Engineering of Transparency Requirements in Business Information Systems

Seyed Mahmood Hosseini Moghaddam

FACULTY OF SCIENCE AND TECHNOLOGY

BOURNEMOUTH UNIVERSITY

Engineering of Transparency Requirements in Business Information Systems

By
Seyed Mahmood Hosseini Moghaddam

A thesis submitted in partial fulfilment of the requirements of Bournemouth University for the degree of Doctor of Philosophy

October 2016

Dedicated to my wife, Parisa.

ABSTRACT

Transparency is defined as the open flow of high quality information in a meaningful and useful manner amongst stakeholders in a business information system. Therefore transparency is a requirement of businesses and their information systems. It is typically linked to positive ethical and economic attributes, such as trust and accountability. Despite its importance, transparency is often studied as a secondary concept and viewed through the lenses of adjacent concepts such as security, privacy and regulatory requirements. This has led to a reduced ability to manage transparency and deal with its peculiarities as a first-class requirement. Ad-hoc introduction of transparency may have adverse effects, such as information overload and reduced collaboration.

The thesis contributes to the knowledge on transparency requirements by proposing the following. First, this thesis proposes four reference models for transparency. These reference models are based on an extensive literature study in multiple disciplines and provide a foundation for the engineering of transparency requirements in a business information system. Second, this thesis proposes a modelling language for modelling and analysing transparency requirements amongst stakeholders in a business information system. This modelling language is based on the proposed four reference models for transparency. Third, this thesis proposes a method for the elicitation and adaptation of transparency requirements in a business information system. It covers the entire life cycle of transparency requirements and utilises the transparency modelling language for modelling and analysis of transparency requirements. It benefits from three concepts of crowdsourcing, structured feedback acquisition and social adaptation for the elicitation and adaptation of transparency requirements.

The thesis also evaluates the transparency modelling language in terms of its usefulness and quality using two different case studies. Then, the feedback acquisition section in the transparency elicitation and adaptation method is evaluated using a third case study. The results of these case studies illustrate the potentials and applicability of both the modelling language and the method in the engineering of transparency requirements in business information systems.

Contents

Appendices

List of Figures

List of Tables

ACKNOWLEDGEMENTS

Firstly, I would like to express my sincere gratitude to my first supervisor, Dr Raian Ali, for the continuous support of my PhD study and related research. I would like to thank him for his patience, motivation, and immense knowledge. His guidance helped me in all the time of research and writing of this thesis. Without him, this journey would not have been possible.

Besides my first supervisor, I would like to thank my second and third supervisors, Professor Keith Phalp and Associate Professor Jacqui Taylor, for their insightful comments and encouragement, and also for their involvement in various stages of my PhD which incented me to widen my research from various perspectives.

I am also thankful of my friends in Bournemouth, who made this journey pleasant and memorable. I would like to thank my parents for their support and their help, and also my in-laws for their constant motivation.

Last but definitely not least, I would like to thank my beloved wife. Words cannot express how grateful I am to her for all the sacrifices she made on my behalf. She has cherished with me every great moment and supported me whenever I needed it. My deepest gratitude goes to her for her unflagging love and unconditional support throughout my life and my studies.

Mahmood Hosseini

Publications Resulted from This Thesis

1. Hosseini, M., Phalp, K.T., Taylor, J. and Ali, R., 2014. Towards crowdsourcing for requirements engineering. In *20th International working conference on Requirements engineering: foundation for software quality-Empirical Track*.
2. Hosseini, M., Phalp, K., Taylor, J. and Ali, R., 2014, May. The four pillars of crowdsourcing: A reference model. In *2014 IEEE Eighth International Conference on Research Challenges in Information Science (RCIS)* (pp. 1-12). IEEE.
3. Hosseini, M., Shahri, A., Phalp, K., Taylor, J., Ali, R. and Dalpiaz, F., 2015, May. Configuring crowdsourcing for requirements elicitation. In *2015 IEEE 9th International Conference on Research Challenges in Information Science (RCIS)* (pp. 133-138). IEEE.
4. Hosseini, M., Shahri, A., Phalp, K., Taylor, J. and Ali, R., 2015. Crowdsourcing: A taxonomy and systematic mapping study. *Computer Science Review*, *17*, pp.43-69.
5. Hosseini, M., Shahri, A., Phalp, K. and Ali, R., 2015, May. Recommendations on adapting crowdsourcing to problem types. In *2015 IEEE 9th International Conference on Research Challenges in Information Science (RCIS)* (pp. 423-433). IEEE.
6. Hosseini, M., Phalp, K., Taylor, J. and Ali, R., 2015. On the configuration of crowdsourcing projects. *International Journal of Information System Modeling and Design (IJISMD)*, *6*(3), pp.27-45.
7. Hosseini, M., Moore, J., Almaliki, M., Shahri, A., Phalp, K. and Ali, R., 2015. Wisdom of the Crowd within enterprises: Practices and challenges. *Computer Networks*, *90*, pp.121-132.
8. Hosseini, M., Shahri, A., Phalp, K.T. and Ali, R., 2015. Transparency as a requirement. In: *Joint Proceedings of REFSQ-2015 Workshops, Research Method Track, and Poster Track co-located with the 21st International Conference on Requirements Engineering: Foundation for Software Quality (REFSQ).*
9. Hosseini, M., Shahri, A., Phalp, K. and Ali, R., 2015, August. Towards engineering transparency as a requirement in socio-technical systems. In *2015 IEEE 23rd International Requirements Engineering Conference (RE)*(pp. 268-273). IEEE.
10. Hosseini, M., Shahri, A., Phalp, K. and Ali, R., 2016, June. A Modelling Language for Transparency Requirements in Business Information Systems. In *International Conference on Advanced Information Systems Engineering*(pp. 239-254). Springer International Publishing.
11. Hosseini, M., Shahri, A., Phalp, K.T. and Ali, R., 2016. Crowdsourcing Transparency Requirements through Structured Feedback and Social Adaptation. In *Proceedings of the IEEE Tenth International Conference on Research Challenges in Information Science (RCIS)*.

12. Hosseini, M., Shahri, A., Phalp, K. and Ali, R. Four Reference Models for Engineering Transparency Requirements in Business Information Systems. *Requirements Engineering Journal.* [Under Review]
13. Hosseini, M., Shahri, A., Phalp, K. and Ali, R. Engineering Transparency Requirements: a Modelling and Analysis Framework. *Information Systems*. [Submitted]
14. Hosseini, M., Shahri, A., Phalp, K. and Ali, R. Transparency: a literature review. [Under Preparation]

Declaration of Co-authors' Contribution to the Published Work of This Thesis

The author of this thesis was the first author of all the resulted publications of this thesis. The contribution of the first author was as follows:

- Forming and articulating the idea and aim of each paper.
- Deciding upon the appropriate methodology to be adopted in each paper (e.g., following a qualitative approach).
- Designing and implementing the empirical studies presented in each paper (e.g., developing interview scripts, recruiting participants, and collecting the data).
- Analysing and interpreting the collected data and drawing the conclusions (e.g., quantitative and qualitative analyses).
- Reporting the findings and fully writing each paper.

The co-authors contributed to the published papers in terms of verifying and validating the studies' findings by comparing them against the actual responses from the participants. They also provided guidance and feedback on the structure and overall articulation of the papers' message. In addition, they gave insights on the methodologies and also checked the quality of the papers and suggested modifications on some parts of the text. Furthermore, the co-authors enriched the papers with the appropriate terminologies in certain places, especially those related to the venue where the papers were published.

In publication number 7, the author of this thesis shared responsibilities with Mr Jack Moore in the contributions listed above, and would like to thank him for his efforts.

Chapter 1

Introduction

"The last thing that we find in making a book is to know what we must put first."

Blaise Pascal

1 Introduction

Requirements engineering (RE) refers to the process of the elicitation, evaluation, specification, analysis and evolution of the objectives, functionalities, qualities and constraints to be achieved by a software-intensive system within some organisational or physical environment (Van Lamsweerde 2009). Requirements engineering assures that a software solution can appropriately solve the problem for which it has been designed. In order to achieve this, however, requirements engineers should understand and define the problem. They need to discover, understand, formulate, analyse and agree on what the problem is, why the problem needs a solution, and who should be involved in the responsibility of solving the problem (Van Lamsweerde 2009).

In the field of requirements engineering, requirements are generally broken down into two major categories, functional and non-functional requirements (NFRs). Even though there is still no consensus about the nature of NFRs, functional requirements have a rather broadly accepted definition (Glinz 2007). A functional requirement is defined as a function that a software system must be able to perform (IEEE Standards Association 1990), what the software product must do (Robertson and Robertson 2012), and what the software system should do (Sommerville 2004). Since functional requirements may also refer to the behaviour of a software system (Anton 1997), a broader definition has also been proposed as follows: "A requirement that specifies an action that a system must be able to perform, without considering physical constraints; a requirement that specifies input/output behaviour of a system." (Jacobson et al. 1999)

NFRs, on the other hand, have been defined in many different ways, and there have been definition problems, classification problems, and representation problems with NFRs (Glinz 2007). However, most definitions refer to NFRs as non-behavioural aspects of a software system which capture the properties and constraints under which a software system operates (Anton 1997), requirements that specify physical constraints on a functional requirement (Jacobson et al. 1999), and requirements that do not have a bearing on a software system functionality, but describe attributes, constraints, performance considerations, design, quality of service, environmental considerations, failure and recovery (SCREEN Glossary 1999). Therefore, one might state that non-functional requirements describe how the system works, while functional requirements describe what the system should do.

One of the less discussed NFRs in software systems is **transparency**. Transparency is defined as the open flow of information amongst stakeholders (Holzner and Holzner 2006). The definition of transparency used throughout this thesis is based on the above definition, and is as follows: "Transparency is defined as the open flow of high quality information in a meaningful and useful manner amongst stakeholders in a business information system." Therefore, transparency

requirements relate to the information which is provided to stakeholders, usually in order for them to make informed decisions. In the requirements engineering literature, the study of transparency requirements has been a scarcity, and the earliest works in this field date back to 2007 (Cappelli et al. 2007).

Transparency requirements look like any information provision or information request within a business information system and can be formatted as a user story as follows:

> "As stakeholder A, I want to get information from stakeholder B, so that I can use the information in my decision making."

Or as follows:

> "As stakeholder A, I want to give information to stakeholder B, so that stakeholder B can use the information in their decision making."

For example, an insurance company customer may need to get some information from the insurance company about their cancellation policies, so that they can decide whether they want to take that insurance product from that company or not. This is an example of transparency for the first user story. For another example, a bank provides information on different current account products and their comparison with each other to the bank customer, so that the bank customer can make an informed decision on what current account product to choose. This is an example of transparency for the second user story.

Because the word transparency offers a nicely ambivalent notion which has a positive normative meaning (Michener and Bersch 2011), it is generally considered to be a positive attribute of information systems. However, transparency has been shown to be an undesirable information quality in some cases. For instance, it is stated that increased transparency in the relationship between buyers and suppliers may result in some negative effects such as unwanted exposure of information to competitors (Hultman and Axelsson 2007). Consequently, it is imperative to take precautionary steps towards providing transparency in order to reduce such adverse effects.

Furthermore, the change of the millennium and the emergence of the new generation, sometimes called the digital natives, who are both transparent and are actively seeking transparency (Casey 2015) often through the use of the Internet, Web 2.0 and social media, plus the occurrence of several recent crises in the financial sector (Michener and Bersch 2011) and the social sector (Ko et al. 2015) which mainly arose either from the lack of transparency or abundance of transparency, have shifted attention to transparency requirements.

Eliciting transparency requirements can be a difficult task, as information related to transparency may be intermixed with general information requests which are not related to transparency (Hosseini et al. 2015b). Furthermore, the difficulty increases as it should be made clear what information to reveal, how this disclosure of information should be regulated considering other information-related NFRs, such as privacy requirements (Sprague 2007), and to whom such information should be revealed, amongst other concerns related to transparency. For example, not every request of information from a website should be replied to by posting the requested information publicly on the website, because it can lead to information overload, information misuse, breaches of security, etc.

Another issue regarding the engineering of transparency requirements is their evolution over time. Initially, transparency requirements can be elicited in the early stages of software development, to be embedded in the business information system-to-be. However, transparency requirements may change over time, e.g., as certain pieces of information may no longer be needed to be transparent because they are already well-known by the stakeholders. Consequently, business information systems should be able to adapt to such changes. Let us assume that, in the example of a human resources (HR) website, a pop-up window opens up every time employees are asked for a certain piece of information, explaining (and therefore being transparent) why that piece of information is needed by the HR and how it can help them in their decision-making process. Some employees, however, may be uninterested to know the rationale behind such information requests (which may cause information overload for them), while others, once they have read the information, may never want to read the same explanation again with every HR request for the same piece of information (which may cause unnecessary transparency).

Another issue to consider is that stakeholders in a business information system have different roles within the business environment. However, transparency requirements often vary not only at the role level but also at the individual level. Therefore, it is inevitable that more stakeholders should be actively engaged during the elicitation process for the discovery of their heterogeneous requirements, and their voices should also be heard for the evolution of the business information system.

In the domain of information systems and requirements engineering, transparency is currently an under-researched topic. There is a lack of conceptual models and rigorous methods for engineering transparency as a requirement. Transparency is often studied as an element of other requirements concepts, such as privacy, security and regulatory requirements (Kotz et al. 2009). However, in order to better manage transparency requirements of stakeholders, there is a need to study it as a first-

class requirement concept. Furthermore, the literature on transparency in general, and in computer sciences in particular, still lacks a critical focus, which is a systematic modelling of transparency. Without a rigorous and systematic model, several other issues cannot be duly addressed. First, a transparency model can facilitate a consistent method for eliciting transparency requirements of stakeholders. Second, a transparency model can provide methods for analysing transparency, which could be automated as well. Third, a rigorous transparency model can also make way for automated validation and evaluation of transparency. Such a model, however, does not exist for transparency yet.

Due to the nature of transparency requirements, their elicitation requires novel approaches. Traditionally, requirements elicitation is carried out during the design time, usually by gathering a sample group of (expert) users and performing interviews, focus groups, questionnaire distribution and similar methods of data collection. It is generally believed that when the sample is sufficiently representative of the users of a software system, requirements engineers are able to successfully elicit all the requirements from that sample and design the system based on the elicited requirements from that group of users (Van Lamsweerde 2009).

Recently, however, there has been a shift in the paradigm of requirements engineering from the traditional methods of requirements elicitation to more modern, adaptive methods. These methods, as will be revealed in this thesis, also have a great potential to aid the engineering of transparency requirements. The motive for this shift has been the inadequacy of the traditional methods of requirements elicitation which cannot cope with the ever-changing context in which new software-intensive systems operate, and the growing diversity amongst software users. The advent of Web2.0 and mobile applications has also rendered traditional methods of requirements elicitation less productive and functional (Herbsleb 2007). Furthermore, the need to evolve software-intensive systems more frequently to meet the new requirements of the users and to give their developers a competitive advantage in the fast-growing software market has increased the need for more efficient and less costly methods of requirements elicitation (Damian and Zowghi 2002).

