'surveys: '
75   return txt = txt + '''
76   <<FOR surv : resource.allContents.filter(Survey).toIterable>>
77
78     <<surv.name>>:
79     name: <<surv.title>>
80     <<IF (surv.description != null)>>
81     description: >-
82       <<surv.description>><<ENDIF>>
83     <<IF (surv.welcometxt != null)>>
84     welcometxt: <<surv.welcometxt>><<ENDIF>>
85     <<IF (surv.welcometxt != null)>>
86     closingtext: <<surv.welcometxt>><<ENDIF>>
87     <<IF (surv.rate.zero === null)>>
88     responserate: 1<<ENDIF>>
89     <<IF (surv.rate.one === null)>>
90     responserate: 0.<<surv.rate.decimal>><<ENDIF>>
91     questions: <<SectionGenerator(surv)>><<ENDFOR>>'''
92 }
93
94 def SectionGenerator(Survey surv)
95 {
96   var counter = 1;
97   var txt = ''
98   return txt = txt + '''
99
100   <<FOR section : surv.eAllContents.filter(Section).toIterable>>
101   <<FOR question : section.eAllContents.filter(Question).toIterable>>
102   <<IF(question.instruction === null)>> <<question.name>>:
103     name: >-
104       <<question.qtitle>>
105     order: <<counter++>>
106     <<IF (question.qdescription != null)>>
107     description: >-
108       <<question.qdescription>><<ENDIF>>
109     <<IF (question.linkIndicator != null)>>
110     indicator: <<question.linkIndicator.name>><<ENDIF>>
111     topic: <<section.linkTopic.name>>
112     ismandatory: <<question.mandatory.getName>>
113     <<IF (question.answertype.singleinput != null)>>
114     answertype: <<question.answertype.singleinput.sinput>>
115     others: N<<ENDIF>>
116     <<IF (question.answertype.enuminput != null)>>
117     answertype: <<question.answertype.enuminput.enuminput>>
118     others: N<<ENDIF>>
119     <<IF (question.answertype.enumuserdef != null)>>
120     <<IF (question.answertype.enumuserdef.singlecardinality != null)>>
121     answertype: <<question.answertype.enumuserdef.singlecardinality.uisinglecomponent>>
122     options:
123       <<FOR o: question.answertype.enumuserdef.singlecardinality.option>>
124       - <<o>>
125       <<ENDFOR>>
126     others: <<question.answertype.enumuserdef.others.getName>><<ENDIF>>
127     <<IF (question.answertype.enumuserdef.multiplecardinality != null)>>
128     answertype: multipleChoice
129     aggregatedqs:
130       <<FOR o: question.answertype.enumuserdef.multiplecardinality.subq>>
131       - <<o>>
132       <<ENDFOR>>
133     others: <<question.answertype.enumuserdef.others.getName>><<ENDIF>><<ENDIF>><<ENDIF>>
134   <<IF(question.instruction != null)>> <<question.name>>:
135     name: >-
136       <<question.instruction>>
137     order: <<counter++>>
138     topic: <<section.linkTopic.name>>
139     ismandatory: N
140     answertype: instruction
141     others: N
142   <<ENDIF>><<ENDFOR>><<ENDFOR>>'''
143 }

```

```
144
145
146 def FormulaCalculator(Formula formula)
147 {
148     var formList = newArrayList
149     if(formula.indicatorhandler != null) {
150         formList.add(formula.indicatorhandler.superIndicator.name)
151     }
152     if(formula.operator.getName != ' ') formList.add(formula.operator.literal)
153     if(formula.number != 0) formList.add(formula.number)
154     return formList
155 }
156
157 }
```


Q. DSL constraints

IDs should be unique

```
1 Topic.id != Indicator.id && Topic.id != Survey.id && Topic.id != Question.id && Indicator.id != Survey.id
  && Indicator.id != Question.id && Survey.id != Question.id
```

If indirect indicator formula has multiple direct indicators, then operators are needed

```
1 IndirectIndicator.formula.superIndicator._count = (IndirectIndicator.formula.operator._count -1 )
```

indirect indicator formula should not end with operator

```
1 IndirectIndicator.formula[_formula.length - 1] != IndirectIndicator.formula.operator
```

Indicator unit text should only be summed

```
1 IndirectIndicator.formula.superIndicator.unit = text
2 &&
3 IndirectIndicator.formula.indicatorHandler.statistic = sum
4 &&
5 IndirectIndicator.formula.operator = +
```

Every Direct Indicator should be linked to a question

```
1 Indicator.indicatorType.directIndicator && Indicator.Id != Question.referenceTo
```

The unit used in indirect indicators, should be the same as the direct indicator.

```
1 Indicator.indicatorType.indirectIndicator.unit = Indicator.indicatorType.directIndicator.unit
```

The question answer data type has implications on the statistical test handling the answers, see table ??.

Table X
ANSWERDATATYPE AND STATISTICAL TEST CONSTRAINTS

AnswerDataType	Answer statistics					
	Min	Max	Sum	Mean	Mode	Median
date	x	x			x	
number	x	x	x	x	x	x
textHuge			x			
textLong			x			
textShort			x			
enumYesNo					x	
enumFivePoint					x	
enumGender					x	
enumUserDefined					x	

```
1 Question.AnswerDataType.date = IndirectIndicator.formula.indicatorHandler.statistic.min
2 ||
3 Question.AnswerDataType.date = IndirectIndicator.formula.indicatorHandler.statistic.max
4 ||
5 Question.AnswerDataType.date = IndirectIndicator.formula.indicatorHandler.statistic.mode
6 ||
7 Question.AnswerDataType.number = IndirectIndicator.formula.indicatorHandler.statistic.min
8 ||
9 Question.AnswerDataType.number = IndirectIndicator.formula.indicatorHandler.statistic.max
10 ||
11 Question.AnswerDataType.number = IndirectIndicator.formula.indicatorHandler.statistic.sum
12 ||
13 Question.AnswerDataType.number = IndirectIndicator.formula.indicatorHandler.statistic.mean
14 ||
15 Question.AnswerDataType.number = IndirectIndicator.formula.indicatorHandler.statistic.mode
16 ||
17 Question.AnswerDataType.number = IndirectIndicator.formula.indicatorHandler.statistic.median
18 ||
19 Question.AnswerDataType.textHuge = IndirectIndicator.formula.indicatorHandler.statistic.sum
20 ||
21 Question.AnswerDataType.textLong = IndirectIndicator.formula.indicatorHandler.statistic.sum
22 ||
23 Question.AnswerDataType.textShort = IndirectIndicator.formula.indicatorHandler.statistic.sum
24 ||
25 Question.AnswerDataType.enumYesNo = IndirectIndicator.formula.indicatorHandler.statistic.mode
26 ||
```

```
27 Question.AnswerDataType.enumFivepoint = IndirectIndicator.formula.indicatorHandler.statistic.mode
28 ||
29 Question.AnswerDataType.enumGender = IndirectIndicator.formula.indicatorHandler.statistic.mode
30 ||
31 Question.AnswerDataType.enumUserDefined=IndirectIndicator.formula.indicatorHandler.statistic.mode
```

R. ESEA methods' fragments expressiveness

The tables below depicts all method fragments as displayed in the PDDs in Appendix [XII-C](#), [XII-C](#) and [XII-C](#). The meta-model coverage, represents whether a meta-model class covers (1) or does not cover (0) a ESEA method fragment. In addition, obsolete abstract methods fragments are not considered, e.g. COMMON GOOD MATRIX represents all other method fragments and is therefore not interesting for analysis.

Table XI
CGM METHOD FRAGMENTS COVERED BY META-MODEL AND DSL

Method fragment	Meta-model coverage	Explanation and meta-model fragment
ASPECT	1	QUESTION
BALANCE SHEET CALCULATOR	0	Not implemented in DSL
CERTIFICATE	0	Not implemented in DSL
COMANY DETAILS	1	in openESEA and QUESTIONs in the DSL can be defined to require those
COMMON GOOD REPORT	1	Report page in openESEA shows all items
COMMON GOOD BALANCE SHEET	0	Not implemented in DSL
COMMON GOOD MATRIX	-	The matrix is covered by providing evidences for aspects and getting certified, which is done partly, although covered with the other method fragments.
COMPULSORY INDICATOR	1	Question
CONTRIBUTION STATEMENT	0	Not implemented in DSL
EVALUATION LEVEL	1	TOPIC description
EVALUATION TOOL	1	TOPIC description
EVIDENCE	1	ANSWER
INSTRUCTION	1	Since INTRODUCTION, EVALUATION LEVEL, EVALUATION TOOL are met, this is also met.
INTRODUCTION	1	TOPIC description
MATURITY LEVEL	0	Not implemented in DSL
REPORT QUESTION	1	Question
SCORE	0	Not implemented in DSL
STAKEHOLDER	1	Since THEME bundles this, this abstract class is met
THEME	1	TOPIC
VALUE	1	Since THEME bundles this, this abstract class is met

Table XII
BIA METHOD FRAGMENTS COVERED BY META-MODEL AND DSL

Method fragment	Meta-model coverage	Explanation and meta-model fragment
ANSWER	1	OPTION
ASSESSMENT DISCLOSURE	1	Obsolete, since this covered with answers given to questions
B IMPACT ASSESMENT	-	The assesment is covered by answering questions and getting certified, which is done partly, although covered with the other method fragments
CALCULATED SCORE	0	Not implemented in DSL
CERTIFICATE	0	Not implemented in DSL
CONTEXTUAL INFORMATION	1	This is covered with answers given to questions
DIRECT SCORE	0	Not implemented in DSL
DOMAIN EXAMPLE	1	INSTRUCTION
EVIDENCE	0	Not implemented in DSL
EXAMPLE	1	INSTRUCTION
EXPLANATION	1	TOPIC description
INSTRUCTION	1	QUESTION description
QUESTION	1	QUESTION
SCORE	0	Not implemented in DSL
TOPIC	1	The question TOPIC

Table XIII
GRI METHOD FRAGMENTS COVERED BY META-MODEL AND DSL

Method fragment	Meta-model coverage	Explanation and meta-model fragment
SUSTAINABILITY REPORT	1	Report in openESEA
SERIES	1	TOPIC
REPORTING PRINCIPLE	1	TOPIC and its descriptions is able to cover this, although this is not implemented
SUSTAINABILITY CONTEXT	1	TOPIC and its descriptions is able to cover this, although this is not implemented
DISCLOSURE	1	TOPIC
MATERIAL MATRIX	0	Not implemented in DSL, although can be transformed to TOPIC and QUESTION
IMPACT SIGNIFICANCE DIMENSION	0	Not implemented in DSL, although can be transformed to TOPIC and QUESTION
STAKEHOLDER ANALYSIS DIMENSION	0	Not implemented in DSL, although can be transformed to TOPIC and QUESTION
TOPIC SPECIFIC DISCLOSURE	1	TOPIC
GUIDANCE	1	TOPIC description
RECOMMENDATION	1	QUESTION optional
REQUIREMENT	1	QUESTION mandatory
INDICATOR	1	INDIRECT INDICATOR

S. CGM method specification using the DSL

```

1 newTopic:
2 id:C1
3 title:"Human dignity in the workplace and working environment"
4 description:"Human dignity in a company is manifested in an employee-focused organisational culture that is
   built on respect, appreciation and trust. Diversity in the workforce is seen and used as an
   opportunity, and makes for a healthy working environment. People are considered to be the focus, and
   not a factor of production.
5
6 An ECG company...
7 - has an organisational culture and communication based on respect and openness
8 - ensures the engagement of its employees according to their personal strengths,
9 - creates scope for self-management, and promotes the personal and professional development of all
   employees
10 - sees diversity as a strength
11
12 Initial questions
13 - What does human dignity in the workplace mean for our company?
14 - How can we bring more humanity to our company?"
15 newTopic:
16 id:C11
17 title:"Employee-focused organisational culture"
18 superTopic:C1
19 description:"There is mutual respect, appreciation and trust in the workplace. Mistakes are dealt with in a
   constructive manner. Conflicts are seen as an opportunity for improvement and resolved on equal terms
   . Staff and teams have a high degree of self-management and autonomy for what they do. The company
   creates an environment in which individual strengths and talents can develop. Employees find meaning in
   their work.
20
21 Levels of evaluation
22 - Exemplary: There are innovative and/or comprehensive solutions for an employee- focused organisational
   culture, which are sustainable and in evidence, and the effect of which is felt by the employees.
23 - Experienced: The effect or success of the measures to promote and improve employee-focused organisational
   culture are apparent and are being analysed. Measures have been widely implemented.
24 - Advanced: Initial measures to improve or promote an employee-focused organisational culture have been
   implemented.
25 - Getting started: The company is examining its organisational culture for the first time. Concrete
   measures to improve or promote an employee-focused organisational culture are in the planning stages.
26 - Baseline: A conventional organisational culture prevails.
27
28 Evaluation tools
29 An employee-focused organisational culture manifests itself, for example, in the following areas:

```

```

30 - Respect, appreciation, tolerance of mistakes, constructive handling of conflicts:
31   - There is non-material appreciation (e.g. appreciation circles).
32   - Successes are celebrated.
33   - Mistakes are regarded as learning opportunities (neutral or positive).
34   - Conflict is seen as a positive opportunity for finding a better solution.
35   - There is a high degree of competence among employees or conflict resolution.
36 - Personal development, utilising strengths and creating meaning in jobs:
37   - Employees are given a wide range of possibilities for professional and personal
38 development.
39   - Employees are assigned tasks on the basis of their talents and strengths and find their work meaningful
40 .
41 - Clear distribution of tasks, structures and self-management:
42   - Employees have a clear understanding of their roles and responsibilities.
43   - Employees have a high degree of personal responsibility, i.e. they can make independent decisions and
44   be involved as much as possible.
45 The overall picture and the practical implementation of the above in the daily routine is important here.
46   Employee satisfaction surveys can be helpful."
47
48 newIndicator:
49 id:mesures_culture
50 name:"Measures in place for employee-focused culture"
51 topic:C11
52 Unit:text
53 indicatorType:directindicator
54
55 newIndicator:
56 id:mistake_handling
57 name:"Handling of mistakes and conflicts within organisation"
58 topic:C11
59 Unit:text
60 indicatorType:directindicator
61
62 newIndicator:
63 id:autonomy_support
64 name:"Self-management and autonomy of employees encouragement"
65 topic:C11
66 Unit:text
67 indicatorType:directindicator
68
69 newIndicator:
70 id:i11
71 name:"Measures in place for employee-focused culture"
72 topic:C11
73 Unit:text
74 indicatorType:indirectindicator
75 formula:sum(mesures_culture)
76
77 newIndicator:
78 id:i12
79 name:"Handling of mistakes and conflicts within organisation"
80 topic:C11
81 Unit:text
82 indicatorType:indirectindicator
83 formula:sum(mistake_handling)
84
85 newIndicator:
86 id:i13
87 name:"Self-management and autonomy of employees encouragement"
88 topic:C11
89 Unit:text
90 indicatorType:indirectindicator
91 formula:sum(autonomy_support)
92
93 newIndicator:
94 id:employees_current
95 name:"Number of employees in current year"
96 topic:C11
97 Unit:number
98 indicatorType:directindicator
99
100 newIndicator:
101 id:employees_past
102 name:"Number of employees in last year"
103 topic:C11

```



```

101 Unit:number
102 indicatorType:directindicator
103
104 newIndicator:
105 id:ii4
106 name:"Employee turnover rate"
107 topic:C11
108 Unit:number
109 indicatorType:indirectindicator
110 formula:(median(employees_current) - median(employees_past)) / median(employees_past)
111
112 newIndicator:
113 id:employees_service
114 name:"Average length of service from employees"
115 topic:C11
116 Unit:number
117 indicatorType:directindicator
118
119 newIndicator:
120 id:ii5
121 name:"Average length of service from employees in years"
122 topic:C11
123 Unit:number
124 indicatorType:indirectindicator
125 formula:sum(employees_service)
126
127 newIndicator:
128 id:jobs_solicited
129 name:"Number of jobs solicited"
130 topic:C11
131 Unit:number
132 indicatorType:directindicator
133
134 newIndicator:
135 id:jobs_unsolicited
136 name:"Number of jobs unsolicited"
137 topic:C11
138 Unit:number
139 indicatorType:directindicator
140
141 newIndicator:
142 id:ii6
143 name:"Number of jobs solicited"
144 topic:C11
145 Unit:number
146 indicatorType:indirectindicator
147 formula:sum(jobs_solicited)
148
149 newIndicator:
150 id:ii7
151 name:"Number of jobs unsolicited"
152 topic:C11
153 Unit:number
154 indicatorType:indirectindicator
155 formula:sum(jobs_unsolicited)
156
157 newIndicator:
158 id:survey_regularity
159 name:"Regularity of employees satisfaction surveys per year"
160 topic:C11
161 Unit:number
162 indicatorType:directindicator
163
164 newIndicator:
165 id:ii8
166 name:"Regularity of employees satisfaction surveys per year"
167 topic:C11
168 Unit:number
169 indicatorType:indirectindicator
170 formula:sum(survey_regularity)
171
172 newIndicator:
173 id:development_offered
174 name:"Number of development possibilities offered to employees"

```

```

175 topic:C11
176 Unit:number
177 indicatorType:directindicator
178
179 newIndicator:
180 id:development_taken
181 name:"Number of development possibilities taken by employees"
182 topic:C11
183 Unit:number
184 indicatorType:directindicator
185
186 newIndicator:
187 id:development_ratio
188 name:"Personal or professional development possibilities ratio"
189 topic:C11
190 Unit:number
191 indicatorType:indirectindicator
192 formula:sum(development_taken)/sum(development_offered)
193
194
195
196 newTopic:
197 id:C12
198 title:"Health promotion and occupational health and safety"
199 superTopic:C1
200 description:"Health promotion and occupational health and safety are rooted in the entire organisation and
    support the good health of employees. Preventive measures and further employee benefits help to
    maintain, improve and restore their good health."
201
202 newIndicator:
203 id:health_promotion
204 name:"Health promotion measures taken"
205 topic:C12
206 Unit:text
207 indicatorType:directindicator
208
209 newIndicator:
210 id:health_promotion_ii
211 name:"Health promotion measures taken"
212 topic:C12
213 Unit:text
214 indicatorType:indirectindicator
215 formula:sum(health_promotion)
216
217 newIndicator:
218 id:health_issues
219 name:"Health issues possible and actions taken"
220 topic:C12
221 Unit:text
222 indicatorType:directindicator
223
224 newIndicator:
225 id:health_issues_ii
226 name:"Health issues possible and actions taken"
227 topic:C12
228 Unit:text
229 indicatorType:indirectindicator
230 formula:sum(health_issues)
231
232 newIndicator:
233 id:ilness_days
234 name:"Number of working days employees despite illness"
235 topic:C12
236 Unit:text
237 indicatorType:directindicator
238
239 newIndicator:
240 id:ilness_days_ii
241 name:"Number of working days employees despite illness"
242 topic:C12
243 Unit:text
244 indicatorType:indirectindicator
245 formula:sum(ilness_days)
246

```

```
247 newIndicator:
248 id:health_rate
249 name:"Health and sickness rate"
250 topic:C12
251 Unit:text
252 indicatorType:directindicator
253
254 newIndicator:
255 id:health_rate_ii
256 name:"Health and sickness rate"
257 topic:C12
258 Unit:text
259 indicatorType:indirectindicator
260 formula:sum(health_rate)
261
262 newIndicator:
263 id:accidents
264 name:"Number of occupational accidents"
265 topic:C12
266 Unit:text
267 indicatorType:directindicator
268
269 newIndicator:
270 id:accidents_ii
271 name:"Number of occupational accidents"
272 topic:C12
273 Unit:text
274 indicatorType:indirectindicator
275 formula:sum(accidents)
276
277 newIndicator:
278 id:accidents_severity
279 name:"Severity of accidents"
280 topic:C12
281 Unit:text
282 indicatorType:directindicator
283
284 newIndicator:
285 id:accidents_severity_ii
286 name:"Severity of accidents"
287 topic:C12
288 Unit:text
289 indicatorType:indirectindicator
290 formula:sum(accidents_severity)
291
292 newIndicator:
293 id:empl_benefits
294 name:"Employee benefits taken"
295 topic:C12
296 Unit:text
297 indicatorType:directindicator
298
299 newIndicator:
300 id:empl_benefits_ii
301 name:"Employee benefits taken"
302 topic:C12
303 Unit:text
304 indicatorType:indirectindicator
305 formula:sum(empl_benefits)
306
307 newIndicator:
308 id:empl_benefits_h
309 name:"Employee benefits taken in hours"
310 topic:C12
311 Unit:text
312 indicatorType:directindicator
313
314 newIndicator:
315 id:empl_benefits_h_ii
316 name:"Employee benefits taken in hours"
317 topic:C12
318 Unit:text
319 indicatorType:indirectindicator
320 formula:sum(empl_benefits_h)
```

```
321
322
323 newTopic:
324 id:C13
325 title:"Diversity and equal opportunities"
326 superTopic:C1
327 description:"Diversity in the workforce is appreciated as a valuable resource, where differences are viewed
    as an asset. All employees have equal opportunities and the same possibilities are open to all in the
    company. The company aims to overcome social structures that discriminate against certain people and
    groups."
328
329 newTopic:
330 id:C14
331 title:"Negative aspect inadequate working conditions"
332 superTopic:C1
333 description:"Inadequate working conditions stand in the way of an employee-focused culture within the
    company. Companies should be raising awareness of issues around inadequate work environments."
334
335
336
337
338
339
340 newSurvey:
341 id:CGMsingle
342 title:"Survey Human dignity in the workplace and working environment"
343 minResponseRate:1
344
345 newSection:
346 topic:C11
347
348 newQuestion:
349 id:q1
350 question:"What measures and processes are already in place for an employee-focused organisational culture?"
351 mandatory:yes
352 referenceTo:mesures_culture
353 answerDataType:textHuge
354 answerCardinality:single
355 UIcomponent:field
356
357 newQuestion:
358 id:q2
359 question:"How are mistakes and conflicts handled within the organisation?"
360 mandatory:yes
361 referenceTo:mistake_handling
362 answerDataType:textHuge
363 answerCardinality:single
364 UIcomponent:field
365
366 newQuestion:
367 id:q3
368 question:"How are self-management and autonomy of employees encouraged?"
369 mandatory:yes
370 referenceTo:autonomy_support
371 answerDataType:textHuge
372 answerCardinality:single
373 UIcomponent:field
374
375 newQuestion:
376 id:q4
377 question:"How many employees does your company count"
378 mandatory:yes
379 referenceTo:employees_current
380 answerDataType:number
381 answerCardinality:single
382 UIcomponent:field
383
384 newQuestion:
385 id:q5
386 question:"How many employees did your company count last year"
387 mandatory:yes
388 referenceTo:employees_past
389 answerDataType:number
390 answerCardinality:single
```