To respond to this need, it has been suggested that users should be more involved during different stages of software design, so that the designed software system closely matches their requirements (El Emam et al. 1996). It has also been suggested that software evolution should benefit from adaptive methods which adapt the software system to the current needs of software users (Cazzola et al. 2004). In order to involve software users during the design process and give them a broader, more efficient role during the process of requirements engineering, several methods have been proposed. In the following, some of these methods are briefly explained:

a) **User-Centred Design (UCD)**: UCD emphasises that the purpose of any system is to serve its users, and as a result, the needs of users should dominate the interface design, and the needs of the interface should dominate the design of the rest of the system (Norman 1986). It also describes an iterative process, whose goal is developing a system that can be effectively used, by involving its potential users during the system design (Karat 1996). Although UCD has been defined in many different ways (Gulliksen et al. 2003), it is generally considered to be a design-time process of involving users in system design decisions. Therefore, it does not discuss and consider user involvement either during system evolution or during runtime.

b) **Participatory Design (PD):** PD is a similar concept, ensuring that users of a system are involved in its design as co-designers and informants (Schuler and Namioka 1993). It generally stems from the belief that people have a democratic right to be included in the design of what is going to affect them, and that such inclusion results in more efficient and more usable systems (Bowen 2010). Similar to UCD, PD is generally a design-time inclusion.

c) **Computer-Supported Cooperative Work (CSCW)**: CSCW studies and analyses coordination mechanisms for effective human communication and cooperation as well as the systems which support them (Garrido et al. 2005). CSCW applications are open voluntary structures embedding organisational and linguistic rules and serving as resources that mediate and transform cooperative interactions via recurrent use-processes (procedures and practices) within specific organisational contexts (Lyytinen and Ngwenyama 1992). Although this concept was not originally proposed as a way of involving users during the system design process, it has been utilised in the domain of RE with its focus on the social organisation of work (Crabtree 2006, Garrido et al. 2005). CSCW, however, is not focussed primarily on system users, and can be applied on any group of people (e.g., programmers and database administrators) performing any professional activity (e.g., system design, system programming, and database design).

d) **Global Software Engineering (GSE):** GSE advocates the development of software systems globally instead of locally. It advocates that software project team members may be in more than one location, often on more than one continent, the driving force of such a situation being issues such as concerns for cost, the need to tap global pools in search of highly skilled resources, and satisfying investment requirements imposed by government in foreign markets (Herbsleb 2007). Similar to CSCW, GSE is not focussed on system users either, but it implies the involvement of global users in software engineering processes in general and in requirements engineering processes in particular.

e) **Crowdsourcing:** Crowdsourcing is facilitating the engagement of a usually large, diverse group of people through an open call (Howe 2006). Through the use of crowdsourcing, the crowd can be recruited for their skills, innovative ideas, wisdom, and sometimes money, and in return, they are usually incentivised through social, financial, or entertainment incentives.

With regards to software evolution through adaptation, the literature has seen two major breakthroughs:

a) One method of adapting the software system to the needs of its users is through **self-adaptation** (Salehie and Tahvildari 2009). Self-adaptive systems are designed to respond to the ever-increasing complexity of software-intensive systems, in which many requirements are not realised until very late stages of software development, i.e., until the runtime. These requirements stem from the ever-changing environment in which the software works and from the uncertainty which is an inevitable part of some environments, and self-adaptive systems adapt to such environments in an autonomous manner.

   In self-adaptive systems, some design decisions are generally put off until runtime. To this end, self-adaptive systems use a feedback loop in order to adapt themselves with the changes in the environment (Brun et al. 2009). A feedback loop consists of four main activities. The first one is to collect the data from the surrounding environment and also from the system itself, and the second one is to analyse this data. After the data analysis, a decision for the adaptation should be made which becomes the third activity. The fourth and last activity in the feedback loop is to act out that decision.

   Self-adaptive systems, however, rely mainly on autonomous changes during the runtime. The role of users is hardly, if ever, noticed in self-adaptive systems as it is the system itself, and not its users, which decides how and where and when to evolve. Since the ultimate goal of adaptation is to meet users' requirements correctly and efficiently, relying solely on the system to decide on its adaptation may lead to users' dissatisfaction due to some requirements being neglected, as there are adaptation drivers which might not be monitorable through solely autonomous means (Ali et al. 2011).

b) **Social adaptation** is another adaptive method of software evolution, and it advocates that the collective judgement of system users is an effective driver for system adaptation. It discusses that when individual users' feedback are collected, analysed, and applied systematically to the software system, users' requirements are better met and consequently, user satisfaction is more effectively achieved (Ali et al. 2012). Socially-adaptive systems plan and guide their adaptation based on users' collective feedback, which

is given iteratively during the lifetime of a system. Therefore, adaptation process occurs during the runtime and the users, through their continuous feedback provision, decide how and where and when the system should evolve.

1.1 Research Aim

In the light of aforementioned challenges that exist in relation to transparency and limited research in engineering approaches in the identification of transparency requirements, this research aims to provide an engineering solution to capture transparency requirements and deal with them so that such requirements are met effectively and stakeholders' satisfaction is achieved. This engineering approach will consist of reference models for transparency, which will help in the analysis of transparency requirements, a domain-specific modelling language for transparency requirements, which will facilitate their modelling and automated analysis, and a method based on which transparency requirements of stakeholders can be elicited, analysed, evaluated, and evolved.

1.2 Research Question

Based on the aim of this research, the following research questions are formulated in this thesis:

1. How can transparency requirements be modelled in a business information system? (Answered in Chapters 3 and 4)
2. How can transparency requirements be analysed based on the capabilities of the transparency models? (Answered in Chapter 4)
3. How can transparency requirements life cycle be systematically engineered? (Answered in Chapter 5)

1.3 Research Objectives

In order to achieve the aim of this thesis, this research has been conducted to reach the following objectives:

Objective 1: Conduct a literature review of the transparency requirements of stakeholders in business information systems

The first objective in this thesis is to study transparency in multiple disciplines in order to find a holistic view of transparency requirements. A multi-disciplinary literature study is crucial for two reasons. First, the literature on transparency requirements in software engineering in general, and RE in particular, is scarce. Second, in order to get a holistic view of transparency requirements, a multi-disciplinary literature study helps understand different viewpoints expressed in different fields of study (See Chapter 2).

Objective 2: Build reference models for transparency requirements in business information systems

The second objective in this thesis is to create reference models for transparency requirements of stakeholders in business information systems. The reference models are based on the results obtained from the extensive literature study in Objective 1. These reference models can facilitate discussion and evaluation and provide a holistic view of the problem space in the engineering of transparency requirements. Furthermore, they also limit the scope of the study on transparency by focusing on specific variables and defining the specific viewpoints which will help transparency researchers. They are also used as foundations for transparency requirements and are implemented in the design of the modelling language for transparency requirements. The limited study on transparency requirements in the field of requirements engineering, and the subsequent lack of concrete foundations for the engineering of transparency requirements further highlight the importance of these reference models (See Chapter 3).

Objective 3: Provide a language for modelling and analysing transparency requirements in business information systems using a transparency modelling language

The third objective in this thesis is to build a modelling language that can cover different aspects of transparency requirements in a business information system. This modelling language will be based on the reference models built as the outcome of Objective 2, and will help developers and stakeholders to represent their transparency requirements, to facilitate the communication of their transparency requirements amongst different stakeholders, to facilitate the formalisation and automated analysis of transparency requirements, and to facilitate the documentation process. The automated analysis of transparency requirements will further help requirements engineers and other stakeholders to identify possible issues during transparency provision, e.g., information overload, bias, and mismatches in the requested and provided transparency (See Chapter 4).

Objective 4: Create a novel method for the engineering of transparency requirements in business information systems

The fourth objective of this thesis is to create a comprehensive approach for the engineering of transparency requirements. As explained earlier, the peculiarities associated with transparency requirements, plus the limited research which has been conducted on them so far, necessitate the creation of a novel approach for the effective management of such requirements. The approach utilises two concepts of crowdsourcing and social adaptation, along with structured feedback

acquisition, to elicit, analyse, evaluate, and evolve stakeholders' transparency requirements (See Chapter 5).

Objective 5: Evaluate the modelling language and the transparency engineering approach

The fifth objective in this thesis is 1) to evaluate the usefulness of the transparency modelling language from the stakeholders' perspective in order to identify whether it can capture their transparency requirements effectively, 2) to evaluate the quality of the transparency modelling language from the requirements engineers' perspective, using one of the well-known quality evaluation frameworks for modelling languages, and 3) to evaluate the structure and content of the acquired feedback from stakeholders, advocated in the engineering method for transparency requirements, in order to identify how people view transparency and how they express their requirements.

The first and third evaluation studies and part of the second evaluation study will require an empirical approach. The first and third evaluation studies will be entirely based on stakeholders' perspectives. The empirical part of the second evaluation study will be based on modelling experts' views and recommendations. The non-empirical part of the second evaluation study will follow the set of guidelines and standards proposed in the quality evaluation framework for modelling languages (See Chapter 6).

1.4 Research Methodology

In order to achieve the aim of this research, different research methodologies will be followed for accomplishing each objective mentioned above. The details of each research methodology can be found in the corresponding chapters of this PhD thesis, but are briefly explained in this section.

In order to achieve objective one, a literature review will be adopted which will cover multiple disciplines, such as philosophy, finance, and politics, in which transparency is researched. The employment of this research methodology will help review the critical points of current knowledge on transparency, including fundamental findings as well as theoretical and methodological contributions to transparency and transparency requirements.

In order to achieve objective two, a meta-analysis approach will be embraced to build the reference models. The employment of this research methodology will help combine the results obtained from the literature review, analyse them and create a set of reference models that help requirements engineers in the discussion and evaluation of stakeholders' transparency requirements.

In order to achieve objective three, a theory-oriented approach will be utilised to create a transparency modelling language for the modelling and analysis of transparency requirements in business information systems. The employment of this research methodology is essential at this stage as this chapter is part of the main intellectual contribution to this thesis.

Similarly, in order to achieve objective four, a theory-oriented approach will be applied to create a method for the engineering of transparency requirements in business information systems. The employment of this research methodology is essential at this stage as this chapter is also part of the main intellectual contribution to this thesis.

In order to achieve objective five, an empirical software engineering approach will be employed. Empirical software engineering is a discipline that attempts to positively affect the practice of software engineering by comparing theory to reality and to move toward well-founded decisions to drive the software development process. The methods adopted in empirical software engineering are inspired by social sciences and they lead to the creation of theories or frameworks that explain what the researcher observes and measures (Easterbrook et al. 2008). Based on the formulated theories, one can introduce evidence-based changes that are grounded in scientific research to the development process of a software program to empower its success. Therefore, a combination of empirical studies (e.g., focus groups) along with a well-founded literature study, which will enable one to acquire a better picture of the state-of-the-art research, will help to better understand and formulate the topic of transparency and its modelling and analysis.

1.5 Thesis Structure

This thesis is structured as follows. Chapter 2 presents the extensive multi-disciplinary literature review conducted on transparency and its related topics and highlights several (side) effects of transparency on its stakeholders. In Chapter 3, the reference models of transparency are presented, which are based on the literature study on transparency, and as a proof of concept, a major transparency document, the United Kingdom Freedom of Information Act, is studied in the light of the reference models. Chapter 4 presents the modelling language and its associated analyses for the engineering of transparency requirements in business information systems. Chapter 5 reports the novel approach devised for the engineering of transparency requirements, which benefits from crowdsourcing, structured feedback acquisition, and social adaptation. Chapter 6 discusses the methodologies and the empirical and non-empirical studies undertaken in order to evaluate the quality and usefulness of the transparency modelling language and the feedback acquisition part in the transparency engineering approach. Chapter 7 presents a summary of the thesis contributions, and suggests future works on the topic of transparency requirements modelling and analysis.

1.6 Summary

This chapter gave an introduction to the context and domain of this thesis, which is transparency as a requirement of stakeholders in business information systems, and discussed the rationale for this thesis. It also introduced the research aim, research questions, research objectives, research methodology and the thesis structure. In the next chapter, a literature review of transparency in multiple disciplines will be presented.

Chapter 2

Literature Review on Transparency

"There is no knowledge
that is not power."

Ralph Waldo Emerson

2 Literature Review on Transparency

Transparency is a subject that has gained much attention since the last quarter of the twentieth century from different fields of study, including post-modern sociology (Vattimo and Webb 1992), philosophy (Hang 2012), management studies (Berggren and Bernshteyn 2007), accounting (Canning and O'Dwyer 2001), business administration (Zhu 2004), economics and financial markets (Bagella et al. 2006), journalism (Allen 2008), law (Fenster 2006), political science (Wall 1996), public administration (Piotrowski and Van Ryzin 2007), and public relations (Bentele and Seiffert 2009). Transparency is a paradigm-shifting topic. While privacy concerns caused the twentieth century to be titled "the age of privacy", transparency concerns will cause the twenty-first century to be crowned as "the age of transparency". The ongoing attempts by governments, organisations, and noted individuals around the world to publish information online (i.e., on the Internet) and offline (i.e., through periodicals, journals, newspapers, books, etc.) are strong indicators of surpassing from one age to the other. The public demand for all governmental, for-profit and non-profit organisations to be transparent and therefore accountable is increasing and the support of information communications technologies (ICT) is contributing to this cause. In short, transparency is becoming the buzzword of the twenty-first century as time is going on.

Transparency, as much as it is being discussed and researched, has remained an area of research full of ambiguities and little practical solutions. Specifically, in the field of computer science, transparency remains under-researched. Even more specifically, it remains as a little-studied subject for requirements engineers as a non-functional requirement (NFR) or a quality requirement. A lack of automated approaches for eliciting, specifying and engineering transparency requirements is evident during any literature study on this topic. Unlike some other NFRs, such as privacy and security, for which several studies, approaches, and models exist in the literature, transparency apparently suffers from a deliberate negligence of the provision of such formalities, mostly due to its controversial nature and the difficulties in pinpointing its constituents.

This thesis therefore aims to provide such foundations for transparency by delving into the literature of transparency in several fields of study, some of them mentioned above. Indeed, one aim of this thesis is to illustrate the multi-disciplinary nature of transparency and how such nature has deterred researchers, especially in the RE community, to investigate its peculiarities and nuisances, which has deterred automated analysis of transparency as a top-level concern. It also aims to pave the way for the modelling and analysis of transparency requirements, which needs to be an evolutionary and iterative process during the lifetime of any software system.

In this chapter, a complete ontology of different definitions of transparency is provided in Section 2.1. This helps readers to get a comprehensive view of transparency, while also hinting at why dealing with transparency requirements can be difficult. Section 2.2 lists several obstacles to transparency which must be considered in the engineering of transparency requirements. Section 3.3 discusses several categorisations of transparency, some of which form the basis of some of the transparency reference models discussed in Chapter 3. Section 2.4 demonstrates why transparency goes beyond information availability and what the other aspects of information are which must be considered in a useful provision of transparency, while also demonstrating the importance of information quality in transparency. The information in this section is also reflected in the transparency reference models in Chapter 3. Section 2.5 provides a comprehensive view of how transparency levels and degrees have been discussed in the literature, opening the way for another method of classifying transparency levels in Chapter 3.

The importance of transparency is discussed in Section 2.6, which illustrates why the engineering of transparency is desirable, and the effects and side effects of transparency are discussed in Section 2.7, which help form a foundation for transparency analysis in terms of its after-effects in Chapter 4. The neighbouring concepts to transparency are provided in Section 2.8, which shows the possible overlaps and where some of the regulations on transparency originate from, also reflected in part in transparency reference models in Chapter 3. The limitations and regulations of transparency provision are discussed in Sections 2.9 and 2.10, illustrating some of the peculiarities in transparency provision and emphasising why transparency requirements must be engineered.

Section 2.11 provides a background on the work already conducted on transparency in the domain of requirements engineering, and illustrates why further work is still needed in this domain. Section 2.12 lists some of the socio-technical impacts of transparency in real world and how it is gaining more attention all around the globe. The need for engineering transparency is discussed in Section 2.13 and forms the basis of this thesis. Finally, a summary of Chapter 2 is provided in Section 2.14.

2.1 Meanings of Transparency

Transparency, as the concept people know and use today, is a rather new concept, only gaining public attention in the last quarter of the twentieth century. The origins of the word transparency, however, date back to fifteenth century, and to the Medieval Latin word "*transparentum*", which according to Vaccaro and Madsen (2009a) and based on Online Etymology Dictionary, means "to show light through", and according to Merriam Webster Online Dictionary, to the word "*transparere*", which means "to show oneself". Consequently, transparency was started to be used figuratively, meaning "easily seen through".

Since transparency is etymologically and semantically associated with vision, Michener and Bersch (2011) argue that it is awkward, at least for some people, to apply this word and its derivatives (i.e., its noun, adjective, and adverb) to abstract ideas, such as politics, or ideas combined with visually non-transparent solid collections of objects, such as the parliament. According to their research, a Danish academic, who was a non-native English speaker, was the first scholar to have used the word transparency, while discussing problems of 'macro-economic transparency', in the way people now recognise and use it.

Consequently, the meaning of transparency has been debated by researchers. Michener and Bersch (2011) believe that transparency has attracted attention because of its nicely ambivalent notion which has a positive normative charge. They argue that the causes of transparency, its effects, limits, and effectiveness are researched, while what constitutes transparency and what does not, and how one can evaluate its quality are not discussed in the literature. They also argue that most studies have adopted stylised definitions of transparency, or that they assume a "we know it when we see it" attitude towards transparency. They go further to say that it is not clear what people mean when they talk about semi-transparency or full transparency, and that the lack of convergence on the term with the intent of establishing parameters or measures has left a substantial gap in the literature, and has left transparency open to conceptual stretching, uncommunicative, and inaccurate neologisms and several analytical blind spots.