```

391 UIcomponent:field
392
393 newQuestion:
394 id:q6
395 question:"What is the average length of service from your employees?"
396 mandatory:yes
397 referenceTo:employees_service
398 answerDataType:number
399 answerCardinality:single
400 UIcomponent:field
401
402 newQuestion:
403 id:q7
404 question:"What is the number of solicited job applications?"
405 mandatory:yes
406 referenceTo:jobs_solicited
407 answerDataType:number
408 answerCardinality:single
409 UIcomponent:field
410
411 newQuestion:
412 id:q8
413 question:"What is the number of unsolicited job applications?"
414 mandatory:yes
415 referenceTo:jobs_unsolicited
416 answerDataType:number
417 answerCardinality:single
418 UIcomponent:field
419
420 newQuestion:
421 id:q9
422 question:"What is the number and regularity of employee surveys on workplace satisfaction and/or
    organisational culture?"
423 mandatory:yes
424 referenceTo:survey_regularity
425 answerDataType:number
426 answerCardinality:single
427 UIcomponent:field
428
429 newQuestion:
430 id:q10
431 question:"What are the development opportunities (professional and personal) offered to employees, in hours
    per employee"
432 mandatory:yes
433 referenceTo:development_offered
434 answerDataType:number
435 answerCardinality:single
436 UIcomponent:field
437
438 newQuestion:
439 id:q11
440 question:"What are the development opportunities (professional and personal) used by employees, in hours
    per employee"
441 mandatory:yes
442 referenceTo:development_taken
443 answerDataType:number
444 answerCardinality:single
445 UIcomponent:field
446
447
448
449
450 newSection:
451 topic:C12
452
453 newQuestion:
454 id:q12
455 question:"What measures have you implemented towards health promotion in the workplace and occupational
    health and safety? How are they evaluated?"
456 mandatory:yes
457 referenceTo:health_promotion
458 answerDataType:textLong
459 answerCardinality:single
460 UIcomponent:field

```

```
461
462 newQuestion:
463 id:q13
464 question:"What kind of health issues or injuries could affect your employees, and what measures are in
    place to protect them?"
465 mandatory:yes
466 referenceTo:health_issues
467 answerDataType:textLong
468 answerCardinality:single
469 UIcomponent:field
470
471 newQuestion:
472 id:q14
473 question:"What is the number of days where employees come to work despite their illness"
474 mandatory:yes
475 referenceTo:ilness_days
476 answerDataType:textLong
477 answerCardinality:single
478 UIcomponent:field
479
480 newQuestion:
481 id:q15
482 question:"What is the health/sickness rate?"
483 mandatory:yes
484 referenceTo:health_rate
485 answerDataType:number
486 answerCardinality:single
487 UIcomponent:field
488
489 newQuestion:
490 id:q16
491 question:"What is the number of occupational accidents?"
492 mandatory:yes
493 referenceTo:accidents
494 answerDataType:number
495 answerCardinality:single
496 UIcomponent:field
497
498 newQuestion:
499 id:q17
500 question:"How severe where those occupational accidents?"
501 mandatory:yes
502 referenceTo:accidents_severity
503 answerDataType:textShort
504 answerCardinality:single
505 UIcomponent:field
506
507 newQuestion:
508 id:q18
509 question:"What employee benefits are taken by employees?"
510 mandatory:yes
511 referenceTo:empl_benefits
512 answerDataType:enumUserDefined
513 answerCardinality:multiple
514 UIcomponent:checkbox
515 options:"maturity leave","discounted products","insurance"
516 othersOption:yes
517
518 newQuestion:
519 id:q19
520 question:"How many hours of employee benefits are taken?"
521 mandatory:yes
522 referenceTo:empl_benefits_h
523 answerDataType:number
524 answerCardinality:single
525 UIcomponent:field
```


T. BIA method specification using the DSL

```
1 newTopic:
2 id:C1
3 title:"W: Workers"
4
5 newTopic:
6 id:W1
7 title:"Majority Hourly vs. Salaried Workers"
8 superTopic:C1
9
10 newIndicator:
11 id:employee_pay_structure
12 topic:W1
13 Unit:text
14 indicatorType:directindicator
15
16 newIndicator:
17 id:employee_pay_structure_ii
18 topic:W1
19 Unit:text
20 indicatorType:indirectindicator
21 formula:sum(employee_pay_structure)
22
23 newTopic:
24 id:W2
25 title:"Employee Benefits"
26 superTopic:C1
27 description:"If you are interested in improving benefits provided to employees, consider surveying or
    consulting with your employees to identify what they might be most interested in. "
28
29 newIndicator:
30 id:employee_benefits
31 topic:W2
32 Unit:text
33 indicatorType:directindicator
34
35 newIndicator:
36 id:employee_benefits_ii
37 topic:W2
38 Unit:text
39 indicatorType:indirectindicator
40 formula:sum(employee_benefits)
41
42 newTopic:
43 id:W3
44 title:"% of Employees Paid Individual Living Wage"
45 superTopic:C1
46 description:"Engaging and Retaining a Diverse Workforce
47 For a more in depth guide on fostering and maintaining an inclusive and equitable work environment, please
    reference Engaging and Retaining a Diverse Workforce (Please note, this guide is only in English).
48 Consider implementing a living wage policy pegged to the costs of living in your area. For more information
    and resources on how to implement a living wage policy, please visit: http://www.livingwage.org.uk/
    sites/default/files/BAR\_LivingWageReport%20cropped%2021%2001.pdf
49 If interested in supporting the development of Living Wage calculations for your area or your industry, see
    the Global Living Wage Coalition. http://www.isealliance.org/our-work/improving-effectiveness/global
    -living-wage-coalition
50 A living wage goes beyond meeting the minimum wage required by law and ensures that employees have the
    money necessary to meet living expenses in your region.
51 By implementing a living wage policy, businesses can reduce staff turnover, increase workers' morale and
    loyalty, reduce absenteeism, increase productivity, and strengthen recruitment."
52
53 newIndicator:
54 id:employee_FTE
55 topic:W3
56 Unit:text
57 indicatorType:directindicator
58
59 newIndicator:
60 id:employee_FTE_ii
61 topic:W3
62 Unit:text
63 indicatorType:indirectindicator
```

64 formula:sum(employee_FTE)

65

66 newTopic:

67 id:W4

68 title:"High to Low Pay Ratio"

69 superTopic:C1

70 description:"Engaging and Retaining a Diverse Workforce

71 For a more in depth guide on fostering and maintaining an inclusive and equitable work environment, please
reference Engaging and Retaining a Diverse Workforce (Please note, this guide is only in English).

72

73 This question measures the extent to which a business maintains equity in salaries among its highest- and
lowest-earning employees. Income equity is an indicator that wealth is distributed throughout the
business so that as a business excels, all of its employees reap the benefits.

74

75 Lower pay ratios can increase both workers' and consumers' perception of a company. According to a Harvard
Business Review study called Paying Up for Fair Pay, consumers prefer buying from companies with low
pay ratios. Research shows when consumers learn of a business's high pay ratio (e.g., 1000 to 1), it
reduces purchase intention relative to firms with lower ratios (e.g., 5 to 1). Lower pay ratios improve
consumer perceptions across a range of products at different price points, and increase consumer
ratings of both firm warmth and firm competence. [http://www.hbs.edu/faculty/Publication%20Files/15-091/
eb472863-c73b-4aca-a8ee-d7dc1748a91d.pdf](http://www.hbs.edu/faculty/Publication%20Files/15-091/eb472863-c73b-4aca-a8ee-d7dc1748a91d.pdf)

76

77 To manage the multiple of pay from highest to lowest, consider creating policies that link pay increases
for executives with pay increases with for other employees. If your company has an advisory body that
oversees executive compensation, consider discussing with them."

78

79 newIndicator:

80 id:employee_pay

81 topic:W4

82 Unit:text

83 indicatorType:directindicator

84

85 newIndicator:

86 id:employee_pay_ii

87 topic:W4

88 Unit:text

89 indicatorType:indirectindicator

90 formula:sum(employee_pay)

91

92 newTopic:

93 id:W5

94 title:"Supplementary Health Benefits"

95 superTopic:C1

96 description:"Engaging and Retaining a Diverse Workforce

97 For a more in depth guide on fostering and maintaining an inclusive and equitable work environment, please
reference Engaging and Retaining a Diverse Workforce (Please note, this guide is only in English).

98 This question rewards businesses that protect the well-being and financial security of their employees by
providing benefits that go beyond health insurance. These benefits will reduce the cost of essential
services to employees and their families, and protect the employee and their family in the event of
accident.

99

100 Going above and beyond the benefits offered or mandated by government programs can provide higher quality
or broader coverage for employees to protect their financial stability, health, and wellness.

101

102 Employees that have access to benefits which keep them healthy and well are less likely to miss work, and
can increase company loyalty and productivity.

103

104 Consider speaking with employees to understand better what kind of supplemental benefits they would be
interested in. This could be done via survey or conversationally.

105

106 Consider reviewing the programs provided or required by the government and speaking with employees about
potential supplements that would be most valuable to them."

107

108 newIndicator:

109 id:employee_suppl_benefits

110 topic:W5

111 Unit:text

112 indicatorType:directindicator

113

114 newIndicator:

115 id:employee_suppl_benefits_ii

116 topic:W5

117 Unit:text

118 indicatorType:indirectindicator

```

119 formula:sum(employee_suppl_benefits)
120
121 newTopic:
122 id:W6
123 title:"Number of Paid Days Off"
124 superTopic:C1
125 description:"Engaging and Retaining a Diverse Workforce
126 For a more in depth guide on fostering and maintaining an inclusive and equitable work environment, please
    reference Engaging and Retaining a Diverse Workforce (Please note, this guide is only in English).
127
128 Paid time off promotes the personal well-being of employees, giving them opportunities to take care of
    family members, balance work and family obligations, pursue personal interests, and rest or recover
    from sickness.
129
130 Leave, whether paid or unpaid, can have a positive effect on long-term productivity by improving
    recruitment, retention, and employee motivation. From The Economics of Paid and Unpaid Leave by the
    Obama administration's Council of Economic Advisors: https://www.whitehouse.gov/sites/default/files/docs/leave/report/final.pdf
131
132 Please review your employee handbook or employment contracts to determine the minimum total number of paid
    days off provided to an employee."
133
134 newIndicator:
135 id:days_off_payed
136 topic:W6
137 Unit:text
138 indicatorType:directindicator
139
140 newIndicator:
141 id:days_off_payed_ii
142 topic:W6
143 Unit:text
144 indicatorType:indirectindicator
145 formula:sum(days_off_payed)
146
147
148
149 newTopic:
150 id:W7
151 title:"Paid Primary Caregiver Leave for Salary Workers"
152 superTopic:C1
153
154 newIndicator:
155 id:parental_leave
156 topic:W7
157 Unit:text
158 indicatorType:directindicator
159
160 newIndicator:
161 id:parental_leave_ii
162 topic:W7
163 Unit:text
164 indicatorType:indirectindicator
165 formula:sum(parental_leave)
166
167 newTopic:
168 id:W8
169 title:"Professional Development"
170 superTopic:C1
171 description:"If you are interested in implementing or improving professional development programs, consider
    starting with an employee needs assessment.
172
173 For a more in depth guide on how to identify professional development needs, and an overview of different
    types of professional development programs available, see Implementing a Professional Development
    Program."
174
175 newIndicator:
176 id:employee_development
177 topic:W8
178 Unit:text
179 indicatorType:directindicator
180
181 newIndicator:
182 id:employee_development_ii

```