To prove their argument, Michener and Bersch (2011) present several definitions of transparency given in the literature. Amongst these definitions are "the open flow of information" (Holzner and Holzner 2006), "the increased flow of timely and reliable economic, social and political information, which is accessible to all relevant stakeholders" (Vishwanath and Kaufmann 1999), and "the release of information by institutions that is relevant to evaluating those institutions" (Florini et al. 2000). Based on these definitions, they conclude that these definitions neither convey the basic parameters of transparency (i.e., transparency implying a state or quality), nor do they agree with each other. Such divergence in the use of the notion of transparency, in their viewpoint, illustrates increasing deviation from a collectively understood definition, in other words, conceptual stretching.

In the following subsections, this thesis uses the complete ontology of different definitions of transparency presented by Menéndez-Viso (2009) and discusses their implications in the field of RE.

2.1.1 Transparency Synonymous with Invisibility

Transparency, defined in the Online Oxford English Dictionary in its most obvious, non-metaphorical meaning, means "having the property of transmitting light, so as to render bodies lying beyond completely visible; that can be seen through" (Menéndez-Viso 2009). So transparency is seen synonymous to invisibility, and invisibility is one cause of mistake, distrust, violence, and injustice.

Such a definition and usage of the word transparency is already observed in computer sciences, as the hiding of information from its users. According to Turilli and Floridi (2009), in computer sciences and Information Technology (IT) studies, transparency can mean information invisibility and hiding processes from users. For example, Koster et al. (2001) state that one benefit of middleware platforms is that they manage application-independent issues transparently to the programmer and hide underlying complexity. Star et al. (1998) also define a system to be transparent if its user does not need to know its underlying mechanisms.

This thesis does not intend to investigate this particular definition of transparency. Consequently, its possible implications in the field of RE remain beyond the scope of this thesis. However, given the increasing usage of transparency in different literary articles as equivalent to visibility (in contrast to transparency being equivalent to invisibility), this usage is becoming archaic and less used.

2.1.2 Transparency Synonymous with Candidness

The second definition of transparency in Online Oxford English Dictionary, according to Menéndez-Viso (2009), states that transparency means "frankness, openness, candidness, and ingenuousness". As a result, transparency becomes synonymous with sincerity, faithful description, and accurate explanation.

Several definitions of transparency in the literature are in line with this definition of transparency. Rawlins (2008a) defines transparency as the deliberate attempt to make available all legally releasable information, positive or negative in nature, in an accurate, timely, balanced, and unequivocal manner in order to improve the reasoning ability of the public and hold organisations accountable for their actions, policies, and practices. Curtin and Meijer (2006) define transparency as the extent to which one entity discloses relevant information about its own decision processes, procedures, performance, and functioning. The same definition is used by Gerring and Thacker (2004), Welch et al. (2005), and Grimmelikhuijsen et al. (2012).

In this definition, it becomes a duty of requirements engineers to make the system as transparent as possible. That is, the RE community should deal with transparency requirements as a top priority of stakeholders and provide a software system with enough tools to make it transparent to its stakeholders by providing an accurate description of its processes and goals. As stakeholders are also an indispensable part of any business information system, software system transparency will also include stakeholders' process and goal transparency. Finally, this definition of transparency can be described as "the right to show", which means the stakeholders will decide which information to hide and which information to show.

2.1.3 Transparency Synonymous with Interpretive Reality

In the third definition of transparency according to Menéndez-Viso (2009), transparency is defined as information gained not through direct observation of organisations, agencies, etc., but gained through and told by spokespeople, reports, figures, and graphics. In this definition, stakeholders do not know immediately whether such information corresponds to reality and in which way. Consequently, interpretation of information is needed, usually through third parties, in order to achieve the desired transparency.

Some of the definitions of transparency point out to this third notion of transparency. In the context of political sciences, Abu-Shanab (2013) defines transparency as the open communication of effective knowledge with relevant information to citizen's requirements which occurs between citizens and governments. In the same context, Abu-Shanab (2013) also proposes a definition for e-transparency as utilising ICT tools, the Internet, and web 2.0 tools in order to improve public information provision with regards to the operations, budget, and political process conducted by the governments. Such utilisation of ICT tools for transparency provision surely matches this third definition.

In the context of RE, it means that requirements engineers will need help in the process of making a software system transparent, since providing the information by itself is not synonymous with transparency any more. This help is needed to further elaborate on information in the process of making the software system more transparent. Finally, this definition of transparency can be described as "the right to know", which means one stakeholder wishes to know certain information about another stakeholder, and thus make it more transparent.

2.1.4 Transparency Synonymous with Unrestricted Surveillance

In the fourth definition of transparency put forward by Menéndez-Viso (2009), transparency is defined as "the possibility to unrestrictedly look into firms or even people". Consequently, the more transparent one is, the less privacy one may enjoy. Transparency can encourage surveillance and control, as also noted by Mol (2010), and can result in information asymmetry, where one party in an agreement or a decision owns more information than other parties (Stadler and Castrillo,1994). Therefore, transparency needs to be regulated to prevent such possible harms.

Some definitions of transparency in the literature hint at this concept of transparency. For example, O'Neill (2009) states that transparency means that public bodies make information about their activities publicly available, either regularly or on demand, except for specific categories of reserved (i.e., private) information.

In the context of RE, this means that transparency as a requirement may need to be regulated by privacy and security laws. Requirements engineers must ensure that transparency requirements do not interfere with privacy regulations and mitigate privacy requirements. Finally, this definition of transparency can be described as “the desire for unrestricted knowledge”, which allows for one stakeholder to know all public and private information about another stakeholder.

2.1.5 Transparency Synonymous with Self Exposure

According to Menéndez-Viso (2009), in this fifth definition of transparency, the entity who is observing an institution or organisation and giving opinions on it becomes transparent itself, because it is revealing its internal opinions and intentions. Consequently, transparency acts in both directions: it makes the watcher and the watched transparent to each other at the same time. Consequently, this can also result in surveillance and exposure.

This definition of transparency can be found in (Hosseini et al. 2015b), in which the authors state that the transparency of requirements during their elicitation can be an obstacle for requirements engineers, as such transparency may not be desirable by certain stakeholders.

In the context of RE, this means that requirements engineers should not only view transparency as a requirement, but they should also think of the transparency of a requirement. That is, transparency requirements are themselves subject to transparency. For example, an employee may withhold their opinion about a process if they know their opinion is transparent to others, e.g., their managers.

2.1.6 Transparency Synonymous with (Accessible) Information

In its last definition of transparency given by Menéndez-Viso (2009), transparency means access to information about entities and organisations, and lacks any moral content, as it can reveal both good and wicked actions. Consequently, transparency in this sense is equivalent to information and information accessibility.

Some definitions of transparency in the literature fall in this category. Hood (2011) talks about transparency as revealing all the information there is (e.g., WikiLeaks) as opposed to revealing all the information that one should (e.g., under the Freedom of Information Act). Turilli and Floridi (2009) mention that transparency can mean the visibility and accessibility of information, intentions, and behaviours through a process of disclosure. Also, in the definition of transparency provided by Stiglitz (2000), transparency is another name for information.

In the context of RE, this means providing access to any information that exists in the software system. That is, requirements engineers should proactively think of methods for making information more accessible, and therefore more visible to stakeholders.

2.2 Obstacles to Transparency

Considering transparency as information visibility to stakeholders and agents, several obstacles can be thought of. The following obstructions to transparency are recognised (Kolstad and Wiig 2009):

- Secrecy, i.e., hiding and concealing information from certain stakeholders
- Opacity, i.e., obscuring information and making it difficult to understand by stakeholders or to explain it to them
- Wrong information, i.e., providing misleading information to stakeholders in order to affect their decision making
- Biased information, i.e., providing information not based on facts, but on unreasoned personal judgement
- Spinning, i.e., providing information to stakeholders with a particular emphasis that favours information providers
- Incomplete information, i.e., providing stakeholders with information that does not cover the whole truth, thus misleading them
- Inaccessible information, i.e., providing information that is either impossible or, more usually, too difficult to access by stakeholders
- Unequal access to information, i.e., providing different stakeholders with different amounts and levels of information
- Information overload, i.e., overwhelming stakeholders with information they do not need, and in the process, making it difficult for them to spot the relevant information
- Irrelevant information, i.e., providing stakeholders with information that does not serve their purposes

2.3 Categorising Transparency

Many attempts have been made to identify different types of transparency and to classify it based on its constituents. Relating to the different stakeholders of transparency, Michener and Bersch (2011) investigate transparency and its origin. Two concepts of *supply-side* and *demand-side* transparency are therefore introduced. In the first concept, transparency can be supplied in two ways; it is either supplied by government or other organisations voluntarily or as a means of complying with legal obligations. The second concept of demand-side means transparency is provided in response to demands, as with Freedom of Information laws. According to Michener and Bersch (2011), demand tends to drive information visibility, while information inferability is best understood through a careful analysis of the supply of information, i.e., the incentives and constraints of suppliers and how raw and mediated the information is.

A similar concept is provided by Fox (2007), stating that information can be provided in two ways: *proactive dissemination*, where information is made public to the people without them asking for it, and *demand-driven access*, where organisations provide information, otherwise inaccessible, as a response to the public's request. Fox (2007) also talks about two faces of transparency, opaque transparency, which is providing information which is not clearly understandable, and clear transparency, its opposite. However, given that opaque transparency is more misleading than assisting, opaque transparency may better not be categorised as a type of transparency.

Regarding the nature of the information disclosed as a means to provide transparency, Stuart et al. (2012) state that three types of transparency can be observed: 1) *identity transparency*, which makes transparent the identities of those exchanging information, 2) *content transparency*, which makes transparent the content and changes to the content (e.g., Wikipedia keeps a complete history of all the edits made to its pages), and 3) *interaction transparency*, which makes transparent the actions taken during the interaction to a third party observer.

Identity transparency is the visibility of the sender and/or receiver in an information exchange. Identity transparency can be symmetric identity transparency, meaning the sender knows the identity of the receiver and vice versa, or it can be asymmetric identity transparency, meaning that only one side of the information exchange knows the identity of the other side. In this category, identity transparency can go from total anonymity to using aliases to real names and possibly other personal identity information (i.e., personal profiles). Stuart et al. (2012) believe that providing identity information can lead to trust in others and willingness to be accountable for what one says and does, while refraining from providing such information may be beneficial in sharing information that can be embarrassing, controversial, critical, or novel (Kiesler and Sproull 1992, McKenna and Bargh 1998). They also state that one plausible effect of identity transparency is more accurate information. Another one is a decrease in creativity, as people with transparent information usually try to conform to their community's norms and ideas.

Content transparency is provided when provenance information is made available, without which the content will have no clear ownership and will be easy to borrow, steal, repurpose, or fake. Providing provenance can also result in activity awareness, i.e., consciousness about other individuals' actions (Dourish and Bellotti 1992). Stuart et al. (2012) believe that content transparency leads to more productivity, as viewing changes in the information can remind others to contribute or respond to those changes in content and also acts as a mechanism for the information provider to work harder since their actions are visible. However, increased stress and higher chances of making more mistakes are reported to be amongst the negative consequences of content visibility.

Interaction transparency can facilitate the transition of norms and acceptable behaviours, especially to new members. It also increases the public's knowledge about the popularity of information, sources, receivers, and third parties. Furthermore, it can result in new information being discovered, e.g., by looking at the co-authors of co-authors in Microsoft Academic Search.

In a similar fashion, Bannister and Connolly (2011) state that there can be three categories of transparency: 1) data transparency, mostly answering the questions 'what' or 'who', 2) process transparency, mostly answering the question 'how', and 3) decision transparency or policy transparency, mostly answering the question 'why'. They further elaborate that process transparency usually requires data transparency and decision transparency often requires data and process transparency.

In an organisational setting, Vaccaro (2006) distinguishes between external transparency and internal transparency. The former is defined as the degree of information completeness with regards to an organisation's own business activities and the latter is defined as the degree of virtual connectivity (i.e., availability to access through ICT tools) of the workforce to the external environment. Similarly, Weber (2008) identifies four directions of transparency that has to do with organisations and institutions, as follows:

- Transparency upwards means that the hierarchical superior/principal is in a position to observe the conduct, behaviour, and/or "results" of the hierarchical subordinate/agent, usually in a principal-agent relation.
- Transparency downwards means that the "ruled" are in a position to observe the conduct, behaviour, and/or "results" of their "rulers"; this relationship figures prominently in democratic theory and practice, often under the umbrella of "accountability".
- Transparency outwards means that the hierarchical subordinate or agent is in a position to observe what is happening "outside" the organization; this ability is important to monitor the behaviour of an organisation's peers and/or competitors.
- Transparency inwards means that those outside are in a position to observe what is going on inside the organization; the topic insofar is freedom of information.

Furthermore, Weber (2008) provides three aspects for transparency: 1) procedural transparency encompasses rules and procedures in the operation of organisations, 2) decision-making transparency is based on the acknowledgement of access to political mechanisms, and 3) substantive transparency is directed at the establishment of rules containing the desired substance of revelations, standards and provisions which avoid arbitrary or discriminatory decisions.

Scauer (2011) discusses four values that transparency should serve, transparency as regulation, transparency as democracy, transparency as efficiency, and transparency as epistemology. Transparency as regulation means that organisations regulate, or are forced to by external regulatory bodies, the disclosure of their information, so that their information is accessible to the public. Transparency as democracy means that the government itself is regulated by the public or by its appointed representatives, and is meant to reduce corruption, bribery, etc. Both forms of transparency as regulation and transparency as democracy are forms of control. Transparency as efficiency means that availability of information has the capacity to make an organisation or society work more effectively. Transparency as epistemology means that open availability of information can facilitate the identification of truth and as a result, produce more knowledge and greater progress.

Lodge (2004) uses the existence or non-existence of regulations to classify transparency into *coercive transparency* and *voluntary transparency*, i.e., transparency requirements can be established either by the power of regulations or on an uncoerced basis. Similarly, Shkabatur (2013) provides an analytic typology for online transparency policies as follows:

- **Mandatory transparency**. This refers to policies that oblige organisations to disclose specific information, e.g., Freedom of Information Act.
- **Discretionary transparency**. This refers to policies that oblige organisations to publish some information online but do not specify what exactly should be disclosed, e.g., the web site data.gov where federal agencies place online high-value datasets of their choice. This vision of regulatory transparency derives from crowdsourcing.
- **Involuntary transparency**. This refers to regulatory responses to whistleblowers and information leaks.

Regarding the control of the flow of information in transparency, Lindstedt and Naurin (2006) state that there are two types of transparency: *agent-controlled transparency* (ACT) and *non-agent-controlled transparency* (NACT). In ACT, information is disclosed by an agent in response to some requirements on the agent, such as freedom of information acts, to make some information about its activities available. These requirements may be externally imposed on the agent or internally imposed. In NACT, free independent third-party actors, such as the press, disclose information by wilfully investigating and reporting the activities of an agent. A similar observation is also made in (Lindstedt and Naurin 2010).

Transparency can also be classified based on where it originates. Brito and Perraut (2010) express that transparency can be divided into two categories of public transparency and private transparency. Public transparency is about transparency in government and the public sector, and private transparency is about transparency in the private sector. Furthermore, do Prado Leite and Cappelli (2010) identify the concept of "individual transparency" as the ability of every person to release their opinions and their observations of real life incidents through the World Wide Web (e.g., blogs and tweets).

2.4 Transparency: Beyond Information Availability

While transparency starts with **information availability**, it certainly does not stop there. All scholars studying transparency unanimously agree that information availability does not mean transparency. For example, Rawlins (2008a) states that just giving away the information must be called disclosure, which alone, may defeat the notion of transparency, because it can be obfuscating instead of enlightening. Also, transparency reviews have raised questions of what should be made transparent, to whom and how they should be assessed (Neyland 2007). Consequently, researchers have discussed several other dimensions of information which will be discussed in this section.

For any available information to be used for achieving transparency, it should be first interpreted and translated to a language understandable by its stakeholders. Therefore, **information interpretability** is one dimension of information. For instance, in their open learners model, Tanimoto (2005) illustrates the importance of information interpretability. It is argued that to achieve a useful kind of transparency, providing an interpretive mechanism is necessary for translating the information from a pedagogical perspective to a learner's perspective, otherwise the information will be rendered as incomprehensible.

Another dimension in information is **information accessibility**. For example, Kaufmann and Bellver (2005) state that even with the Freedom of Information laws in practice, if the general public are not aware or do not know how to access the information, transparency is not fully achieved. In another example, in their study of recommender systems, Sinha and Swearingen (2002) state that transparency is providing explanations about why a recommender system has suggested a particular recommendation to a user.

The dimension of **information perception**, along with information accessibility is discussed in the work of Van der Cruijsen and Eijffinger (2010). It is argued that for central banks, simply being more transparent is not enough; they should embark on other actions, such as practising clear communication policies to the general public. They state that individual and psychological factors (such as confirmation bias) can influence the perceived level of transparency (as opposed to the

actual level of transparency) and therefore information must be presented in a clearly inferable way to minimise such a distance. They further argue that information must be easily accessible through common, everyday search procedures to minimise people's relying on media information, which is mostly biased towards discussing transparency weaknesses. Rawlins (2008a) also argues that transparency must be measured from the perspective of the receiving stakeholders, not from those who provide it. Furthermore, if the receiving stakeholders' perception of transparency does not match that of the providers, it can lead to no increase in their trust.

Griffith (2006) presents three dimensions of information, information accessibility, information interpretability and **information understandability**. It is argued that to achieve a meaningful level of transparency, transparency must be defined in terms of the ability of the users of those systems not only to have access to information, but also to understand the provided information and the actions behind them. The quote by the President of European Parliament, stated in their paper, also refers to the importance of information interpretability: "There is no point in putting a report adopted in plenary online if no effort is made to explain it."

Michener and Bersch (2011) also have a similar view. They state that two necessary conditions for transparency are information visibility and information inferability. Visibility is the degree to which information is complete and can be easily located, and inferability is the degree to which information can be used to draw verifiable inferences. They state that visibility is a necessary condition for transparency, but insufficient on its own. Based on these definitions, visibility can be mapped to accessibility and inferability can be mapped to understandability. They also state that just because some information is public (i.e., information availability) does not mean that it is visible (i.e., information accessibility). They further state that incomplete information will lead to "poor visibility", which is not seeing the complete picture. They also state that inferability has everything to do with the quality of information, because inaccurate or obscure data diminishes the ability to draw verifiable inferences from such information and casts doubt on the credibility of what has been made visible. It is argued that the mediation of information can influence its inferability. Mediation occurs in degrees and raw data is usually mediated before it is presented to the public.

Wall (1996) discusses another dimension of information, **information acceptability**, along with information accessibility and information understandability. It is stated that transparency can only be useful when it enhances understanding, not just increasing the flow of information. Furthermore, transparent information should also be acceptable by the public. Therefore, transparency should meet the three conditions of accessibility of information to the public, understandability of information by the public, and acceptability of information by the public. There are difficulties

though, e.g., how to assess acceptability (Tagiuri et al. 1955). Gower (2006) also argues that stakeholders must perceive and believe that the organisation has a transparency policy and that they are given all the information they need to know.

Fung (2013) presents another dimension of information, **information actionability**, in introducing the notion of democratic transparency, in which information has four dimensions:

- Information availability, or information being available to the public,
- Information proportionality, or information being proportionate to the extent to which actions performed by organisations threaten the interests of the public,
- Information accessibility, or information being understandable by the public, and
- Information actionability, or the enabling of the public to act based on the provided information to protect themselves and influence powerful organisations.

Information actionability is also mentioned by Simon (2006). They state that transparency can be achieved when decision makers receive the information essential to make sound decisions, therefore acting upon those information. It is also mentioned by Scauer (2011), stating that transparency is more than information availability; it is about information accessibility and information usability (i.e., information actionability). Frentrup and Theuvsen (2006) mention that transparency, in the sociological and psychological sense, is gaining information and knowledge about the environment in order to prepare actions or decisions. Therefore, information actionability is emphasised in their view of transparency. Finally, Holzner and Holzner (2006) state that information must be understandable (i.e., information understandability) and usable (i.e., information actionability) by the people who have access to that information.

Tanimoto (2005) discusses three dimensions of transparency which can answer the questions of what information to show and how to show it. They speak of quantitative dimension, which represents the amount of available information, interpretive dimension, which represents the amount of support in explaining and interpreting the provided information, and validation dimension, which represents the extent of authentication facilities for the provided information.

Griffith (2006) identifies the following best practices for achieving a meaningful transparency to be the most significant ones:

- Summaries of proposals and activities: This helps the information receiver to better understand the information, and helps them in the process of informed decision-making.

- Integration of resources: As information resources increase, there is a chance of information overload. It may also lead to confusion as where to best find the information. Integrating resources provides a substantial benefit as it makes these problems to be avoided.
- Management mechanisms: In Griffith's viewpoint, establishing effective management mechanisms for policy setting, priority sorting, and ensuring an integrated and collaborative approach remains a challenge.
- Usability testing: Usability testing is undertaken to ensure that the revisions to the information are actually an improvement, and that users see the benefit.

Michener and Bersch (2011) state that high quality transparency depends on two notions: 1) how visible information is made, and 2) how well it lends itself to accurate inference. Therefore, the quality of transparency relies on the quality of information or data, or as they state, on informational quality. They argue that information is most useful and most easily verified when it is presented in the rawest form possible (i.e., with the lowest possible level of mediation), is verified by a third-party mediator, and contains a simplifying device, such as a label or a score. So, the most visible and inferable transparency is raw, verified, and simplified. So, for example, an annual report should include a) raw information, b) third party verification, and c) a simplifying heuristic such as graphs or charts, to become transparent, while also to be appropriate for the intended audience. They also mention misrepresentation and manipulation of information as transparency's dilemmas.

Winkler (2000) states that transparency is about the following notions: 1) openness, which is about the amount and precision of disclosed information, 2) clarity, which is about processing, structuring, and simplifying information and putting it into context to make it more comprehensible, and 3) common understanding, which is effective transmission of information between an information sender and a receiver. He names honesty as an additional, fourth requirement for true transparency.

Besides the dimensions of information discussed above, the information quality is another dimension of transparency that has been given attention to. For example, in the definition of transparency proposed by Mitchell (1998), transparency is facilitating the acquisition, analysis, and distribution of regular, prompt, accurate, regime-relevant information. Therefore, transparency consists of three actions and the information has four quality characteristics. Harrison et al. (2011) state that transparency is not achieved just by having the information available or accessible for the public; the information must be reliable, valid, and should enable the public to do something they find valuable and important. Williams (2000) states that to achieve transparency, society members should have access to consistent, high-quality, accurate information. Grimmelikhuijsen and Meijer (2012) emphasise that transparency has two crucial dimensions of timeliness and comprehensibility.

Grimmelikhuijsen (2012) states that for transparency to be achieved, information must be available, comprehensible, and timely. Schnackenberg and Tomlinson (2014) mention that transparency has three dimensions of disclosure, clarity and accuracy. Disclosure is defined as the perception that relevant information is received in a timely manner. Clarity is defined as the perceived level of comprehensibility of obtained information. Accuracy is defined as the perception that information is correct and unbiased. They go on to say that disclosure can be decreased by keeping secrets, and increased by the use of open information systems; clarity can be decreased by stimulating tactical confusion and ambiguity, and increased by bringing coherence and understanding to stakeholders; accuracy can be decreased through faking and decoupling, and increased through candid interactions with stakeholders.

Furthermore, it is similarly argued that in order to achieve a meaningful level of transparency, information accessibility (e.g., through the Internet) is not enough, and the accessible information should also have the highest possible standards in five areas of accuracy, timeliness, completeness, clarity, and context (Griffith 2006). Similarly, it is stated that the information provided by transparent organisations to the public should contain all legally releasable information (whether positive or negative in nature), and should be accurate, timely, balanced, and unequivocal (Heise 1985).

In another study, it is mentioned that availability of information is not enough for transparency, and the disclosed information should be easy to interpret, timely, and with low cognitive costs (Fung 2013). Rawlins (2008a) also provides 13 guidelines for transparency, stating that transparent organisations should voluntarily make public information which is inclusive, auditable (verifiable), complete, relevant, accurate, neutral, comparable, clear, timely, accessible, reliable, honest, and holds the organisation accountable.

In the business world, Simon (2006) argues that making strategic decisions solely based on internal information is bound to fail. However, it is also a challenge how to incorporate external information into the internal decision-making process. According to Simon (2006), it is important that external information be reliable and relevant to achieving business goals. To this end, they state that information attributes (criteria) such as authority (i.e., creator and/or provider), timeliness and cost must be rigorously examined.

In a study concerning users' interaction online about a Brazilian government project called "Transparencia Olimpica", or Olympic Transparency, do Prado Leite and Cappelli (2010) state that users' failed transparency requirements could be categorised in four groups:

1. Outdated data (which is relevant to information credibility),
2. Deleted data which was perceived to be confidential (which is relevant to information accessibility),
3. Unaccountable information (which is relevant to information accountability), and
4. Non-detailed information (which is relevant to information comprehensiveness).

2.5 Identifying Transparency Degrees and Levels

Transparency is not a dualistic or binary concept, meaning that there can be several degrees and different levels of transparency. For example, Finel and Lord (1999) state that transparency comes in different levels, and Santana and Wood (2009) mention that there are different degrees of transparency in Wikipedia. Furthermore, transparency has been shown to have different levels, e.g., from a governmental perspective (Cucciniello et al. 2012) or moral perspective (Elia 2009).

Fairbanks et al. (2007) state different factors that can influence the level of transparency. These factors can be personal, organisational, or resource-related, as follows:

- **Personal factors:** Different personal factors can influence transparency.
    - *Personal beliefs:* The belief that transparency is essential to a democratic society is a factor that affects the amount of information one can demand from a government.
    - *Fear:* Fear can influence the type of disclosed information as well as the amount of released information. This fear exists because of what may happen once the information is disclosed, e.g., poor reflection of the organisation or people's inability to comprehend and analyse the disclosed information.
- **Organisational factors:** Various organisational factors can influence transparency as well.
    - *Administrators' stance:* The position managers and administrators take in regard to transparency has a big influence on how open and accessible information will be to the public, as they are the ones who decide how the organisation should work.
    - *Organisation mission:* The mission of an agency plays a huge rule in its level of transparency, e.g., national security offices may hinder the release of potentially panicking information to the public.
    - *Organisation communication structure:* The communication structure plays a role in transparency because communicators cannot do a satisfactory job of making information externally available and accessible if they are not well-informed in the first place. Whether communicators have a seat at the management table, communicators' personal relationship with other staff, and their level of access to restricted information can change this structure for the better or for the worse.

- *Politics:* Politics is another criterion as it can influence items such as communicators' selection and access to organisational information.

- **Resource factors:** Several resource factors can also influence transparency.
  - *Time:* Acting and communicating transparently takes more time.
  - *Staff:* Acting transparently also needs dedicated staff or staff with enough time to spend on transparency requirements.
  - *Money:* Transparency can be very costly for organisations. Developing web material, press releases, news conferences, and other ways of informing the public requires financial means.

The literature on transparency provides several viewpoints on transparency levels. Levels of transparency can be defined as the amount or volume of information provided, which might be troublesome for transparency, as hiding some information and revealing other may lead to misinformation and disinformation. Level of transparency can be about the stakeholders involved, meaning which stakeholders should or should not have access to the information provided and how they view and rate transparency. Levels of transparency can also be defined from an architectural point of view, where the constructs of information provision are argued. Finally, there is a pragmatic view to the levels of transparency, which is based on whether the provided information achieves its intended results in the stakeholders. In the following, different viewpoints into the levels and degrees of transparency are investigated.

2.5.1 Levels of Transparency Based on Information Architecture

Some studies in the literature on transparency discuss transparency levels from an architectural viewpoint. By architectural viewpoint, it is meant that the study investigates the building blocks of information which is exchanged in an act of transparency provision. This view advocates that the more complete, accessible, understandable, etc. the information which an organisation provides is, the more transparent that organisation becomes.

Griffith (2006) argues that to achieve a meaningful level of transparency, information accessibility (e.g., through the Internet) is not enough. The accessible information, it is argued, should also have the highest possible standards in five areas of accuracy, timeliness, completeness, clarity, and context.

Lawrence et al. (1993) talk about degrees of transparency and discuss what degree of transparency is necessary, what degree of transparency is possible, and how one can achieve optimal transparency in tele-operation systems. Therefore, they provide three degrees or levels of transparency: necessary transparency, possible transparency, and optimal transparency.

Another viewpoint into the levels of transparency is provided by do Prado Leite and Cappelli (2010). They state that transparency can have three different levels:

1. *Social transparency*, which aims at the general public,
2. *Target transparency*, which aims at the consumers of a certain service or product, and
3. *Organisational transparency*, which aims at an organisation's stakeholders.

2.5.2 Levels of Transparency Based on Information Volume

Some studies in the literature on transparency view transparency levels as the volume or amount of information provided to the stakeholders. This view simply advocates that the more information an organisation provides to its stakeholders, the more transparent that organisation becomes. After all, transparency cannot satisfy its stakeholders' requirements unless the information provider knows what they want and need to know (Rawlins 2008a).

Granados and Gupta (2013) discuss four possible strategic options regarding information:

1. Information disclosure, which is full revelation of information which is available and easy to interpret, e.g., about a product quality
2. Information distortion, which is giving out out-dated, incomplete, or obfuscated information, e.g., about a firm's inventory
3. Information bias, which is preferential display of information, e.g., about a product feature
4. Information concealment, which is unavailability or opacity of information, e.g., about a product cost

Geraats (2002) also defines transparency as the degree to which central bank provides information about its monetary policy making process. In a similar view, Wong (2008) discusses the optimal level of transparency which is needed for a central bank, stating that providing full transparency is not necessarily always desirable. Grimmelikhuijsen (2012) mentions an experiment in which they investigate websites with different degrees of transparency. Their definition of transparency level is the amount of willingness in an organisation to allow the public to monitor its performance, which they state is based on the amount of information provided by that organisation.

This view has been challenged by some scholars though. Griffith (2006) mentions that an increase in accessing documents does not necessarily provide greater understanding of the released information. Therefore, more information does not necessarily mean more transparency. Similarly, Strathern (2000) maintains that more information often leads to less understanding, and therefore can result in less transparency and less trust.

2.5.3 Levels of Transparency Based on Stakeholders' Involvement and View

In the literature on transparency, several studies also define transparency levels based on the type, number, or viewpoint of the stakeholders who receive information in an act of transparency provision. This view advocates that the more stakeholders an organisation reaches out to, and the more those stakeholders are satisfied with the provided information by that organisation, the more transparent that organisation will be.

From the stakeholders' type perspective, different degrees of transparency are studied, with these degrees being ultimately a function of three factors: information possessor, the information itself, and the ones who are given that information (Scauer 2011). Based on these factors, it is argued that transparency is a variable, i.e., it is possible to have partial transparency. Similarly, Mitchell (1998) states that different incentives and capacities of actors (i.e., information providers and receivers) will influence variation in the level of transparency. Madhani (2008) also states that the degree of transparency relies on both the willingness and capability of managers to amend informational differences with people in the market.

Another view on stakeholders' type affecting levels of transparency is proposed by Hultman and Axelsson (2007). They mention two degrees of transparency in their study of buyer-supplier relationship, low transparency and high transparency. They conclude that new levels of transparency also seem to produce new types of problems, and that transparency involves a need for a proper balance. They also talk about unidirectional and bidirectional transparency, emphasising the direction of the flow of information. The idea of unidirectional and bidirectional transparency between organisations and their stakeholders is also supported in the work of Vaccaro and Madsen (2009b), being called static transparency and dynamic transparency respectively.

Another view of stakeholders' type is related to an organisation structure. A four-level intra-organisational transparency is proposed by Berggren and Bernshteyn (2007), in which it is stated that the level of transparency at which strategy can be transmitted to an organisation's employees influences the performance of that organisation. Another multi-lateral transparency agreement is proposed by Arrowsmith (1998), which is considered to be an important first step in engaging all World Trade Organisation members in a discourse on public procurement issues.

Stakeholders' viewpoints and requirements for transparency also differ from each other. Piotrowski and Van Ryzin (2007) state that different individuals have different levels of demand for governmental transparency, with some being very interested in knowing more about what the government is doing, and others being less interested.