```

183 topic:W8
184 Unit:text
185 indicatorType:indirectindicator
186 formula:sum(employee_development)
187
188
189 newTopic:
190 id:W9
191 title:"Employee Review Process"
192 superTopic:C1
193 description:"Engaging and Retaining a Diverse Workforce
194 For a more in depth guide on fostering and maintaining an inclusive and equitable work environment, please
195 reference Engaging and Retaining a Diverse Workforce (Please note, this guide is only in English).
196 Providing regular formal performance promotes career development and personal growth for employees, who are
197 able to continuously refer back to suggestions and track their development over time.
198 Performance feedback provides employees with a clear understanding of how they are doing, what is working,
199 and what isn't working. It provides a mechanism for identifying areas for improvement regarding task
200 execution and work style, and increases clarity around performance and role-related expectations.
201 Consider what feedback structure would be appropriate for your company and employees. Here is a one-pager
202 on structuring performance feedback from MIT Human Resources: http://hrweb.mit.edu/performance-
203 development/performance-reviews/preparing-and-conducting-annual-performance-review
204 Here's another one-page from the U.S. Office of Personnel Management: https://www.opm.gov/policy-data-
205 oversight/performance-management/performance-management-cycle/monitoring/feedback-is-critical-to-
206 improving-performance/"
207
208 newIndicator:
209 id:employee_review
210 topic:W9
211 Unit:text
212 indicatorType:directindicator
213
214 newIndicator:
215 id:employee_review_ii
216 topic:W9
217 Unit:text
218 indicatorType:indirectindicator
219 formula:sum(employee_review)
220
221 newTopic:
222 id:W10
223 title:"Worker Engagement Practices"
224 superTopic:C1
225
226 newIndicator:
227 id:employee_engagement
228 topic:W10
229 Unit:text
230 indicatorType:directindicator
231
232 newIndicator:
233 id:employee_engagement_ii
234 topic:W10
235 Unit:text
236 indicatorType:indirectindicator
237 formula:sum(employee_engagement)
238
239 newSurvey:
240 id:BIA
241 title:"BIA single input survey"
242 minResponseRate:1
243
244 newSection:
245 topic:W1
246 newInstruction:
247 id:I1
248 instruction:"This question is used to determine the set of questions that your company will see in
249 reference to their employee impact. The nature of the majority of a company's employment is very
250 important for determining the type of impact the company has and for establishing best practices.
251 Salaried employees are those workers that receive a fixed amount of pay for regular work that is not
252 dependent upon the time worked. This is usually quantified on an annual or monthly basis. Daily/hourly
253 employees are those that are paid dependent upon the amount of time worked, and are either contracted

```

on a daily basis or or paid for the amount of hours worked in a given time period. If workers punch a time card, and get paid overtime when working extra hours, consider them as hourly paid. For the purposes of this question, please count workers on a headcount basis instead of on a full-time equivalent (FTE) basis. Only include payrolled employees and exclude independent contractors and interns in your calculation."

244 newQuestion:
245 id:Q1
246 question:"Are the majority (greater than 50%) of your employees paid on a fixed salary or a daily or hourly wage?"
247 help:"This is a REQUIRED question that determines the set of additional questions your company will respond to regarding your employee impact. The answer to this question affects questions you'll encounter further on in your assessment."
248 mandatory:yes
249 referenceTo:employee_pay_structure
250 answerDataType:enumUserDefined
251 answerCardinality:single
252 UIcomponent:dropdown
253 options:"Fixed Salary","Daily or hourly wage"
254 othersOption:no
255
256 newSection:
257 topic:W2
258 newInstruction:
259 id:I2
260 instruction:"This question is intended to identify companies that provide benefits to employees that increases their financial stability and allows them to build wealth. Select options that apply to a majority of your employees."
261 newQuestion:
262 id:Q2
263 question:"Does your company provide any of the following benefits to your employees?"
264 help:"In addition to voluntary benefits provided by the company, include any offerings that are required or provided by government programs."
265 mandatory:yes
266 referenceTo:employee_benefits
267 answerDataType:enumUserDefined
268 answerCardinality:multiple
269 UIcomponent:checkbox
270 options:"At or above market compensation packages, as compared to industry averages/benchmarks","Annual Cost of Living Adjustments","Bonuses or Profit Sharing","Retirement Plan","Health insurance coverage","Stock Options or Ownership in the Company"
271 othersOption:yes
272
273 newSection:
274 topic:W3
275 newInstruction:
276 id:I3
277 instruction:"To find if a Living Wage calculation is available for your country and learn more about the Living Wage methodology visit the Global Living Wage Coalition (<https://www.globallivingwage.org>)
278 The living wage is defined as the wage a full-time worker would need to earn to support a family above the federal poverty line in a given locality.
279 Identify your lowest paid wage and compare it to a recognized third-party living wage standard, such as those identified below.
280 In the United States, please use the MIT Living Wage Calculator to find the appropriate wage based on the local cost of living: <http://livingwage.mit.edu> (use wage rate for one adult). For example, the living wage for New York City in 2016 according to this calculator is \$14.30/hour.
281
282 To access Canada's Living Wage calculator, please visit: <http://www.livingwageforfamilies.ca/employers/living-wage-calculator/>
283 For Vancouver, Manitoba Kingston and Toronto see Page 15.
284 For the UK living wage rate, please visit: <http://www.livingwage.org.uk/calculation>
285 Importantly, calculations of living wages in your region may vary, particularly if your local government has specified a different wage in contracting policies. B Lab will review different methodologies for potential inclusion for this question. For many countries a living wage that meets equivalent standards as the ones above have not been developed. In those cases, select N/A."
286 newQuestion:
287 id:Q3
288 question:"What percentage of employees on an FTE (Full Time Equivalent) basis are paid at least the equivalent of a living wage for an individual?"
289 mandatory:yes
290 referenceTo:employee_FTE
291 answerDataType:enumUserDefined
292 answerCardinality:single
293 UIcomponent:dropdown
294 options:"<75%","75-89%","90-99%","100%","N/A"

295 othersOption:no

296

297 newSection:

298 topic:W4

299 newInstruction:

300 id:I4

301 instruction:"IRIS Glossary Term: Full-time employee: Full-time paid employees work year round and typically work 35-50 hours per week. If local definitions of full-time equivalency differ, use appropriate standard.)

302

303 Identify the highest and lowest-paid full-time employees and calculate the multiple using both wages and bonuses (but exclude equity). If the company has employees in both emerging and developed markets, calculate a compensation ratio for workers in each of those markets separately. You should then choose the highest multiple between the two calculations."

304 newInstruction:

305 id:I5

306 instruction:"Seventh Generation, a producer of household cleaning supplies, maintains a wage equity policy that caps executive compensation so that it may not exceed 14x the lowest paid employee. Learn more about Seventh Generation's program;

307

308 Namaste Solar, an employee-owned cooperative based out of Colorado, maintains a 4-to-1 ratio for highest to lowest total pay per employee, including executives. Learn more about why they think this is important ;

309

310 Overall, it is more common for OSBs to have a smaller difference between the highest and lowest paid full-time worker.

311

312 For salary differences according to company size, both OSBs and OBs have a smaller difference between the highest and lowest paid full-time employee if the company has >50 employees. OSBs and OBs with >50 employees tend to have a greater difference in salary between the highest and lowest paid full-time employees."

313 newQuestion:

314 id:Q4

315 question:"What multiple is the highest compensated individual paid, inclusive of bonus, as compared to the lowest paid full-time worker?"

316 mandatory:yes

317 referenceTo:employee_pay

318 answerDataType:enumUserDefined

319 answerCardinality:single

320 UIcomponent:dropdown

321 options:">20x","16-20x","11-15x","6-10x","1-5x"

322 othersOption:no

323

324 newSection:

325 topic:W5

326 newInstruction:

327 id:I6

328 instruction:"Review the company's employee handbook, employee contracts, or other benefits documents and mark any of the answers options if they are available to tenured employees. If these benefits are provided to all employees from the start then they should also be selected. Other benefits should only be included if they are not included in other questions of the assessment. Included in other questions are retirement plans, wellness programs, days off, community service, etc. Vision insurance can be included as other.

329

330 Tenured employee: An employee who has worked at least one year with the company, or, if part time, at least 1000 hours."

331 newInstruction:

332 id:I7

333 instruction:"Fingerlakes Wealth Management provides generous benefits to their employees, including, a nap room and massage therapist hours.

334

335 Impact Square, a consulting firm based in Seoul, provides employees with a generous number of vacation days , a flexible working hours, sports breaks (cycling, running, etc.), as well as various bikes, skateboards and scooters that employees can use for commuting.

336

337 New Belgium Brewing Company provides employees with an on-site bicycle fleet to borrow as they need. The company also gifts each employee with a custom bike on their 1-year anniversary, and has been named a platinum-level bike friendly business by the The League of American Bicyclists."

338

339 newQuestion:

340 id:Q5

341 question:"What benefits does your company provide to all full-time tenured workers to supplement government programs?"

342 mandatory:yes