Similarly, it is argued that users' awareness of and agreement to the degree of transparency are more important that transparency itself (Johnson 1997), and that in the end, it is the society which determines the level of transparency (Felgenhauer 2010). One way to ensure stakeholders' satisfaction in the level of transparency is through the use of software. Cysneiros (2013) states that software designed to cater for transparency must be able to deliver appropriate levels of transparency. He mentions that software systems can be configured to deliver different levels of transparency depending on the stakeholder who is using the system. They state that these different levels of transparency correspond to levels of information exposure to different stakeholders.

2.5.4 Transparency Levels Based on Pragmatic Results

The final view on transparency levels found in the literature is concerned with the pragmatic results of information provision through an act of transparency. This view advocates that transparency levels should be viewed based on the results they achieve, and therefore, higher transparency levels do not necessarily lead to more desirable achievements. In other words, the level of transparency can make it socially desirable or undesirable, based on the efficient or inefficient equilibrium becoming risk dominant (Anctil et al. 2010). Vaccaro and Madsen (2006) also emphasise that an optimal level of transparency should be reached in any act of transparency provision, which they argue is not necessarily the highest possible level. It is also argued that transparent information must meet a standard called substantial completeness, which is the level of transparency at which a reasonable person's requirements for information are satisfied (Klaidman 1987).

Trust, as one of the possible results of transparency, can be a criterion in the level of transparency. For example, Mercuri (2005) states that the level of system transparency must be enough to ensure trust in the system. Similarly, Vaccaro and Madsen (2009a) mention that higher levels of transparency can positively affect trust.

Accountability, as another possible result of transparency, is also shown to rely on a certain level of transparency (Craft and Heim 2009). Cukierman (2009) speaks of desirable levels of transparency in some areas of policy making processes, while Bac (2001) states that a higher level of transparency in decision making processes increases the possibility of detecting corruption. Meanwhile, Lidberg (2009) provides the example of Freedom of Information Acts, which can ensure a level of political transparency that can prevent corruption, nepotism, and other forms of political malpractice. However, higher levels of transparency do not imply more peace or democracy (Lord 2006).

In economics, transparency levels have been shown to have various results based on the context and use of the disclosed information. For example, Allenspach (2009) states that enhancing transparency above a certain level can harm banks, and that an optimal level of transparency is needed, which

changes when the context changes. Furman et al. (1998) confirm that greater transparency in banks could have seriously worsened the savings and loan crisis in the US. On the other hand, Wehmeier and Raaz (2012) state that low levels of transparency cause financial risks and greater transparency may result in better financial performances, and Alt and Lassen (2006) speak of different levels of fiscal transparency, which have been associated with public debts and deficits, and can positively or negatively affect the stakeholders based on the context in which the information is disclosed.

2.6 Importance of Transparency

Transparency has invaded the most trivial aspects of people's daily lives. In fashionable bakeries, customers can now see people at work behind a transparent window; the TV is being flooded with reality shows; bricks and mortar in modern buildings are now being replaced by glass panes (Bessire 2005). These examples accentuate the increasing importance of transparency. The literature on transparency views various importance measures on transparency. As well as financial, legal, and organisational importance, the literature also puts moral and ethical importance on transparency.

From a **moral** perspective, Sullivan (1965) discusses that every person has the right to true information in matters which affect them, and the right to participate in decisions which affect them. This is called the moral essence of transparency (Rawlins 2008a). In the same fashion, Birkinshaw (2006) states that transparency and the right to know are fundamental human rights and Jayal (2007) states that access to information via transparency initiatives is a right and an end in its own merit. Interestingly, Von Furstenberg (2001) argues that transparency is a relationship variable, meaning that it is required from those whom we do not trust, or do not consider to be accountable, reliable, etc. Whether a human right and a moral obligation or not, in public discourse, transparency should not be considered as a self-evident good (Etzioni 2010). Such a view to transparency may end to the point that one might say that more-transparent-than-thou has become the secular equivalent of holier-than-thou in modern debates regarding organisation and governance (Hood 2006). Ball (2009) also states that believing in the value of transparency does not mean that transparency must be supported and encouraged in all situations.

From a **legal** perspective, it is shown that transparency plays a major role in reducing uncertainties for governments (Bagdai et al. 2012). Furthermore, Weber (2008) states that the purpose of providing transparency is to achieve a greater degree of clarity, predictability, and information about regulations. Gupta (2008) states that transparency is a moral and political imperative, and is associated with goals such as accountable, inclusive, legitimate, and democratic governance. Transparency of information is also argued to have the potential to reduce the risks of conflicts and war (Schultz 1998).

From a **financial** perspective, the assessments of the "Code of Good Practices on Transparency in Monetary and Financial Policies" highlight the main benefits of transparency within monetary and financial policies: 1) enhancing accountability of policy makers, 2) fostering the effectiveness of monetary policies by making them more predictable, 3) benefiting the operation of financial markets and improving coordination, and 4) providing the driving force for maintaining a high quality of work (Friðriksson 2000). Furthermore, It is also stated that transparent regulations are a major requirement for attracting investment and promoting economic growth (Weber 2008), and that higher levels of fiscal transparency are associated with lower public debts and deficits (Alt and Lassen 2006).

From an **organisational** perspective, transparency of the workflow is shown to be able to increase motivation in online microtask platforms such as Amazon Mechanical Turk (Kinnaird et al. 2012). Furthermore, since transparency in financial reports in an organisation can enhance competitiveness, voluntary disclosure of financial information is viewed as an opportunity by organisations, not as a burden (Madhani 2008).

2.7 Effects and Side Effects of (Lack of) Transparency

Transparency provision, and also lack of transparency provision, introduces several effects and side effects, each of which has been investigated in the literature, both in relation to transparency, and independently. This literature study will provide a reasonably well-studied view into such effects and side effects of (lack of) transparency.

2.7.1 Effects and Side Effects of Lack of Transparency

Lack of transparency in providing high quality information to its intended stakeholders has mostly been associated with negative effects. For example, it is believed that lack of transparency in financial environments was one cause of the global financial crisis of 2008-2010 (Castells 2010).

Based on the literature review that they did in their study, Carlo Bertot et al. (2012) identified multiple adverse effects as a result of lack of transparency, including:

- Making corruption less risky
- Less responsibility in public officials
- Unfair information advantages to privileged people
- Perpetual control over resources
- Reduced cooperation and increased chances of opportunism
- Reduced honesty and efficiency in the public sector
- Hindering social trust and hence, development

Similarly, Abelson et al. (2004) argue that lack of transparency has resulted in the public's mistrust of officials and organisations, and Kolstad and Wiig (2009) state that lack of transparency can have several undesirable results, such as making corruption less risky, making it difficult to choose efficient people for public sector positions, lowering participation opportunities, undermining social norms, and reducing trust. In the world of politics, lack of transparency magnifies the moral hazard problem in the interaction between the electorate and the ruler (Kaufmann and Bellver 2005). It is also argued to be one possible reason why recommender systems have not been used in high-risk decision-making (Herlocker et al. 2000). Finally, Bhatnagar et al. (2003) state that lack of transparency can facilitate for perpetrators to cover their footsteps and can make it difficult to find corruption, for which they propose the use of e-government as a remedy.

In some cases, however, lack of transparency is not unintentional. Companies, for example, often resist providing full and accurate information because of costs, marketing, and competitive advantages (Santana and Wood 2009). Furthermore, in global supply chains, lack of transparency can be because of commercial protectionism or the fear of increased liability risks (Klievink et al. 2013, Hultman and Axelsson 2007). Consequently, under certain circumstances, lack of transparency may be necessary and publicly desired (Bannister and Connolly 2011).

2.7.2 Transparency and Accountability

The link between transparency and accountability has been the subject of several studies in transparency. Generally, it is believed that transparency facilitates democratic accountability (Swank and Visser 2013, Menéndez-Viso 2009, Piotrowski and Van Ryzin 2007), along with collaboration, cooperation, and commitment (Jahansoozi 2006), which in turn can lead to less corruption (Abu-Shanab 2013). It is argued that the most noticeable virtue of transparency is accountability (Scauer 2011), and that transparency is an indispensable element of public accountability (Craft and Heim 2009, Vaccaro and Madsen 2009c). The link between transparency and accountability is important, as transparency itself is not considered to be an end, but a means to reach accountability (Brito and Perraut 2010).

There are several studies which illustrate the potentials for transparency to lead to accountability, e.g., in making legislative bodies and governments more accountable through the disclosure of information view the web (Griffith 2006, Cucciniello et al. 2012, O'Neill 2009), in making central banks accountable for their policies by using transparency as a tool (Van der Cruijsen and Eijffinger 2010, Cukierman 2009), in making health care organisations more accountable for safer systems (Kachalia 2013), and in more corporate accountability by using corporate social transparency as a mechanism (Williams 2000). Other examples of transparency leading to accountability include

making non-governmental organisations more accountable (Marschall 2002), and in managers' more accountability towards outsiders (Hope et al. 2009). The bottom line is that transparency provides the opportunity to hold accountable those in power, and this, in turn, will lead to democracy (Birchall 2011).

It is important to know how transparency can help increase accountability. Rawlins (2008a) maintains that transparent organisations become accountable for their actions and decisions because their transparency makes it possible for others to see and evaluate them. Furthermore, transparency can result in questioning the accountability of governmental bodies and policy makers (Margetts 2011). Transparency can increase both horizontal accountability amongst interested parties and stakeholders, and vertical accountability within the policy process (Truman 2008).

However, some scholars have questioned the direct link between more transparency and more accountability. These scholars emphasise that transparency is an essential prerequisite to accountability, but not sufficient to cause accountability. For example, Gaventa and McGee (2013) state that increased transparency in government decision-making processes leads to greater accountability to the public. However, they mention that transparency does not automatically produce accountability; it is a necessary condition but not a sufficient one.

Kolstad and Wiig (2009) mention public power as a leverage and state that the availability of information alone is not enough for fighting corruption, and the public needs to have some power as well to act based on information and put officials accountable to their actions. Similarly, Hale (2008) states that accountability consists of two components, the ability to know what an actor is doing and the ability to make that actor do some other thing, and transparency clearly provides the first, but to provide the second component, market power, external discourse and internal norms should be recruited. Fox (2007) also states that transparency does not necessarily lead to accountability, i.e., transparency is essential but not enough. The argument is that if transparency is dependent on the power of shame, then it may have limited influence on the shameless.

Some reasons are stated as to why transparency does not necessarily bring accountability. One reason is related to the peculiarities of transparency provision. Shkabatur (2013) states that the demand for accountability is mainly satisfied by regulatory transparency, and that accountability has been inseparably associated with transparency. He argues, however, that the existing transparency policies do not enforce public accountability. This happens because most basic questions about regulatory transparency, such as what type of information should be made public, how such information should be presented and how transparency pitfalls should be avoided, are often left

unanswered. Furthermore, he says that the technology has also strengthened the traditional pitfalls of transparency policies. This is because the existing architecture of online transparency, in their opinion, allows organisations to retain control over regulatory data and withhold the disclosure of those pieces of information which is necessary for public accountability.

The second reason is related to an intermediary concept related to transparency and accountability, which is publicity. Naurin (2006) states that accountability is mainly a function of publicity, rather than transparency, and that publicity is a causal mechanism which links transparency to accountability. It is discussed that transparency literally means that it is possible to look into something and to investigate it. But publicity means that information is actually spread to and absorbed by the stakeholders. Therefore transparency is about availability of information, while publicity is about accessibility and understandability of information. Naurin (2006) mentions that different reasons, such as lack of mediators (e.g., social media), lack of demand (i.e., rational ignorance), and lack of stakeholders' capacity to access and process information may lead to lack of publicity, and as a result, accountability. Finally, it is also observed that publicity, like transparency, is also a necessary condition for accountability, not a sufficient one. The sufficient condition is met when some instruments can be utilised to enforce accountability.

2.7.3 Transparency and Fighting Corruption

One of the more-researched effects of providing transparency is its potential to help fight corruption. Studies on transparency generally confirm such potentials. For example, Kolstad and Wiig (2009) state that transparency is an effective tool in fighting corruption through many mechanisms, e.g., making corruption actions riskier. Peisakhin and Pinto (2010) state that, based on field experiment, greater transparency can act as an anti-corruption mechanism. Transparency is generally believed to be a public value to counter corruption (Ball 2009), it is historically seen as a safeguard against corruption (Craft and Heim 2009), and it is promoted as a necessary condition for better government quality, higher accountability, and limiting corruption and impunity (Bauhr and Grimes 2014, Cucciniello et al. 2012). Furthermore, the use of ICT in transparency provision has been shown to further increase the potential to limit the scope for corruption (Sturges 2005).

Transparency can indeed act as a remedy against corruption, when information is actually accessed by the public (i.e., publicity) and that such publicity will be backed up by sanctioning mechanisms against the corrupt (i.e., accountability) (Lindstedt and Naurin 2006). However, some scholars question a cause-and-effect association between transparency and fighting corruption.

Bac (2001) states that a higher level of transparency in decision making processes increases the possibility of detecting corruption, but it does not necessarily lead to less corruption because of the

"connection effect", i.e., potential corrupted people receive better information about whom they should connect with. For example, revealing the identity of university exam designers to students may increase favouritism or bribery, as the students may connect with those designers. Kolstad and Wiig (2009) state that transparency alone is not sufficient to fight corruption, and other measures, such as educating the public, should be taken alongside transparency. They argue that transparency alone may even increase corruption.

Joshi (2013) states that transparency is regarded as a mechanism to fight corruption by pointing out discrepancies in public accounts and triggering accountability mechanisms such as investigations. But they argue that this also makes several underlying assumptions that information made public through transparency mechanisms will be digested by concerned people, that these people will voice their outrage at exposed misconduct, and that such outrage will improve accountability and reduce corruption consequently. It is therefore concluded that contextual factors should be considered before transparency outcomes are to be advocated.

2.7.4 Transparency and Credibility

Transparency has been shown to influence credibility of the organisations and individuals providing information as well. Craft and Heim (2009) state that through providing transparency, credibility may be enhanced, and Rawlins (2008a) states that transparency can increase credibility.

Some empirical studies further confirm the existence of such links between transparency and credibility. For example, McCarthy (2007) provides an example of how embracing transparency restored, at least partially, the credibility of the Archdiocese of Boston. Santana and Wood (2009) state their concern on how the lack of transparency by unaccountable anonymous users in Wikipedia has resulted in seriously questioning the credibility of information provided in Wikipedia.

In central banks, central bankers view transparency as an important tool to increase credibility (Blinder 1999). Similarly, transparency is shown to facilitate accountability, predictability, credibility, and effectiveness in monetary policy making (Winkler 2000). In governments, transparency in the government communication process is considered to be essential, as it increases trust and credibility (Fairbanks et al. 2007), and managers in organisations may lose their management credibility if they cannot provide standard transparency (Madhani 2008).

2.7.5 Transparency and Effectiveness

Transparency has been shown to have an influence on the effectiveness of organisations as well. For example, Woodford (2005) argues that transparency has an effect on the effectiveness of monetary policy, and Mitchell (1998) and Weber (2008) name transparency as a crucial factor to the effectiveness of international regimes.

Several studies point to the positive effect of transparency on effectiveness. Rawlins (2008a) views transparency as an important characteristic of an organisation because it will expose their weaknesses and areas that need to be improved. Therefore, transparency acts as a motivation for improvement in an organisation, and by doing so, it can ultimately increase the effectiveness of that organisation. Similarly, Brito and Perraut (2010) state that transparency can make all principal-agent relationships more efficient and effective.

There have been empirical studies supporting such a positive link between transparency and effectiveness. In medicine, transparency is shown to be able to lead to more engagement of clinicians in improvement efforts in health care organisations (Kachalia 2013), making transparency of medical institutions an essential characteristic for improving healthcare (Wyden 1995). In politics, information disclosure has allowed consumers to become "citizen-regulators" and act more efficiently than the government (Roth 2009), has improved administrative effectiveness as well as policy effectiveness in governments (Hirsch and Osborne 2000), and has become a critical component for efficiency and well-functioning of governments (Cucciniello et al. 2012). In the finance domain, it has been illustrated that financial transparency can decrease market uncertainty about policy makers' preferences, which leads to more predictable monetary policy and more efficient financial markets (Bellver and Kaufmann 2005).

There are, however, studies highlighting the adverse effects of transparency on effectiveness. For example, Allenspach (2009) states that greater transparency does not necessarily lead to more efficiency in the banking system. Similarly, Etzioni (2010) states that transparency alone can only raise awareness, but it does not obviate regulation. The examples provided by Etzioni include the introduction of alcohol consumption warning labels and food products with a 'healthy' label on them, in which awareness was increased but it led to little or no change in the public's behaviour, and therefore it did not lead to the effectiveness of the disclosed information. Griffith (2006) also argues that in the legislative process, some lobbyists understandably want earlier access to the "drafts of the drafts", but there are necessary limits to transparency that must be respected in order for the process of formulating ideas and negotiating outcomes to proceed effectively.

2.7.6 Transparency and Trust

An important effect of transparency is considered to be the effect of transparency on trust relations between information providers and information receivers. Not only is it generally assumed that transparency can increase trust (Rawlins 2008a), but also it is assumed that there is a demand for trust based on transparency in modern societies (do Prado Leite and Cappelli 2008). In fact, some studies show that one of the best methods of building trust is by engaging in transparent

communications (Rawlins 2008a). Transparency is considered to be fundamental to trust and trustworthiness (Bannister and Connolly 2011), and building trust amongst stakeholders is argued to be a strategic value of transparency (Bellver and Kaufmann 2005). The link between transparency and trust is strategically important (Hultman and Axelsson 2007), because trust is a social capital, which, for example, makes businesses flourish and become more efficient (Elia 2009). Furthermore, the relation between trust and transparency is bidirectional, meaning that transparency and trust are dependent on each other (Rawlins 2008b).

Higher levels of transparency are usually associated with higher trust levels. Vaccaro and Madsen (2009a) mention that higher levels of transparency can positively affect stakeholders' trust in a business. Schnackenberg and Tomlinson (2014) argue similarly that higher transparency is a facilitator of higher stakeholders' trust in an organisation. This is because transparency increases the trustworthiness of an organisation, and such trustworthiness leads to more trust in stakeholders.Transparency also plays a vital role in rebuilding trust when there has been a decline in trust (Jahansoozi 2006). This is also confirmed by Craft and Heim (2009), who claim that transparency is a method that journalists can use to re-establish trust with the public, and by Lidberg (2009), who argues that transparent governments, upheld by Freedom of Information acts, have the potential to restore people's trust in politics.

Several examples link trust to transparency as well. For example, Tanimoto (2005) states that providing transparency in designing interfaces helps to build trust and permit error detection. In public relations, transparency is usually seen as a precondition for trust, legitimacy and reputation (Bentele and Seiffert 2009). In medicine, transparency can lead to more trust in patients in health care organisations (Kachalia 2013). In politics, transparency can be viewed as a main principle for building trust between the public and the government (Serrano and Leite 2011), and as a means for reducing uncertainty and increasing public trust (Meijer 2009).

But why does transparency lead to trust, and where does it originate from? There are some reasons provided to advocate such an association. For example, Osborne (2004) reasons that increasing transparency aims to make it harder for people to act corruptly, and therefore to infuse trust. As for the origins, Menéndez-Viso (2009) states that transparency has its stems in distrust, and that is because people do not trust organisations and governments in what they do, and therefore they ask them to be transparent and visible.

Some studies do not necessarily view an always positive association between transparency and trust. Cysneiros and Werneck (2009) argue that transparency and trust can also have a negative

impact on each other. Similarly, and based on examples such as WikiLeaks, Margetts (2011) argues that transparency, while resulting in more openness and more public surveillance, can change the nature of the public's trust in governments the provide limits to the benefits of transparency, i.e., in some cases it may lead to less trust in the government and policy makers. Grimmelikhuijsen (2012) mentions that the effects of government transparency on public trust are exaggerated, mostly because of pre-existing beliefs formed by the public about the government. In another cross-cultural study, Grimmelikhuijsen et al. (2013) illustrate that transparency can have a negative effect on public trust in governments, which can be magnified by cultural differences.

Proponents of the inverse relation between transparency and trust list their own reasons. O'Neill (2002) points to the confusion as a result of information overload, and argues that as transparency advances, trust seemingly recedes, because of the flood of unsorted information and misinformation which leads to confusion. O'Hara (2012) states that transparency has the potential to undermine trust, by revealing that the trustee's interests are not aligned well with the trustor's interests.

Finally, Grimmelikhuijsen and Meijer (2012) reasonably argue that for transparency to inspire trust in public, it is arguably essential that the disclosed results which are presented to the public are positive ones. That is, any positive effect of transparency on trust should be anticipated when good policy results are revealed to the public. Therefore, no general conclusions about transparency and perceived trustworthiness can be drawn in advance.

2.7.7 Transparency and Democracy

A well-studied and well-emphasised result of transparency is its aid in progressing democracy. The literature on transparency almost unanimously advocates the positive influence of transparency on democracy, to the point that it is odd to consider that transparency has no democratic benefits (Moore 2011). For example, Michener and Bersch (2011) argue that accessible information (i.e., transparency) is the primary building block of solid democracies and markets, and it dispels opacity, which is the first refuge of corruption, inefficiency and incompetence. Similarly, transparency and the right to access information are crucial to many functions of democracy such as citizen participation, trust in government, fighting corruption, and informed decision-making (Carlo Bertot et al. 2012, Bertot et al. 2010a).

Transparency and transparent decision-making are generally regarded as prerequisites for the working of a representative democracy (Swank and Visser 2013, Tagiuri et al. 1955) because they provide measures to prevent bad government and abuse of power (Cucciniello et al. 2012), and that increasing the level of transparency in governmental decision-making processes can improve democracy and citizen involvement (Ball 2009).

Transparency is also becoming a vital concept in western democracies (Wehmeier and Raaz 2012, Serrano and Leite 2011) and apparently plays a role in maintaining democratic peace (Van Belle and Oneal 1998). Democratic governments have the responsibility to be open, accessible and transparent to the public (Dawes 2010), and they can achieve greater transparency because of the generally more open information flow within such societies (Mitchell 1998). In general, democratic governments tend to be more transparent that other states (Small 1996).

2.7.8 Transparency and Governance

The literature on transparency suggests that providing transparency can affect governance as well. It is considered to be one of the best means to achieve better corporate governance (Bessire 2005), and is observed as a major component of good governance on its own right (Kaufmann and Bellver 2005, Weber 2008). Furthermore, The Organisation for Economic Co-operation and Development (OECD) lists transparency as one element of good corporate governance (McGee 2009). Good corporate governance includes, amongst other things, a transparent ownership structure that can identify any conflicts of interests between managers, directors, stakeholders, and other related parties (Patel and Dallas 2002).

One reason why transparency can lead to better governance is given by Cucciniello et al. (2012), who state that transparency is the key to better governance because it can increase trust. It is also argued that transparency contributes to better administration of public work and open government (Abu-Shanab 2013). For this reason, transparency is promoted as a necessary condition for better government quality (Bauhr and Grimes 2014). An empirical study also reveals that information transparency has improved governance and institutional quality in 169 countries (Islam 2003).

The opponents of transparency in the context of governance are but a few scholars, who mainly argue that transparency may add uncertainty and unpredictability to governance and therefore prove to be harmful (Moore 2011). This, however, illustrates that the link between transparency and governance is not a well-defined link.

2.7.9 Transparency and Ethics

More often than not, transparency is tied to ethics (Rawlins 2008a) and morality (Stirton and Lodge 2001). It is considered an ethical duty of all agents to adopt transparency to ensure that all stakeholders receive the requested information (Vaccaro and Madsen 2009a), and an essential ethical practice which raises stakeholder trust and confidence in organisations (Vaccaro and Madsen 2006). Transparency has a moral value as well, because it improves an individual's autonomy by involving them directly in the process of making decisions which can affect their lives and interests (Stirton and Lodge 2001).

Turilli and Floridi (2009) state that information transparency can be ethically "enabling" or "impairing". They also state that there are two relations between ethical principles and disclosed information. The first one is 'dependence', meaning that some information is needed in order to endorse ethical principles, e.g., accountability, safety, and welfare. The second one is 'regulation', meaning that some ethical principles regulate the flow of information by limiting its access, usage, dissemination, and storage, e.g., privacy, anonymity, copyright, and freedom of expression. Transparency is therefore ethically enabling when it provides the necessary information for endorsing ethical principles or details on how information is limited. Transparency is ethically impairing if false information (i.e., misinformation), partial, inappropriate, or excessive information is revealed.

Transparency can also help the ethics within an organisation. Rawlins (2008a) argues that transparency enhances the ethical nature of an organisation in two ways: first because it makes an organisation accountable for their actions and policies; and second, because it respects the autonomy and reasoning ability of individuals who deserve to have access to information that can potentially affect their lives. The first reason is backed by Stasavage (2003), who says: "The most direct way to eliminate problems of moral hazard is to make an agent's behaviour more observable". The second reason is backed by Wall (1996), who argues that the public owes an honest, publicly accessible justification for the use of power in their society, and that such justification must appeal to reasons and evidence that can be publicly stated and evaluated.

Transparency is important for preserving ethical processes which are performed within public, private, and non-profit sectors (Vaccaro and Madsen 2009c), and an organisation's transparency is conditioned by financial and economic forces, as well as ethical pressures, such as privacy and security (Vaccaro and Madsen 2006). However, Turilli and Floridi (2009) state that dealing with ethical issues in disclosing information is a major challenge for information providers. They choose the example of disclosing medical records which can help life-saving research, but at the same time may expose patients to fraud or a breach of privacy. However, they state that if disclosed information is ethically neutral, then there will be no ethical challenges regarding the disclosure of such information. Furthermore, lack of transparency, and also being transparent against client wishes, are considered to be two of several ethical issues in the practice of public relations (Baker 2009), which illustrate the importance of keeping a balance in the amount of provided information to avoid such ethical dilemmas.

2.7.10 Transparency and Information Overload

Information overload is usually listed as one of the side-effects of transparency. Information overload happens when people are given too much information in a short time, and it can lead to confusion and poorer decision-making (Ripken 2007). For instance, Etzioni (2010) provides an example of a comparison between a 47-page mortgage document which may give the customers a wrong sense of security (as they might think more details means more honesty), and a simple, shorter, easy-to-understand mortgage document, which actually enables the customers to digest and use the provided information.

Gupta (2008) states that providing too much information can become similar to drowning in disclosure, where information recipient gets bombarded with large volumes of disclosed information and cannot find "the needle in the haystack". Similarly, Craft and Heim (2009) argue that transparency can be counterproductive by bombarding people with so much information that it becomes impossible for the public to separate the signal from the noise.

As an example of how information overload resulted from transparency can have catastrophic consequences, Finel and Lord (1999) argue that when transparency leads to information overload, it may actually hinder international conflict resolution as it makes it difficult for policy makers to discern what information is valuable and authoritative. They go on to conclude that transparency often exacerbates international crises, may undermine behind-the-scenes efforts at negotiated settlements, make it difficult for observers to decide who controls a given policy decision, and that in such circumstances, a lack of transparency may actually help nations avoid conflict.

With the advent of World Wide Web, and the increasing flow of information amongst entities on the web, information overload seems inevitable. During a study, it was observed that developers reported problems with information overload during watching several active repositories or following several active people (Dabbish et al. 2013). This calls for pragmatic approaches towards transparency provision to circumvent information overload.

2.7.11 Transparency and Collaboration

Several scholars have studied the possible effects that transparent information exchanges might have on collaboration. Transparency has the potential to aid coordination within online communities (Dabbish et al. 2014, Erickson and Kellogg 2000) and within a workplace (Dabbish et al. 2012, Dabbish et al. 2013), can indirectly enhance collaboration within the public and facilitate democratic processes (Casalino et al. 2013), and can enhance coordination in collocated work environments (Carlile 2002). Similarly, Jahansoozi (2006) relates transparency to other responsible dimensions and forms of organisational behaviour, such as trust, accountability, collaboration and cooperation.

One example of how transparency helps collaboration is provided by Dalsgaard and Paulsen (2009) in the context of online education. It is stated that transparency in online educational activities, e.g., the students' and teachers' having insight into each other's activities and resources, has the potential to support and is important for cooperative learning in online learning communities.

On the other hand, transparency has the potential to hinder collaboration, when collaboration is achieved through information hiding. For example, one study shows that too much transparency may inhibit cooperation of international partners and governments, as international negotiations often require diplomatic secrecy (Mitchell 1998).

2.7.12 Transparency and Open-Data Movement

One of the noticeable influences of transparency is on the creation and nourishment of the open-data movement. Open-data initiatives allow the public to question official accounts and policy maker actions (Margetts 2011). It has been observed that transparency and the open-data movement together have contributed to the increase of trust in the public (O'Hara 2012).

Michener and Bersch (2011) mention that the on-going movement for transparency has led to the open-data movement, which is a new generation of tech-savvy activists and policy specialists who seek verifiable, usable information. Open-data advocates demand for open-format applications that use application programming interfaces (APIs) and provide data that is downloadable, machine readable, platform-independent, and open. The open-data movement has become a key reason why inferability is becoming increasingly important. Michener and Bersch (2011) express that open-data initiatives can boost accountability through greater transparency. The open-data movement pledges to increase the quality of transparency because of having dedicated, resourceful advocates.

2.8 Transparency and Neighbouring Concepts

As transparency relates to the flow of information, at least three adjacent concepts, also related to information and information exchange, should be examined. These three concepts are secrecy, anonymity, and privacy and security. In this subsection, these three concepts are briefly presented.

2.8.1 Transparency and Secrecy

Secrecy is the apparent antonym of transparency (Birchall 2011, Rawlins 2008b, Yosha 2003), which is reflected in several studies of transparency. Rawlins (2008a) defines transparency as the opposite of secrecy, with secrecy being defined as "deliberately hiding your actions" and transparency being defined as "deliberately revealing them" (Florini 1998). Similarly, Davis (1998) defines transparency as removing the veil of secrecy, and Pasquier and Villeneuve (2006) state that transparency and secrecy are two ends of the spectrum. However, the relation between transparency and secrecy is not an either-or relation (Florini 1998).

While transparency and secrecy are opposite concepts, depending on the context, both transparency and secrecy have been praised. For example, depending on the situation affecting the lobbies and politicians, either transparency or secrecy may be optimal (Felgenhauer 2010). Therefore, in certain cases, secrecy and lack of transparency may not be an enemy of trust (O'Neill 2002). That being said, transparency is commonly viewed as a general virtue and secrecy as a general vice (Baker 2009). For example, Ball (2009) states that transparency must be seen as the opposite of secrecy, i.e., if there is transparency, it conveys honesty and integrity.

Furthermore, transparency can be used to maintain secrecy as well, by disclosing information with no fanfare (O'Neill 2009). On a different note, transparency of secrecy is also discussed (Bok 1989), meaning that even though an organisation does not have to make all their information public, and that having some secrets are justified, those justifications must be made public and transparent.

In the literature, some attempts have been made to model secrecy. For example, Pernul et al. (1998) propose a semantic data model for secure database applications which considers three kinds of constraints, integrity constraints, secrecy constraints, and access control requirements. Another research investigates the privacy and secrecy requirements of people in their daily social activities (marques et al. 2012). A general investigation into secrecy reveals that research on secrecy is also mostly paired up with investigations into privacy and security.

2.8.2 Transparency and Anonymity

Anonymity is considered as the right not be identified (Woo 2006), and is argued to be one of the ethical principles that govern transparency and the flow of information (Turilli and Floridi 2009).Anonymity is concerned with the hiding of the information that can reveal a person's identity (or an organisation's identity), and therefore it is considered to be the lowest level of identity transparency (Stuart et al. 2012). Regarding identity information, anonymity is sometimes labelled as the opposite of transparency (Lucas 2013).

While anonymising information and anonymity might be necessary in certain contexts, e.g., for obtaining news from sources who would not disclose the news unless their names are anonymised (Carlson 2011), it also remains crucial for organisations to reveal information about how they manage personal and identity-related information flow to prove to their stakeholders that no correlation will exist between their identity and their online activities (Turilli and Floridi 2009). Similarly, anonymisation and deanonymisation of data should be governed by establishing transparency in how data receivers comply with regulations regarding these two tasks (Kataoka et al. 2014).

Modelling anonymity has been researched particularly in relational databases (Kayem et al. 2012), where several anonymisation techniques have been investigated, such as k-anonymity (Wong et al. 2006), l-diversity (Machanavajjhala et al. 2007), and t-closeness (Li et al. 2007). Other research includes methods for the classification of anonymity requirements (Kharaji and Rizi 2015), a foundation for privacy maintenance where anonymity is seen as a privacy goal (Beckers and Heisel 2012), and an approach for a structure which can provide a balance between anonymity of users and their accountability in their use of e-transactions (Jayasree and Damodaram 2012).