```
343 referenceTo:employee_suppl_benefits
344 answerDataType:enumUserDefined
345 answerCardinality:multiple
346 UIcomponent:checkbox
347 options:"Disability coverage or accident insurance","Life insurance","Private dental insurance","Private
    supplemental health insurance","None of the above"
348 othersOption:yes
349
350 newSection:
351 topic:W6
352 newInstruction:
353 id:I8
354 instruction:"Only select responses that apply to at least 80% of your workers"
355
356 This calculation is inclusive of sick days, holidays, personal days, and vacation days etc., and should be
    calculated at the minimum number of days available for a tenured employee. Please include all leave
    regardless of whether the company voluntarily offers it or government requires it. For example, New
    York City requires employers to provide 5 days of paid sick leave annually; therefore, if your company
    is located in NYC, you may count at least 5 days toward this question. Do not double count, however - i
    .e. if an NYC company offers employees 10 paid days of sick leave, it would count as 10 days of sick
    leave, not 15 (15=10 provided by the company and 5 required by NYC). If your company has an informal
    policy with no specifically-stated sick day allowance, and workers are directed to take sick days as
    needed, please count 5 days in your sum for this question. (This is used as a reasonable estimate of
    the amount actually taken, as it can not be precisely verified.) If your company allows unlimited
    vacation days, please count 10 days in your sum for this question regarding vacation, but also factor
    in holidays, sick days, and others.
357
358 Tenured employee: An employee who has worked at least one year with the company, or, if part time, at least
    1000 hours."
359 newInstruction:
360 id:I9
361 instruction:"ReWork, a New York-based impact-focused recruiting firm, allows employees to choose their home
    base city around the country, in addition to encouraging working remotely for 4 weeks in a location of
    their choice, unlimited sick leave and flexible scheduling options.
362
363 Aerzen USA provides their tenured employees at least 25 paid days. This practice is not only beneficial to
    the employees and their families, but also help Aerzen reduce their employee turnover. This practice is
    unusual for a small business like Aerzen and has helped them garner a Best Places to Work recognition.
364
365 TMI Consulting provides all full time salaried employees (i.e. those working 30 or more hours a week and
    enrolled in the benefits program) 21 days of paid vacation annually, for the first 2 years of tenure.
    After that vacation time is unlimited to all full time salaried employees, reviewable on a quarterly
    basis by your supervisor and the Advisory Board. Unlimited is defined by the quality and quantity of
    work that the employee is submitting to the company. As long as the work is there, you are free to come
    and go as you please, responsibly. All part time or hourly workers are allotted 10 days of paid
    vacation annually for the first 2 years, after that they are allowed 21 days of paid vacation annually.
    All vacation needs to be calendared at least 3 weeks in advance and noted on the company calendar for
    reference. The company asks that employees exercise personal responsibility regarding paid time off to
    support and maintain our flexible and compassionate culture."
366 newQuestion:
367 id:Q6
368 question:"What is the annual minimum number of paid days off (including holidays) for full-time employees?"
369 mandatory:yes
370 referenceTo:days_off_payed
371 answerDataType:enumUserDefined
372 answerCardinality:single
373 UIcomponent:dropdown
374 options:"0-15 work days","16-22 work days","23-29 work days","30-35 work days","36+ work days"
375 othersOption:no
376
377 newSection:
378 topic:W7
379 newInstruction:
380 id:I10
381 instruction:"Only select responses that apply to at least 80% of your workers"
382 newQuestion:
383 id:Q7
384 question:"Which of the following describe the primary parental leave policies for salaried workers, either
    through the company or government program?"
385 help:"If applicable, please select one answer indicating total time off (answers 1-3), and one answer
    indicating fully paid time off (answers 4-7)."
```


389 answerCardinality:single
390 UIcomponent:dropdown
391 options:"Primary caregivers receive 4-12 weeks of time off for parental leave (including unpaid and paid leave)", "Primary caregivers receive 12 weeks to 6 months of time off for parental leave (including unpaid and paid leave)", "Primary caregivers receive 6 months or more of time off for parental leave (including unpaid and paid leave)", "5-12 weeks of primary parental leave (or equivalent) is fully paid", "12-18 weeks of primary parental leave (or equivalent) is fully paid", "18-24 weeks of primary parental leave (or equivalent) is fully paid", "24+ weeks of primary parental leave (or equivalent) is fully paid", "Primary caregivers receive no time off for parental leave"
392 othersOption:no
393
394 newSection:
395 topic:W8
396 newInstruction:
397 id:I11
398 instruction:"This question awards companies that provide training and professional growth opportunities for their employees to create career track, either at the company or externally."
399 newInstruction:
400 id:I12
401 instruction:"Roshan, a telecom provider in Afghanistan, provides its newly hired employees with apprenticeship/technical training of more than 1 month. Roshan pairs a newly hired employee with an existing one so as to better incorporate the new member into the team.
402
403 Wilmar Flowers, Ltd., a Kenyan company, offers all workers training on functions of each department, beyond the day-to-day requirements of their individual positions. These workers enjoy personal growth and the company is more resilient through busy quarters as a result.
404
405 Husk Power Systems, a producer of small scale bio-mass powerplants in India, offers its newly hired employees with apprenticeship/technical training of more than 1 month. The company has an internal program called Husk Power University where both their employees and the farmers who use their technology learn how to generate their own power with their mini power plants.
406
407 Dewey's Bakery Inc . is committed to the ongoing education of their employees. The company's Dewey's Center for Learning (DCL), is a free program that will provide employees an opportunity to enhance skills that will impact their future both in and out of the organization. Courses include, but are not limited to: Technical Skills (i.e. Excel, Food Safety, How to Read Financial Statements) Communication (i.e. English as a Second Language, Conversational Spanish) Soft Skills (i.e. Conflict Resolution, Teamwork, Leadership) - Personal Development (i.e. Personal Budgeting, Saving for Retirement)
408
409 Reho Travel uses an outside company to run trainings on public speaking and leadership training to executive and non-executive employees.
410
411 Firespring offers employees regular lunch and learn sessions and life skills trainings such as non-verbal communication strategies and proper use of punctuation.
412
413 Papel Semente based in Rio de Janeiro provides employees with training on basic life skills including leadership. 90% of the company's employees come from underrepresented communities nearby company facilities."
414
415 newQuestion:
416 id:Q8
417 question:"Does your company provide any of the following opportunities for professional development for your employees?"
418 mandatory:yes
419 referenceTo:employee_development
420 answerDataType:enumUserDefined
421 answerCardinality:multiple
422 UIcomponent:checkbox
423 options:"Company has formal onboarding process for new employees", "Company provided ongoing training to employees in the last year", "Company has a policy to encourage internal promotions and hiring for advanced positions (posting job openings internally first, etc.)", "Company provides cross-skills training for career advancements or transitions (i.e. management training for non-managers)", "Company provides non-career specific life-skill training to improve the personal development of employees (financial literacy, ESL. etc.)", "Company facilitates or has an allocated budget for external professional development opportunities, including conference attendance, online trainings, etc.", "None of the above"
424 othersOption:no
425
426 newSection:
427 topic:W9
428 newInstruction:
429 id:I13
430 instruction:"A 360-degree feedback process includes feedback from individuals materially affected by the performance of the employee. This includes managers, team members, subordinates, as well as customers."

Customers could be external or internal to the organization, (e.g. the clients of the company for a client-facing role, or an internal employee for an internally-facing role). For a human resources representative, for instance, a 360-degree review could include feedback from the other non-HR employees of the company.

431
432 Only select responses that apply to at least 80% of your workers
433

434 If your company conducts regular performance reviews, examine templates or examples to determine which of the answer options appropriately apply."

435 newInstruction:
436 id:I14
437 instruction:"Blue Garnet, a social impact consultancy firm located in Los Angeles, has a thorough 360 degree feedback process for thier employees that includes a formal discussion of impact related goals, individual goals and professional development goals.
438

439 Source: Blue Garnet"
440 newQuestion:
441 id:Q9
442 question:"Which of the following is included or applies to your company's formal process for providing performance feedback to employees?"
443 help:"Check all that apply."
444 mandatory:yes
445 referenceTo:employee_review
446 answerDataType:enumUserDefined
447 answerCardinality:multiple
448 UIcomponent:checkbox
449 options:"Process has a regular schedule and is conducted at least annually","Peer and subordinate input","Written guidance for career development","Social and environmental goals","Clearly-identified and achievable goals","A 360-degree feedback process","All tenured employees receive feedback","None of the above"
450 othersOption:no
451

452 newSection:
453 topic:W10
454 newInstruction:
455 id:I15
456 instruction:"This question is intended to identify companies that pro-actively create a workplace where employees can feel engaged, protected, and satisfied."
457 newInstruction:
458 id:I16
459 instruction:"Dew Crisp, one of the leading suppliers of value added salad & vegetable products to retail & food services industries in South Africa, has designated multiple agents to assist in resolving problems between workers or workers and management, including an employee representative mutually-designated by company management and employees.
460

461 Grupo GAIA , located in Brazil, conducts internal satisfaction surveys to measure employee satisfaction. The company promotes employee wellness throug meditation programs, language courses, recreational lunches, a 50% refund for participating in marathons, and an organized blood drive called, Sangre Azul.
462

463 QoC Health conducts a quarterly town hall meeting, where the executive team leads conversation and answers questions around an employee-submitted agenda.
464

465 Salt Spring Coffee , based in British Columbia, conducts annual employee engagement surveys based on 12 questions developed by Gallup to measure the success of a workplace. Salt Spring uses the survey responses to identify good practices and areas for improvement"
466 newQuestion:
467 id:Q10
468 question:"Do you conduct any of the following worker engagement practices to promote worker voice and satisfaction?"
469 mandatory:yes
470 referenceTo:employee_engagement
471 answerDataType:enumUserDefined
472 answerCardinality:multiple
473 UIcomponent:checkbox
474 options:"Company conducts an employee satisfaction or engagement survey at least annually","Company has complaint mechanisms to allow employees to raise issues or concerns without fear of reprisal","Company formally solicits non-executive employee input or empowers employees in strategy setting","Company employees have union representation","None of the above"
475 othersOption:yes

U. GRI method specification using the DSL

```
1 newTopic:
2 id:C401
3 title:"Employment"
4 description:"This Standard includes disclosures on the management approach and topic-specific disclosures.
5   These are set out in the Standard as follows:
6   - Management approach disclosures (this section references GRI 103)
7   - Disclosure 401-1 New employee hires and employee turnover
8   - Disclosure 401-2 Benefits provided to full-time employees that are not provided to temporary or part-time
9     employees
10  - Disclosure 401-3 Parental leave"
11 newTopic:
12 id:t401_0
13 title:"Management approach disclosures"
14 superTopic:C401
15 description:"Management approach disclosures are a narrative explanation of how an organization manages a
16   material topic, the associated impacts, and stakeholders' reasonable expectations and interests. Any
17   organization that claims its report has been prepared in accordance with the GRI Standards is required
18   to report on its management approach for every material topic, as well as reporting topic-specific
19   disclosures for those topics. Therefore, this topic-specific Standard is designed to be used together
20   with GRI 103: Management Approach in order to provide full disclosure of the organization's impacts.
21   GRI 103 specifies how to report on the management approach and what information to provide."
22 newIndicator:
23 id:work_policies
24 name:"policies or practices covering the relationships under which work is performed for the organization"
25 topic:t401_0
26 Unit:text
27 indicatorType:directindicator
28 newIndicator:
29 id:work_policies_ii
30 name:"policies or practices covering the relationships under which work is performed for the organization"
31 topic:t401_0
32 Unit:text
33 indicatorType:indirectindicator
34 formula:sum(work_policies)
35 newIndicator:
36 id:supplychain_legal
37 name:"actions taken to determine and address situations where work undertaken within its supply chain does
38   not take place within appropriate institutional and legal frameworks"
39 topic:t401_0
40 Unit:text
41 indicatorType:directindicator
42 newIndicator:
43 id:supplychain_legal_ii
44 name:"actions taken to determine and address situations where work undertaken within its supply chain does
45   not take place within appropriate institutional and legal frameworks"
46 topic:t401_0
47 Unit:text
48 indicatorType:indirectindicator
49 formula:sum(supplychain_legal)
50 newIndicator:
51 id:supplychain_labor_protection
52 name:"actions taken to determine and address situations where persons working for suppliers are not
53   provided the social and labor protection that they are entitled to receive by national labor law"
54 topic:t401_0
55 Unit:text
56 indicatorType:directindicator
57 newIndicator:
58 id:supplychain_labor_protection_ii
59 name:"actions taken to determine and address situations where persons working for suppliers are not
60   provided the social and labor protection that they are entitled to receive by national labor law"
61 topic:t401_0
62 Unit:text
63 indicatorType:indirectindicator
64 formula:sum(supplychain_labor_protection)
```