2.8.3 Transparency and Privacy and Security

Unlike secrecy, transparency is not the opposite of privacy, but there are occasions where the two concepts get at odds with each other, leading to conflicting demands between transparency and privacy (Osborne 2004). For example, Menéndez-Viso (2009) states that transparency conflicts with privacy when it is perceived as unrestricted looking into organisations and people. Furthermore, when personal data is concerned, more transparency is linked to less privacy and bigger privacy challenges (Dalsgaard and Paulsen 2009).

Privacy is usually considered to be the ethical issue of the 20th century, and some scholars believe that it has now been replaced by transparency, making it the new ethical issue of this century (Capurro 2005). Transparency is "the flashpoint at the intersection of the public's right to know and individual's or organisation's right to privacy" (Oliver 2004). Still, transparency must be handled carefully in order to prevent privacy issues, ensuring users that their privacy is respected (Dalsgaard and Paulsen 2009).

Unlike secrecy and anonymity requirements, there are several studies conducted for the engineering of privacy requirements. Amongst them are the framework proposed for the engineering of smart-grid-specific privacy requirements (Neureiter et al. 2013), the framework that exploits the notion of transparency awareness requirements for the identification of runtime privacy requirements (Omoronyia et al. 2013), and the framework originally designed for security requirements comparison which is utilised in the comparison and evaluation of privacy requirements engineering approaches (Beckers 2012).

Similarly, security and transparency are sometimes viewed as two antagonistic requirements which must be dealt with in the early phases of system analysis (Cappelli et al. 2010). Therefore, transparency must be squared with values such as security and privacy (Etzioni 2010), otherwise it can threaten both privacy and security, even though transparency is seen as a positive concept (Meijer 2009). Consequently, privacy and security are seen as two forces that can affect an organisation's transparency (Vaccaro and Madsen 2006).

Security engineering is also a well-established research field and several studies have focused on it. For example, security has been modelled using Secure Tropos (Giorgini et al. 2006), an ontology has been proposed for it using Secure Tropos (Mouratidis et al. 2006), and a conceptual model for reasoning about security requirements in Internet of Things (IoT) systems, called Apparatus, has been proposed, which is architecture-oriented and uses Javascript Notation Object (Mavropoulos et al. 2016).

2.9 Limitations of Providing Transparency

With so many possible effects and side-effects attributed to transparency, it is normal to expect to encounter limitations and precautions while providing transparency to its intended stakeholders. In practice, transparency benefits should be weighed against other goals and objectives of an institution or regime to minimise such adverse effects (Mitchell 1998).

Such limitations on providing transparency can have several reasons. First, there are regulations which can limit the flow of information and transparency. Some of these reasons have been investigated to be confidentiality (which is essential for national security, crime investigations, and the validity of commercial competition) and personal privacy issues (Osborne 2004). Similar reasons for limiting transparency within an organisation are listed by Brito and Perraut (2010) to be privacy concerns, national security or internal deliberations within that organisation. Scauer (2011) also states that transparency decreases in cases of secrecy, privacy, anonymity, and confidentiality, meaning that it must be squared with these values (Etzioni 2010). It is important to acknowledge that all these notions have their own values (e.g., transparency is a more desirable value for sunroom windows than it is for bathroom doors) (Scauer 2011). Furthermore, it is also argued that transparency should not only disclose one's actions, but also one's performance, which is the result of one's actions, and that transparency must be mandatory to become effective, i.e., the agent should not be disclosing information whenever they feel like it, but this process must be regulated. This regulation should include substantive and truthful information about one's performance, and should include stakeholders who are entitled to that information (Brito and Perraut 2010).

Second, the context in which information is exchanged can heavily influence the choice of transparency. One example provided by Tanimoto (2005) is about the transparency of information unnecessary for students to know, information that teachers and testing agencies may wish to keep hidden from them. In this example, a latent semantic analysis (LSA) based scoring technique is described which ignores word order in the input and bases its results only on the frequencies of occurrence of the words. It is argued that if students know about this technique, they may be tempted to game the grading system by finding out what kinds of words are required for a particular

essay, and then to submit gobbledygook on their assignments that nevertheless will fulfil the LSA-based assignment system. Therefore, the assessment process will no longer work appropriately if it is exposed to the students. Furthermore, the context of information exchange may even render transparency provision useless. For example, transparency is clearly not relevant in secret ballots (Etzioni 2010).

Third, there is the cost of collecting, processing and disseminating the information. When and if transparency has no costs, all stakeholders benefit from it (Demertzis and Hoeberichts 2007). But when it becomes costly to provide transparency, limits might become an inevitable option to keep the costs to a reasonable extent. This is why it is argued that it may not be efficient for the public to process and absorb all the disclosed information (Etzioni 2010).

Several studies mention and confirm limitations on transparency to avoid its side effects. In medicine, for example, it is illustrated that if precautionary steps are not taken towards providing transparency, transparency efforts may have a negative effect if clinicians avoid discussion because of the fear of feeling exposed or further upsetting patients and their families (Kachalia 2013).

In economic studies, it is argued that transparency policies may pose a threat when the authorities must gather information from the private sector (Wong 2008). Therefore, it is optimal to reduce transparency in order for the policy authorities to gather more information, which in turn will result in more informative policy statements. Hultman and Axelsson (2007) also discuss that increased transparency in buyer-supplier relationship may bring about negative consequences. In another study, Van der Cruijsen and Eijfinger (2010) name the perception of transparency as an obstacle, and argue that perceived transparency significantly deviates from the actual transparency practices, and since perceptions can greatly influence one's behaviour, imperfect transparency perceptions can have an impact on people's economic actions, such as their perceptions and expectations of inflation, as well as their level of trust in the central bank.

In legal studies, transparency is shown to become limited because of the language used in formal documents (Ripken 2007). When corporate lawyers use a formal language in preparing disclosure documents, they intend to protect the organisations from liability rather than to provide the public with meaningful information. Therefore, these documents cannot satisfy their communicative purposes as they are incomprehensible for the public. Another study reveals that more transparency in discussing decision-making within the European Council of Ministers may result in more back-room discussions or deals over lunch (Stasavage 2006). Similarly, Swank and Visser (2013) point out that more transparency may lead to pre-meetings and scripted public meetings.

There are also studies in which it is argued that transparency does not necessarily promote better decision-making, less corruption, and more effectiveness (Bauhr and Grimes 2014). In fact, Florini (2000) states that without mutual compatible norms, transparency can actually deteriorate a situation. It is well argued that some secrets are worth protecting, such as certain corporate or national security information. Furthermore, it is argued that information can sometimes be misused or misinterpreted, because it reveals behaviour and not intention. However, sometimes what is being done is less important that why it is being done. This view of transparent actions and non-transparent intentions is also argued by (Cysneiros 2013).

Ball (2009) states that the existence of conflicting goals in policy design makes transparency creation difficult to achieve, and therefore the degree of transparency varies from one policy to another. Also, it is argued that a policy is transparent not only if the goal is clear, but also if its impact, e.g., the decision making process becoming easier, is clear. This most probably occurs when information is both available and easily accessible. Finally, it is argued that transparency may not always work, because other interests may prevent one person or organisation to change behaviour, e.g., in the case of companies emitting noxious chemicals in the United States and disclosing such information to the public (Florini 2000).

While the Internet has been shown to have the potential to improve transparency in democratic societies (Margetts 2011), the use of computer and Information Communication Technology (ICT) can also affect transparency in a negative way. Technical advances have led to new horizons in social transparency which sometimes exceeds the public's comfort levels, leading to debates on privacy and anonymity (Stuart et al. 2012). Furthermore, it is investigated that unlike direct, face-to-face forms of transparency, computer-mediated transparency can actually threaten trust, since it is unidirectional (i.e., not interactive), decontextualised (i.e., removed from shared social experience), and too structured (i.e., highly selective and simplified with a bias towards quantitative information) (Meijer 2009). Vaccaro and Madsen (2009a) also discuss four limitations to ICT-based dynamic transparency. The first one is the "digital divide", which omits people who do not have access to the Internet. The second one is the digital distribution of false information which is facilitated by the exploitation of the anonymity on the Internet. The third issue relates to the costs of implementing dynamic transparency, which dramatically raises information transaction costs for organisations. The fourth and final issue is related to respecting intellectual property rights while disclosing information in order to reach transparency. These studies illustrate the delicate nature of transparency and the need for a careful implementation of transparency in a computerised environment.

2.10 Transparency Regulations

It was discussed earlier that transparency needs to be regulated in order to minimise its adverse effects and maximise its benefits. This regulation is conducted "to ensure the veracity of the information that is released, to promote releases that are comprehensible to the public and comparable to information released by other sources, and to secure that such information will be regularly made available" (Etzioni 2010), and should enable independent access to information held by information providers (e.g., governments or corporations) (Lidberg 2009).

Some of the adjacent concepts to transparency, such as secrecy, anonymity and privacy, were discussed previously. These adjacent concepts can all be used to regulate the flow of information, and therefore, the amount and degree of transparency (Vaccaro and Madsen 2009b, Birchall 2011).

Intellectual property rights such as copyright laws and trade secrets are also two of the regulating forces of transparency (Vaccaro and Madsen (2009a). Similarly, Weitzner et al. (2008) also mention copyright regulations along with privacy regulations amongst those which regulate the flow of information, and Turilli and Floridi (2009) mention ethical principles, such as privacy, copyright and anonymity, should regulate the flow of information.

In the same fashion, Freedom of Information laws regulate transparency provision. Freedom of Information regimes will lead to increased transparency, prevention of corruption and greater public participation in the political process, and without them, there will be no 'proper' democracy (Lidberg 2009). However, formal obligations to disclose information, such as Freedom of Information laws and corporate governance codes, have to be balanced against considerations such as commercial confidentiality, privacy, and security (Hood 2011). Similarly, it is argued that freedom of information implies a right to know that contradicts the right to privacy (Osborne 2004). In other words, these instrumental rights to know advocate standards of information disclosure that both justify and limit transparency, allowing for a reasonable balance of stakeholders' interests in other matters such as privacy and security, and allowing organisations to remain competitive, protect their private data, and also meet the legal requirements (Elia 2009).

Once again, certain contexts may introduce certain regulators of transparency. In the case of non-governmental organisations, five main forces are identified that can influence the levels of transparency: privacy, security, financial supporters (donors), competing institutions, and beneficiaries (Vaccaro and Madsen 2009b). In the case of public administration, four factors are identified which can influence the policies on transparency: costs and risk, effective public administration, public's right to know, and rights of public servants (Bannister and Connolly 2011).

What remains to be said in this section is that transparency is not only the target of regulations, such as privacy or freedom of information regulations. Transparency also remains as an attribute of regulatory systems, meaning that the regulations involving privacy or freedom of information should be transparent to the public in order for them to be assessed and evaluated (Weber 2008). To conclude, regulating transparency ensures that transparency, while it is valuable, should not be maximised at the expense of other interests (Scauer 2011).

2.11 Study of Transparency in Requirements Engineering

Transparency is a long-studied topic in fields of study such as politics, economy, and journalism. In all these fields of study, transparency of information is considered to be a requirement of citizens (Araujo et al. 2013). But in the field of requirements engineering, the study of transparency as a requirement is a relatively new topic. While transparency has been mentioned in studies relating to the citing and classification of non-functional requirements, is has seldom been paid a scholarly attention to, and has been mostly studied as a second class concept. Furthermore, the existence of two contradicting definitions for transparency in software engineering has complicated the study of transparency as a requirement (Turilli and Floridi 2009). Transparency has been used to mean invisibility, e.g., a software system is considered to be transparent when its users do not need to know its underlying mechanisms (Star et al. 1998), but it has also been used to mean visibility, e.g., when a software system is considered to be transparent when all functionalities of software are disclosed to users (Meunier 2008).

When transparency is used in its second meaning, sometimes it is argued in two categories of “information transparency” and “process transparency”. For example, do Prado Leite and Cappelli (2008) state that a software system is transparent if it makes both the information it deals with and the internal functioning process transparent, called information transparency and process transparency respectively. This same concept is also reflected in another study conducted by them (do Prado Leite and Cappelli 2010).

From the perspective of requirements engineering, transparency is commonly categorised as a non-functional requirement (NFR), because it is orthogonal to the software functionality since it is a quality issue, and because software can work with or without transparency (do Prado Leite and Cappelli 2010). Because of the nature of transparency as an NFR, it is argued that transparency can rarely be satisfied; it can only be satisficed (Cysneiros 2013). Furthermore, as an NFR, transparency is aided by other non-functional requirements such as accessibility, usability, informativeness, understandability, and auditability (do Prado Leite and Cappelli 2010).

Some works on transparency requirements have been conducted by the researchers in requirements engineering. For example, using the NFR Framework, a software transparency softgoal interdependency graph has been proposed which illustrates the interdependencies between transparency requirements and other NFRs (Chung et al. 2012). Similarly, Cappelli et al. (2007) argue that transparency requirements can be managed using the NFR Framework (Chung et al. 2012) and *i** modelling (Yu 2011). However, they also admit that *i** is not the final answer to transparency, as there are shortcomings to be addressed.

Another study on transparency requirements argues that organisations must know what transparency is and how they can demonstrate transparency (do Prado Leite and Cappelli 2008). For this purpose, a transparency ladder is presented, which contains the following five NFRs of accessibility, usability, informativeness, understandability, and auditability, and it is argued that these five NFRs must be achieved in order to reach transparency. By using Github as an example of a transparent environment, Dabbish et al. (2012, 2013) illustrate that transparency has the ability to reveal users' needs and requirements.

In another study, and for eliciting transparency requirements, Serrano and Leite (2011) use a novel approach to capture transparency requirements of stakeholders through an Argumentation Framework (Serrano et al. 2011). It is also advocated that to provide transparency, it must be dealt with in the context of requirements specification (do Prado Leite and Cappelli 2010). In another study, Cunha et al. (2013) illustrate the difficulties of presenting the transparency catalogue and provide solutions for them, while Cappelli et al. (2007) illustrate that the evaluation of transparency has a close relationship with "Quality Questions" known as 5W1H (de Oliveira 1996), as follows:

- WHAT: What will be done? (task/artifact)
- WHEN: When will each task be done? (time)
- WHERE: Where will each task be performed? (place)
- WHY: Why does the work need to be executed? (rationale)
- WHO: Who will perform the task? (responsibility)
- HOW: How will the work be done? (method)

2.12 Some of the Socio-Technical Impacts of Transparency in Practice

Transparency impacts on society and the way people live and obtain information have been enormous. The demand for more transparency in several aspects of the daily lives of people is now increasing on a daily basis. Several examples are provided by Scauer (2011), showing the ever increasing demand for more transparency:

- Courts, which are amongst the more transparent of decision-making institutions because of open hearings, public access to records, and written statements of reasons, are demanded to become even more transparent.
- Regulatory changes have responded to consumer advocates urging more transparency in mortgages, consumer financing, banking, and other financial transactions.
- Shareholder advocates require that corporations be more transparent about their governance and decisions, while at the same time the corporations themselves, as well as others, urge greater transparency as an alternative to so-called more awkward regulation.
- Proponents of open source computer technology demand laws and contracts that raise property over transparency.

In a similar fashion, stakeholders of financial institutes demand more transparency, leading to new regulations regarding reporting and financial disclosure, e.g., the Sarbances-Oxleys Act in 2002 and the Financial Markets Transparency Obligations Directive in 2004 (Wehmeier and Raaz 2012). In politics, human rights groups such as Transparency International, the Open Society Foundations, Greenpeace and Lobbycontrol Germany treat governmental transparency as one of their major goals (Scauer 2011, Wehmeier and Raaz 2012).

In the United Kingdom Higher Education, government has demanded that transparency be delivered through the government's Higher Education Funding Council for England (HEFCE), and universities are required to provide compatibility between their activities and the demands of the Freedom of Information Act (Neyland 2007). It should be noted that such transparency demands have also raised several concerns in research, in teaching, and in University management, leading to increasing pressure to demonstrate financial responsibility, e.g., through internal auditors, external auditors, the Research Assessment Exercise, demands of Value for Money, and Teaching Quality Assessments.