```

60
61 newIndicator:
62 id:supplychain_workconditions
63 name:"actions taken to determine and address situations where working conditions in its supply chain do not
    meet international labor standards or national labor law;"
64 topic:t401_0
65 Unit:text
66 indicatorType:directindicator
67
68 newIndicator:
69 id:supplychain_workconditions_ii
70 name:"actions taken to determine and address situations where working conditions in its supply chain do not
    meet international labor standards or national labor law;"
71 topic:t401_0
72 Unit:text
73 indicatorType:indirectindicator
74 formula:sum(supplychain_workconditions)
75
76 newIndicator:
77 id:supplychain_remuneration
78 name:"actions taken to determine and address situations where work undertaken in its supply chain is
    inadequately remunerated;"
79 topic:t401_0
80 Unit:text
81 indicatorType:directindicator
82
83 newIndicator:
84 id:supplychain_remuneration_ii
85 name:"actions taken to determine and address situations where work undertaken in its supply chain is
    inadequately remunerated;"
86 topic:t401_0
87 Unit:text
88 indicatorType:indirectindicator
89 formula:sum(supplychain_remuneration)
90
91 newIndicator:
92 id:supplychain_false_employment
93 name:"actions taken to determine and address situations of disguised employment relationships where workers
    in its supply chain are falsely considered to be self-employed or where there is no legally recognized
    employer;"
94 topic:t401_0
95 Unit:text
96 indicatorType:directindicator
97
98 newIndicator:
99 id:supplychain_false_employment_ii
100 name:"actions taken to determine and address situations of disguised employment relationships where workers
    in its supply chain are falsely considered to be self-employed or where there is no legally recognized
    employer;"
101 topic:t401_0
102 Unit:text
103 indicatorType:indirectindicator
104 formula:sum(supplychain_false_employment)
105
106 newIndicator:
107 id:supplychain_work_home
108 name:"actions taken to determine and address situations where work undertaken in its supply chain that is
    performed at home is not subject to legally recognized contracts."
109 topic:t401_0
110 Unit:text
111 indicatorType:directindicator
112
113 newIndicator:
114 id:supplychain_work_home_ii
115 name:"actions taken to determine and address situations where work undertaken in its supply chain that is
    performed at home is not subject to legally recognized contracts."
116 topic:t401_0
117 Unit:text
118 indicatorType:indirectindicator
119 formula:sum(supplychain_work_home)
120
121 newTopic:
122 id:t401_1
123 title:"New employee hires and employee turnover"

```

```
124 superTopic:C401
125 description:"The number, age, gender, and region of an organization's new employee hires can indicate its
strategy and ability to attract diverse, qualified employees. This information can signify the
organization's efforts to implement inclusive recruitment practices based on age and gender. It can
also signify the optimal use of available labor and talent in different regions. A high rate of
employee turnover can indicate levels of uncertainty and dissatisfaction among employees. It can also
signal a fundamental change in the structure of an organization's core operations. An uneven pattern of
turnover by age or gender can indicate incompatibility or potential inequity in the workplace.
Turnover results in changes to the human and intellectual capital of the organization and can impact
productivity. Turnover has direct cost implications either in terms of reduced payroll or greater
expenses for the recruitment of employees."
126
127 newIndicator:
128 id:hire_num_agegroup
129 name:"Number of new hired employees per age group"
130 topic:t401_1
131 Unit:number
132 indicatorType:directindicator
133
134 newIndicator:
135 id:hire_num_agegroup_ii
136 name:"Number of new hired employees per age group"
137 topic:t401_1
138 Unit:number
139 indicatorType:indirectindicator
140 formula:mean(hire_num_agegroup)
141
142 newIndicator:
143 id:hire_num_gender
144 name:"Number of new hired employees per gender"
145 topic:t401_1
146 Unit:number
147 indicatorType:directindicator
148
149 newIndicator:
150 id:hire_num_gender_ii
151 name:"Number of new hired employees per gender"
152 topic:t401_1
153 Unit:number
154 indicatorType:indirectindicator
155 formula:mean(hire_num_gender)
156
157 newIndicator:
158 id:hire_num_region
159 name:"Number of new hired employees per region"
160 topic:t401_1
161 Unit:number
162 indicatorType:directindicator
163
164 newIndicator:
165 id:hire_num_region_ii
166 name:"Number of new hired employees per region"
167 topic:t401_1
168 Unit:number
169 indicatorType:indirectindicator
170 formula:mean(hire_num_region)
171
172 newIndicator:
173 id:hire_rate_agegroup
174 name:"New employees hire rate per age group"
175 topic:t401_1
176 Unit:number
177 indicatorType:directindicator
178
179 newIndicator:
180 id:hire_rate_agegroup_ii
181 name:"New employees hire rate per age group"
182 topic:t401_1
183 Unit:number
184 indicatorType:indirectindicator
185 formula:mean(hire_rate_agegroup)
186
187 newIndicator:
188 id:hire_rate_gender
```

```

189 name:"New employees hire rate per gender"
190 topic:t401_1
191 Unit:number
192 indicatorType:directindicator
193
194 newIndicator:
195 id:hire_rate_gender_ii
196 name:"New employees hire rate per gender"
197 topic:t401_1
198 Unit:number
199 indicatorType:indirectindicator
200 formula:mean(hire_rate_gender)
201
202 newIndicator:
203 id:hire_rate_region
204 name:"New employees hire rate per region"
205 topic:t401_1
206 Unit:number
207 indicatorType:directindicator
208
209 newIndicator:
210 id:hire_rate_region_ii
211 name:"New employees hire rate per region"
212 topic:t401_1
213 Unit:number
214 indicatorType:indirectindicator
215 formula:mean(hire_rate_region)
216
217 newIndicator:
218 id:turnover_num_agegroup
219 name:"Number of employees turnover per age group"
220 topic:t401_1
221 Unit:number
222 indicatorType:directindicator
223
224 newIndicator:
225 id:turnover_num_agegroup_ii
226 name:"Number of employees turnover per age group"
227 topic:t401_1
228 Unit:number
229 indicatorType:indirectindicator
230 formula:mean(turnover_num_agegroup)
231
232 newIndicator:
233 id:turnover_num_gender
234 name:"Number of employees turnover per gender"
235 topic:t401_1
236 Unit:number
237 indicatorType:directindicator
238
239 newIndicator:
240 id:turnover_num_gender_ii
241 name:"Number of employees turnover per gender"
242 topic:t401_1
243 Unit:number
244 indicatorType:indirectindicator
245 formula:mean(turnover_num_gender)
246
247 newIndicator:
248 id:turnover_num_region
249 name:"Number of employees turnover per region"
250 topic:t401_1
251 Unit:number
252 indicatorType:directindicator
253
254 newIndicator:
255 id:turnover_num_region_ii
256 name:"Number of employees turnover per region"
257 topic:t401_1
258 Unit:number
259 indicatorType:indirectindicator
260 formula:mean(turnover_num_region)
261
262 newIndicator:

```

```

263 id:turnover_rate_agegroup
264 name:"Employee turnover rate per age group"
265 topic:t401_1
266 Unit:number
267 indicatorType:directindicator
268
269 newIndicator:
270 id:turnover_rate_agegroup_ii
271 name:"Employee turnover rate per age group"
272 topic:t401_1
273 Unit:number
274 indicatorType:indirectindicator
275 formula:mean(turnover_rate_agegroup)
276
277 newIndicator:
278 id:turnover_rate_gender
279 name:"Employee turnover rate per gender"
280 topic:t401_1
281 Unit:number
282 indicatorType:directindicator
283
284 newIndicator:
285 id:turnover_rate_gender_ii
286 name:"Employee turnover rate per gender"
287 topic:t401_1
288 Unit:number
289 indicatorType:indirectindicator
290 formula:mean(turnover_rate_gender)
291
292 newIndicator:
293 id:turnover_rate_region
294 name:"Employee turnover rate per region"
295 topic:t401_1
296 Unit:number
297 indicatorType:directindicator
298
299 newIndicator:
300 id:turnover_rate_region_ii
301 name:"Employee turnover rate per region"
302 topic:t401_1
303 Unit:number
304 indicatorType:indirectindicator
305 formula:mean(turnover_rate_region)
306
307 newTopic:
308 id:t401_2
309 title:"Benefits provided to full-time employees that are not provided to temporary or part-time employees"
310 superTopic:C401
311
312 newIndicator:
313 id:employee_benefits
314 name:"Employee benefits, by significant locations of operation"
315 topic:t401_2
316 Unit:text
317 indicatorType:directindicator
318
319 newIndicator:
320 id:employee_benefits_ii
321 name:"Employee benefits, by significant locations of operation"
322 topic:t401_2
323 Unit:text
324 indicatorType:indirectindicator
325 formula:sum(employee_benefits)
326
327 newIndicator:
328 id:loc_operations
329 name:"Definition for signification locations of operations"
330 topic:t401_2
331 Unit:text
332 indicatorType:directindicator
333
334 newIndicator:
335 id:loc_operations_ii
336 name:"Definition for signification locations of operations"

```



```

337 topic:t401_2
338 Unit:text
339 indicatorType:indirectindicator
340 formula:sum(loc_operations)
341
342
343
344 newSurvey:
345 id:GRISingleSurvey
346 title:"GRI employment survey"
347 minResponseRate:1
348
349
350 newSection:
351 topic:t401_0
352
353 newInstruction:
354 id:i1
355 instruction:"The reporting organization shall report its management approach for employment using GRI 103
Management Approach."
356
357 newInstruction:
358 id:i2
359 instruction:"Guidance for the following question:
360
361 Policies or practices covering the relationships under which work is performed for an organization can
include recognized employment relationships, the use of employees of other organizations (such as
workers supplied by agencies), and the extent to which work is performed on a temporary or part-time
basis. A description of policies and practices can include policies and practices with respect to
discrimination, compensation, promotion, privacy, human resource development and industrial relations.
362
363 Work taking place within an appropriate institutional and legal framework usually entails a recognized
employment relationship with an identifiable and legally recognized employer.
364
365 Conditions of work can include compensation, working time, rest periods, holidays, disciplinary and
dismissal practices, maternity protection, the workplace environment, and occupational health and
safety. They can also include the quality of living accommodations where provided, and welfare matters,
such as safe drinking water, canteens and access to medical services.
366
367 Adequately remunerated work is work where wages and compensation for a standard working week, excluding
overtime, meet legal and industry minimum standards, and are sufficient to meet the basic needs of
workers and their families, and to provide them with some discretionary income. Actions taken to
address situations where work is inadequately remunerated can include:
368 - dialogue with suppliers regarding the relationship of the prices paid to suppliers and the wages paid to
workers;
369 - changes to an organization's procurement practices
370 - support for collective bargaining to determine wages
371 - determining the extent that overtime is used, whether it is mandatory, and whether it is compensated at a
premium rate."
372
373 newQuestion:
374 id:Q1
375 question:"What policies or practises cover the relationship under which work is performed for the
organisation?"
376 mandatory:no
377 referenceTo:work_policies
378 answerDataType:textLong
379 answerCardinality:single
380 UIcomponent:field
381
382 newQuestion:
383 id:Q2
384 question:"What actions are taken to determine and adress situations where work within the supply chain does
not take place within appropriate institutional and legal frameworks?"
385 mandatory:no
386 referenceTo:supplychain_legal
387 answerDataType:textLong
388 answerCardinality:single
389 UIcomponent:field
390
391 newQuestion:
392 id:Q3
393 question:"What actions are taken to determine and address situations where persons working for suppliers
are not provided the social and labor protection that they are entitled to receive by national labor

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    law?"
394 mandatory:no
395 referenceTo:supplychain_labor_protection
396 answerDataType:textLong
397 answerCardinality:single
398 UIcomponent:field
399
400 newQuestion:
401 id:Q4
402 question:"what actions are taken to determine and address situations where working conditions in the supply
    chain do not meet international labor standards or national labor law?"
403 mandatory:no
404 referenceTo:supplychain_workconditions
405 answerDataType:textLong
406 answerCardinality:single
407 UIcomponent:field
408
409 newQuestion:
410 id:Q5
411 question:"what actions are taken to determine and address situations where work undertaken in the supply
    chain is inadequately remunerated?"
412 mandatory:no
413 referenceTo:supplychain_remuneration
414 answerDataType:textLong
415 answerCardinality:single
416 UIcomponent:field
417
418 newQuestion:
419 id:Q6
420 question:"what actions are taken to determine and address situations of disguised employment relationships
    where workers in the supply chain are falsely considered to be self-employed or where there is no
    legally recognized employer?"
421 mandatory:no
422 referenceTo:supplychain_false_employment
423 answerDataType:textLong
424 answerCardinality:single
425 UIcomponent:field
426
427 newQuestion:
428 id:Q7
429 question:"what actions taken to determine and address situations where work undertaken in the supply chain
    is performed from home is not subject to legally recognized contracts?"
430 mandatory:no
431 referenceTo:supplychain_work_home
432 answerDataType:textLong
433 answerCardinality:single
434 UIcomponent:field
435
436 newSection:
437 topic:t401_1
438
439 newQuestion:
440 id:q8
441 question:"What is the total number of new employees hired during the reporting period per age group?"
442 help:"An organization can use the following age groups: Under 30 years old; 30-50 years old; Over 50 years
    old."
443 mandatory:yes
444 referenceTo:hire_num_agegroup
445 answerDataType:number
446 answerCardinality:single
447 UIcomponent:field
448
449 newQuestion:
450 id:q9
451 question:"What is the total number of new employees hired during the reporting period per gender?"
452 mandatory:yes
453 referenceTo:hire_num_gender
454 answerDataType:number
455 answerCardinality:single
456 UIcomponent:field
457
458 newQuestion:
459 id:q10
460 question:"What is the total number of new employees hired during the reporting period per region?"

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```
461 mandatory:yes
462 referenceTo:hire_num_region
463 answerDataType:number
464 answerCardinality:single
465 UIcomponent:field
466
467 newQuestion:
468 id:q11
469 question:"What is the rate of new employees hired during the reporting period per age group?"
470 help:"An organization can use the following age groups: Under 30 years old; 30-50 years old; Over 50 years
    old."
471 mandatory:yes
472 referenceTo:hire_rate_agegroup
473 answerDataType:number
474 answerCardinality:single
475 UIcomponent:field
476
477 newQuestion:
478 id:q12
479 question:"What is the rate of new employees hired during the reporting period per gender?"
480 mandatory:yes
481 referenceTo:hire_rate_gender
482 answerDataType:number
483 answerCardinality:single
484 UIcomponent:field
485
486 newQuestion:
487 id:q13
488 question:"What is the rate of new employees hired during the reporting period per region?"
489 mandatory:yes
490 referenceTo:hire_rate_region
491 answerDataType:number
492 answerCardinality:single
493 UIcomponent:field
494
495 newQuestion:
496 id:q14
497 question:"What is the total number of employee turnover during the reporting period per age group?"
498 help:"An organization can use the following age groups: Under 30 years old; 30-50 years old; Over 50 years
    old."
499 mandatory:yes
500 referenceTo:turnover_num_agegroup
501 answerDataType:number
502 answerCardinality:single
503 UIcomponent:field
504
505 newQuestion:
506 id:q15
507 question:"What is the total number of employee turnover during the reporting period per gender?"
508 mandatory:yes
509 referenceTo:turnover_num_gender
510 answerDataType:number
511 answerCardinality:single
512 UIcomponent:field
513
514 newQuestion:
515 id:q16
516 question:"What is the total number of employee turnover during the reporting period per region?"
517 mandatory:yes
518 referenceTo:turnover_num_region
519 answerDataType:number
520 answerCardinality:single
521 UIcomponent:field
522
523 newQuestion:
524 id:q17
525 question:"What is the rate of employee turnover during the reporting period per age group?"
526 help:"An organization can use the following age groups: Under 30 years old; 30-50 years old; Over 50 years
    old."
527 mandatory:yes
528 referenceTo:turnover_rate_agegroup
529 answerDataType:number
530 answerCardinality:single
531 UIcomponent:field
```

```
532
533 newQuestion:
534 id:q18
535 question:"What is the rate of employee turnover during the reporting period per gender?"
536 mandatory:yes
537 referenceTo:turnover_rate_gender
538 answerDataType:number
539 answerCardinality:single
540 UIcomponent:field
541
542 newQuestion:
543 id:q19
544 question:"What is the rate of employee turnover during the reporting period per region?"
545 mandatory:yes
546 referenceTo:turnover_rate_region
547 answerDataType:number
548 answerCardinality:single
549 UIcomponent:field
550
551 newSection:
552 topic:t401_2
553
554 newQuestion:
555 id:q20
556 question:"Benefits which are standard for full-time employees of the organization but are not provided to
    temporary or part-time employees, by significant locations of operation. These include, as a minimum:"
557 help:"Exclude in-kind benefits such as provision of sports or child day care facilities, free meals during
    working time, and similar general employee welfare programs."
558 mandatory:yes
559 referenceTo:employee_benefits
560 answerDataType:enumUserDefined
561 answerCardinality:multiple
562 UIcomponent:checkbox
563 options:"life insurance","health care","disability and invalidity coverage","parental leave","retirement
    provision","stock ownership"
564 othersOption:yes
565
566 newQuestion:
567 id:q21
568 question:"What is your companies definition for signification locations of operations. "
569 mandatory:yes
570 referenceTo:loc_operations
571 answerDataType:textLong
572 answerCardinality:single
573 UIcomponent:field
```

V. Behavioural requirements validation numbers

Table XIV
BEHAVIOURAL REQUIREMENTS ACHIEVEMENT AND PROOF

User Story	Requirement	Status	Source	
Report	US-R-1	Overview	V	See Appendix XII-W, Fig. 25 and 26
	US-R-2	Export	X	
	US-R-3	Access to all data	X	
	US-R-4	Indicator view	V	See Appendix XII-W, Fig. 27
	US-R-5	Response in indicator	V	See Appendix XII-W, Fig. 27
	US-R-6	Indicator and question link	V	See Chapter VII-B
	US-R-7	Intertwining information	V	See Chapter VII-B
	US-R-8	Indicators and topic link	V	See Chapter VII-B
	US-R-9	Data units	X	
	US-R-10	Unit conversion	X	
	US-R-11	Content merging	X	
Survey	US-S-1	Survey actions	V	See Appendix XII-W, Fig. 29
	US-S-2	Question response overview	V	See Appendix XII-W, Fig. 30
	US-S-3	Automated communication	V	See Appendix XII-W, Fig. 31
	US-S-4	Participants reminders	X	
	US-S-5	Minimum response rate	V	See Appendix XII-W, Fig. 29
	US-S-6	Target participants	V	See Appendix XII-W, Fig. 31
	US-S-7	Anonymous response	V	See Appendix XII-W, Fig. 32
	US-S-8	Answer types	V	See Chapter VII-B
	US-S-9	Answer types	V	See Chapter VII-B
	US-S-10	Intertwining information	V	See Chapter VII-B
Stakeholder	US-STH-1	Stakeholder management	V	See Appendix XII-W, Fig. 33
	US-STH-2	Create stakeholder group	V	See Appendix XII-W, Fig. 34
	US-STH-3	Multiple stakeholder groups	X	
DSL	US-DSL-1	Arithmetic, statistical, and functional indicator operators	X	Only arithmetic and statistical is implemented, see DSL chapter VII-B, Listing 6
	US-DSL-2	Specification file generation	V	See implementation chapter VIII-A
	US-DSL-3	Specification file validation	V	See Appendix XII-W, Fig. 35
	US-DSL-4	Specification file marketplace	X	
	US-DSL-5	Topic taxonomy	V	see chapter VII-B, Listing 4
	US-DSL-6	Survey description	V	see chapter VII-B, Listing 7
	US-DSL-7	Survey messages	V	see chapter VII-B, Listing 7
	US-DSL-8	Answer types, cardinality and ui component	V	see chapter VII-B, Listing 7
	US-DSL-9	Question grouping	V	see chapter VII-B, Listing 7
	US-DSL-10	Custom questions	V	see chapter VII-B, Listing 7
	US-DSL-11	Specification workflow	V	see chapter VII-B, second alinea
	US-DSL-12	Conflicting data units validation	V	see Appendix XII-Q
	US-DSL-13	Missing direct indicator and question link validation	V	see Appendix XII-Q
	US-DSL-14	Non-unique ids validation	V	see Appendix XII-Q
	US-DSL-15	Statistical test and question type validation	V	see Appendix XII-Q

W. Print screens

Reports

Report	Created by	Last updated	Updated by
BIA-2020	Henny Kruiper	21-07-2020	Henny Kruiper

Figure 25. Report overview openESEA

Settings

DETAILS

Name

BIA-2020

Public

This is a public report

This setting is inherited from the organisation's settings. In the future, you will be able to make a report publicly available separately from its organisation.

Save changes

ADVANCED

Delete this report

Figure 26. Report management openESEA

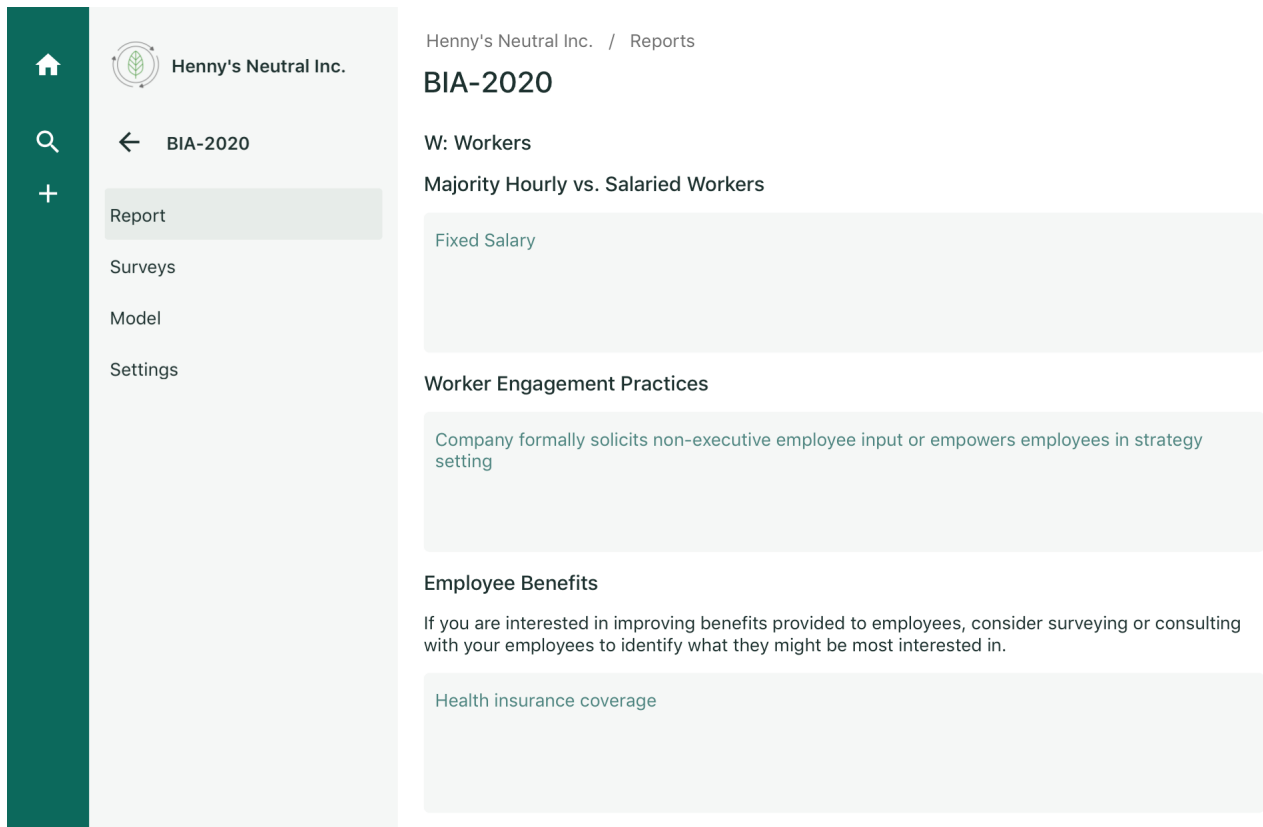


Figure 27. Report openESEA, with automatically populated data based on survey response

```

methodSpec.eseads |
415 newQuestion:
416 id:Q8
417 question:"Does your company provide any of the following opportunities for pro
418 mandatory:yes
419 referenceTo:employee_development
420 answerDataType:enumUserDefined
421 answerCardinality:multiple
422 UIcomponent:checkbox
423 options:"Company has formal onboarding process for new employees","Company pro
424 othersOption:no

```

Figure 28. Linking questions to indicators when specifying a method

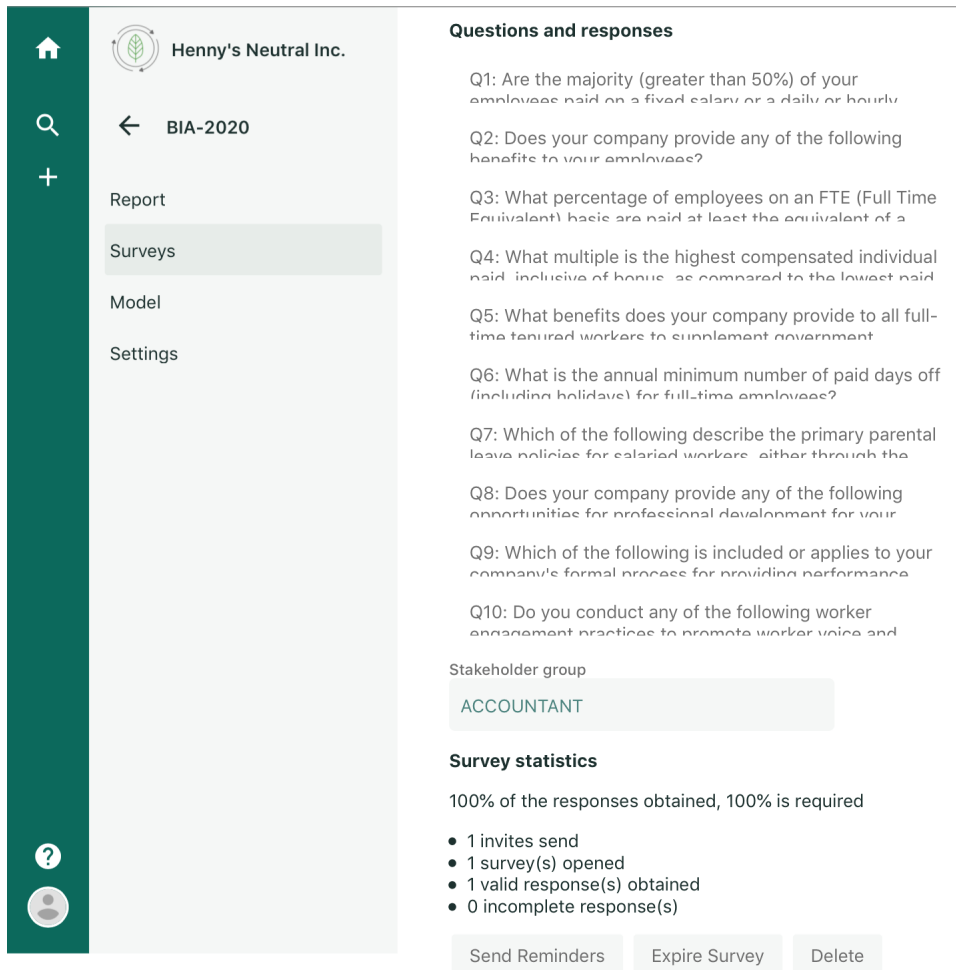


Figure 29. Survey actions to perform

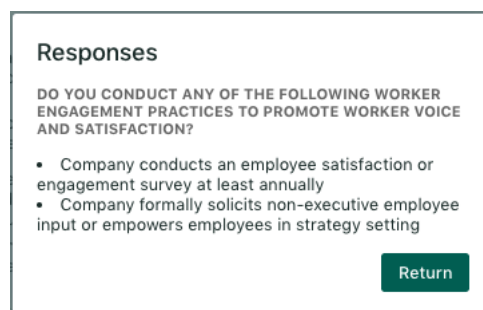


Figure 30. Question response overview

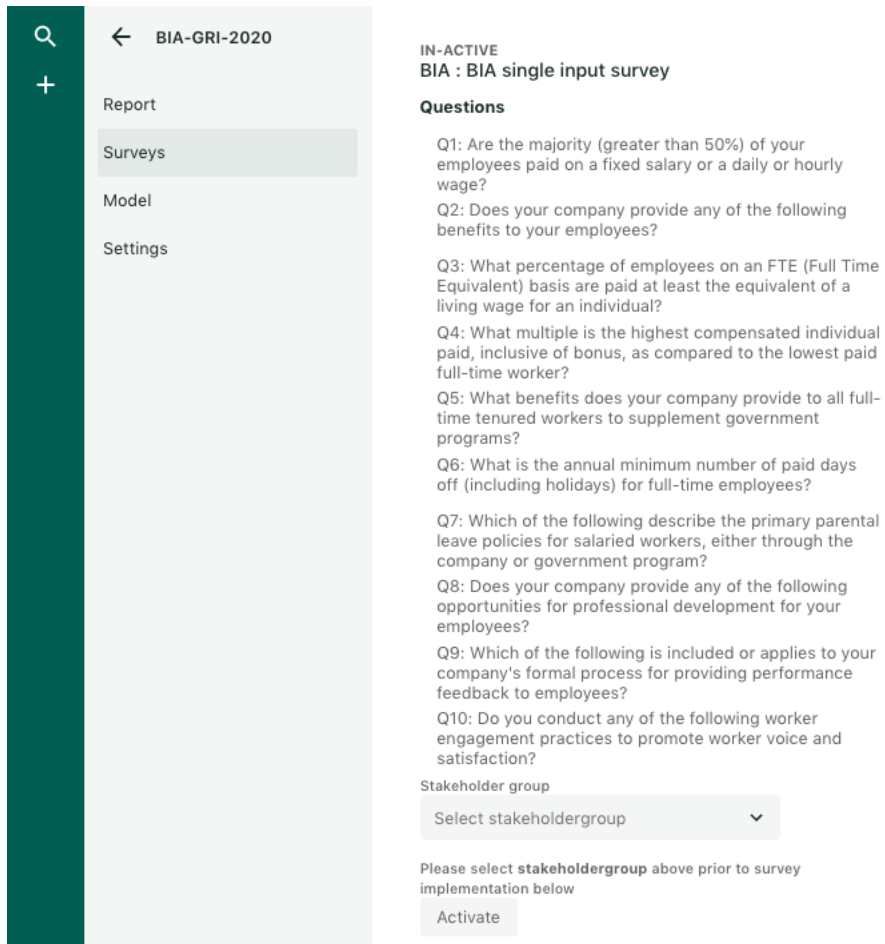


Figure 31. Deploying a survey

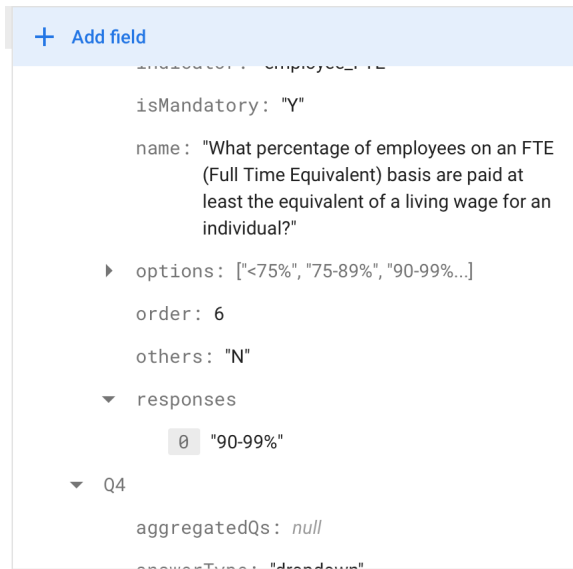


Figure 32. Anonymous responses in database

Henny's Neutral Inc.

People Add Import

Name	Email	Group
Piet Klaassen	pietertje@test123.com	Accountant

Figure 33. Stakeholder management

Please add a stakeholdergroup or stakeholder. Unfortunately, a stakeholdergroup and stakeholder cannot be added simultaneously.

Add stakeholdergroup

Stakeholdergroup name

Add stakeholder

First Name

Last Name

Email adress

Select group ▼

Add Cancel

Figure 34. Adding stakeholders and groups

```
*methodSpec.eseadsl  ⌵
1  newTopic:
2  id:C1
3  title:"W: Workers"
4
5  newTopic:
6  id:W1
7  title:"Majority Hourly vs. Salaried Workers"
8  superTopic:C1
9
10
11  newIndicator:
12  id:employee_pay_structure
13  topic:W1
14  Unit:text
15  indicatorType:directindicator
16
17  newIndicator:
18  id:employee_pay_structure_ii
19  topic:W1
20  Unit:text
21  indicatorType:indirectindicator
22  formula:sum(employee_pay_structu
23
24
```

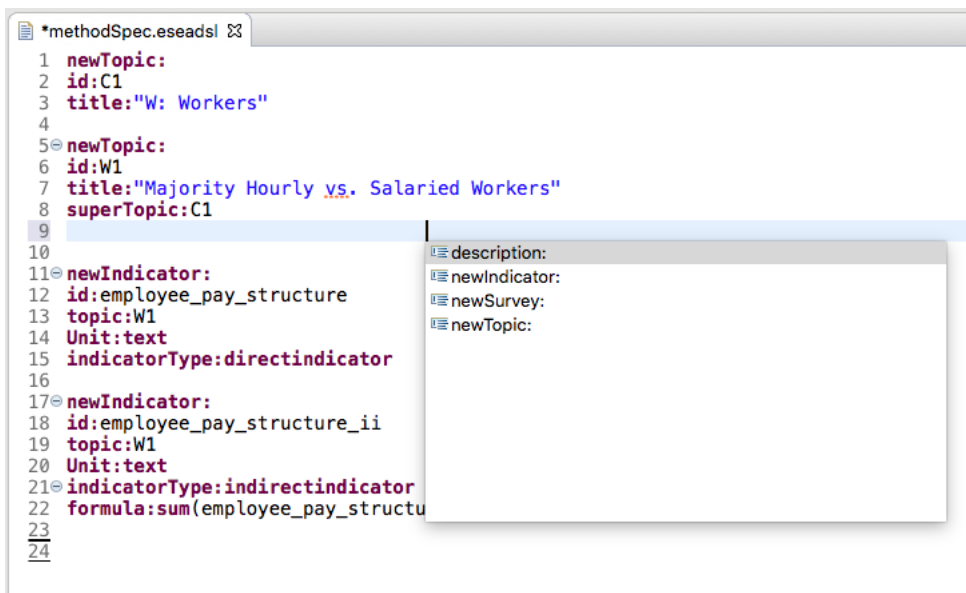


Figure 35. Xtext specification