In the United States, President Barack Obama explicitly promised a more transparent government, and he has issued several directives to fulfil that promise, for example:

- Presidential Memorandum on Freedom of Information Act, 74 Fed. Reg. 4683 (Jan. 26, 2009),
- Presidential Memorandum on Transparency and Government, 74 Fed. Reg. 4685 (Jan. 26, 2009), and
- Memorandum from Peter R. Orszag, Director, Office of Management and Budget, to the Heads of Executive Departments and Agencies (Dec. 8, 2009).

In the international scene, the international community attempts to set up standards for financial transparency through the following efforts (Bellver and Kaufmann 2005):

- The International Monetary Fund (IMF) Code of Good Practices on Transparency in Monetary and Financial Policies
- Accounting standards for the public sector set by the International Federation of Accountants and auditing standards set by the International Organisation of Supreme Audit Institutions
- Transparency principles for international banking established by the Basle Committee on Banking Supervision
- The Organisation for Economic Co-operation and Development (OECD) Best Practices for Budget Transparency
- OECD Declaration on International Investment and Multinational Enterprises
- The Asia-Pacific Economic Cooperation (APEC) transparency standards in Trade and Investment Liberalisation and Facilitation
- OECD Anti-bribery Convention, 1996 Inter-American Convention against Corruption, the 2003 United Nations (UN) Convention against Corruption, and the 2003 African Union Convention on Preventing and Combating Corruption
- Other international agreements currently under discussion with reference to transparency standards are the World Trade Organisation (WTO) Agreement on Procurement, the Charter for Transparency on International Financial Institutions (IFIs), and the OECD Multilateral Agreement on Investment (MAI).

Furthermore, several other efforts have been made for providing greater transparency to the public (Lord 2006), such as:

- Data protection (e.g., Directive 95/46/EC of the European Parliament; European Commission 1995),
- Data availability (e.g., Brazilian habeas data legislation; Republic of Brazil 1997), and
- Access to information (e.g., Freedom of Information Act; United States Department of Justice n.d.)

2.13 The Need for Engineering Transparency

With so many facets and peculiarities present in the concept of transparency, and with the fine line that exists between beneficial transparency and problematic transparency, it is not surprising that some researchers have expressed a need for engineering transparency. It has been already noted

that there is still a lack of systematic approaches for conceptualising and evaluating transparency (Stuart et al. 2012) and that there are no measures provided for transparency, while it is important to propose one (Abu-Shanab 2013). The need for developing techniques for assessing transparency has also been stated (Carlo Bertot et al. 2012).

Griffith (2006) mentions that policy makers and system designers should establish new criteria for transparency that meet the needs of both legislators (as information providers) and citizens (as information receivers) in the emerging and increasingly participatory version of today's information society.

In the information age, the role of technology is becoming more necessary in engineering transparency. It is stated that the third generation of transparency policies, which is gradually emerging, will be driven by technology and collaborative in nature (Fung et al. 2007). However, it is also argued that technology may enable transparency, but it cannot guide it, and therefore, there is a risk of ICT-mediated transparency to be shallow, arbitrary, and biased towards the interests of corporations rather that stakeholders (Elia 2009). Such partial transparency, it is argued, can be more damaging than none at all. Therefore, the technology-driven engineering of transparency requirements should avoid such a detrimental effect.

The impact of ICT on corporate transparency has yielded three areas of research (Vaccaro and Madsen 2009a):

1. Public policy which focuses on transparency as a policy measure and the role of ICT,
2. Computer ethics community, and
3. Social accounting and corporate social responsibility field.

In the first area, transparency is analysed as a policy instrument for social regulation. Transparency policies are effective for resolving controversial issues such as health and safety risks, and fighting corruption, and ICT plays a major role in this context (Fung et al. 2007). In the second area, ICT is seen as a driving force that is changing transparency from a static process to a dynamic and interactive process by providing a new locus where organisations can interact with their stakeholders. In the third area, ICT has been shown to enable stakeholders' engagement and dialogue.

2.14 Summary

In this chapter, a state-of-the-art literature review on transparency was presented, and the advantages, effects, and side-effects of transparency were discussed. Furthermore, some of the socio-technical impacts of transparency in today's world were briefly presented. In the next chapter,

the foundations for the engineering of transparency requirements in business information systems will be described, which will deal with the second objective of this thesis.

Chapter 3

Reference Models for Engineering Transparency Requirements

"Essentially, all models are wrong, but some are useful."

George E. P. Box

3 Reference Models for Engineering Transparency Requirements

The existence of reference models for a particular concept provides several benefits. First, reference models can facilitate discussion and evaluation and offer a comprehensive outlook on the problem space. Second, reference models limit the scope of the study on that specific concept by concentrating on particular variables and defining the particular viewpoints which will help researchers in dealing with that concept. Third, they can be used as a foundation for the design and implementation of that concept. These benefits encourage researchers to devise and develop reference models as a ground work for their study, which is also the reason why reference models are proposed for transparency in this thesis.

The reference models for transparency should facilitate the volatile nature of transparency, as transparency can be viewed both as a regulatory and voluntary requirement. Regulatory requirements are generally about the compliance between system requirements and regulatory constraints. Such constraints could be enforced by law (Ghanavati et al. 2007, Ingolfo et al. 2013) or they could be quality constraints enshrined by some form of contract or commitment (Ojameruaye and Bahsoon 2014). Transparency might be seen as a regulatory requirement because laws and regulations may require organisations to be transparent for certain reasons and on certain processes (Wolfe 2003). Transparency can also be seen as a quality constraint, mainly as complying with information availability to the stakeholders who would need them (Dawes 2010). Transparency could be even twinned with privacy and data protection in the sense of being transparent about the regulations about the right to hide or the obligation to reveal information (Holzner and Holzner 2006).

Despite the existence of such established conceptualisations and requirements engineering approaches, little focus has been paid to transparency as an information receiver's requirement. In other words, information receivers have a wide range of meta-requirements on the basic transparency requirements of making information available and accessible. This becomes more important when organisations decide to be transparent on a voluntary basis without the existence of constraints or regulatory requirements. In such cases, the main focus would be making transparency more meaningful and useful to the audience, the characteristic which has not been the main focus of various reviewed works in requirements engineering literature. As a result, the reference models for transparency should be able to view transparency from both the information provider's and the information receiver's point of view. This thesis provides the necessary concepts in an attempt to pave the way to such a consideration.

As stated earlier in this thesis, the definition of transparency adopted in this thesis is the open flow of high quality information in a meaningful and useful way amongst stakeholders in a business information system. This definition clearly points to the following six pillars:

1. The existence of stakeholders with information needs
2. The existence of stakeholders who hold information
3. The existence of an information flow
4. The characteristics of information as being meaningful
5. The characteristics of information as being useful
6. The characteristics of information as having high quality

Based on this definition, four reference models for the engineering of transparency requirements in a business information system are proposed in this chapter in order to enable requirements engineers and information system analysts to better manage transparency requirements of stakeholders. These reference models capture:

1. The *actors* involved in the process of transparency provision and the information flow amongst them (covering pillars 1, 2, and 3),
2. The *meaningfulness* of the information made transparent through the disclosure of information (covering pillar 4),
3. The *usefulness* of information for a particular audience in terms of providing them with decision making capabilities through the disclosed information (covering pillar 5), and
4. The *quality* of the information disclosed to its intended audience (covering pillar 6).

These reference models provide a foundation to measure and manage transparency as a first-class requirements engineering concept. These four reference models are based on an extensive literature study on transparency in multiple disciplines including philosophy, management studies, business administration, journalism, and economy. The goal is to provide a solid foundation in the engineering of transparency requirements to make quality information available in a meaningful and useful style to the right audience. As a proof of concept, these reference models are utilised to investigate the United Kingdom (UK) Freedom of Information Act and enhancements to it are proposed from the perspective of information receivers and transparency seekers.

The process of the creation of these reference models is as follows. A template analysis approach was adopted where each reference model was initially built based on the information obtained from the literature review on the six pillars mentioned above. Then, the reference models were augmented in order to fit the definition of a reference model. Afterwards, the reference models

were discussed with the experts in the domain of requirements engineering as well as the experts in domain-specific ontology creation and their feedback was utilised when applicable. This feedback was obtained both in the form of face-to-face communication (e.g., in university-wide seminars and in worldwide conferences with people in the same community) and in the form of written feedback (e.g., enhancements to a submitted paper to a conference or journal). Furthermore, the reference models underwent trivial changes as time passed by and they were put into practice in real-world scenarios and case studies.

The rest of this chapter is structured as follows. Section 3.1 discusses the first reference model, Transparency Actors Wheel, which focuses on information circulation amongst relevant stakeholders. Section 3.2 explains the second reference model, Transparency Depth Pyramid, which centres on what constitutes meaningful transparency. Section 3.3 describes the third reference model, Transparency Achievement Spectrum, which concentrates on steps to be taken in order to reach useful transparency. In Section 3.4, the fourth reference model, Information Quality in Transparency, is explained, which is borrowed from the work of Kahn et al. (Kahn et al. 2002). Section 3.5 will discuss several interdependencies that exist amongst these four reference models and their implications for the engineering of transparency requirements. Section 3.6 will investigate the UK Freedom of Information Act from the lenses of the four reference models and provide a detailed discussion and possible amendments on it. Section 3.7 provides a summary of this chapter and introduces the next chapter.

3.1 Reference Model 1: Transparency Actors Wheel

In order to understand transparency requirements, one essential prerequisite is to identify the relevant actors in an information exchange. Amongst other things, the identification of these actors makes it possible to understand where the information originates, which actors provide the information, which actors receive it, and whether certain channels are used to relay information.

An initial model of information exchange illustrating relevant actors is discussed in (Stuart et al. 2012). In this model, which is presented in Figure 3.1 (left-hand side), two entities are introduced, information source and information receiver. The source disseminates some information to the receiver, and the receiver provides feedback based on that information back to the source.

Based on this initial model, a more complicated model of information exchange is proposed by Stuart et al. (2012) in order to fit today's social networks. In this newer model of information exchange, which is presented in Figure 3.1 (right-hand side), receivers can be a group of people instead of one individual. Furthermore, a new entity called observer can observe the exchanged information and can have access to that. The observer may also engage in these exchanges.

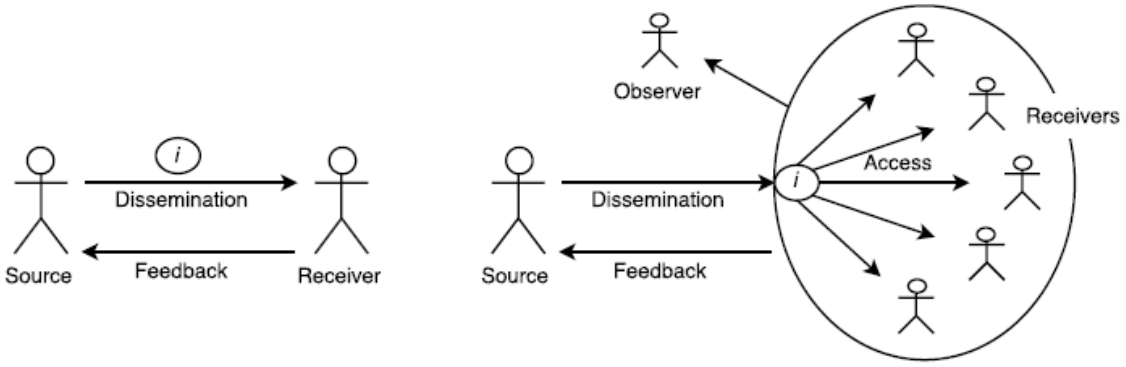


Figure 3.1: Initial information exchange model (left). Model fitted for social networks (right) (Stuart et al. 2012).

While these models have satisfied the needs of those proposing them in the act of information exchange, some key elements are missing that are essential for the study of transparency. The first one is the information medium which relays the information. The consideration of an information exchange medium as a technical actor is essential because it is where information can be stored, and is therefore prone to information leakage and unwanted transparency. The example of Ashley Madison website (an online dating service for married people or people in committed relationships) and the problems caused by its hacking is one of the many examples depicting the significance of information exchange medium in any transparency model of information exchange. The second missing element is information entity, i.e., the entity whose information is being exchanged. More often than not, information providers provide information which involves other entities, e.g., another person or organisation. It is therefore essential to consider them in any transparency model of information exchange. Third, the nature of information has not been thoroughly investigated in these information exchange models. Not all the information in an information exchange model relates to transparency. This is another point to be considered in a transparency model of information exchange.

The above reasons have been considered in Transparency Actors Wheel, which was initially proposed by Hosseini et al. (2015a) and later elaborated on by Hosseini et al. (2015b). This reference model proposes four actors in any information exchange model suited for the analysis of transparency requirements. In this reference model, any flow of information can be broken down into four elements:

- Information Provider (IP): the entity that is providing and presenting some information about another entity, or about itself.
- Information Receiver (IR): the entity that is receiving, probably upon request, the information about another entity, or about itself.

- Information Entity (IE): the entity whose information is being transferred. This can sometimes include the IP or the IR, depending on the context.
- Information Medium (IM): the medium through which the information is being channelled and transferred.

There are a few details which should be noted about these four elements of transparency. These details are as follows:

1) IP and IE will be the same if the information provider is giving information about themselves, for example, when someone is describing their own job.
2) IR and IE will be the same if the information provider is giving information about the information receiver, for example, when someone is telling their colleague about that colleague's performance.
3) IP, IR, and IE will be the same if the information provider is giving information about themselves to themselves, for example, when someone is keeping a private journal about themselves. This can be of importance in the presence of an information medium, as information can be stored and found on it, and this may lead to undesirable transparency.
4) IM might be absent in cases where the information is being transferred without using any medium, e.g., in face-to-face communications.

Therefore, in this reference model, only the presence of the information provider and the information receiver is obligatory. With respect to the information that is being transferred, any information can be divided into two subcategories:

- Transparency-Related Information (TRI): This is the information that carries data related to transparency presented by the information provider (IP) about the information entity (IE).
- Transparency-Unrelated Information (TUI): This is the information whose transparency is not important, relevant, or in question, presented by the information provider (IP) about the information entity (IE).

This reference model is illustrated in Figure 3.2. It should be noted that in this transparency model of information exchange, IP, IR, or IE do not necessarily refer to one stakeholder. Therefore, IP could be one person, a group of people, one organisation, a group of organisations, or any combination of those. The same rule applies to IM, i.e., IM can be one medium or a group of media fulfilling the role of information processing and relaying.

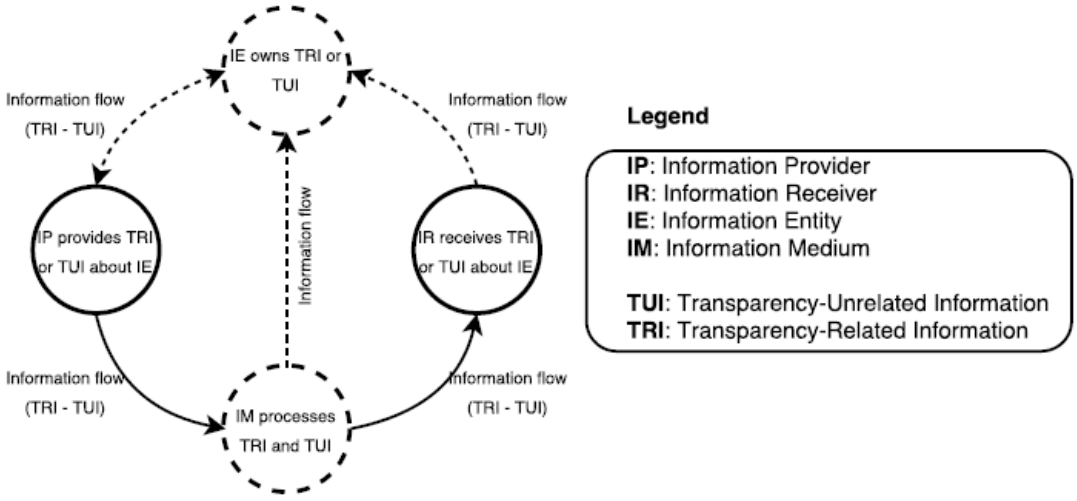


Figure 3.2: Transparency Actors Wheel (dotted lines show non-compulsory elements)

Transparency Actors Wheel facilitates the classification of transparency based on its actors. Michener and Bersch (2011) classify transparency into *supply-side* transparency and *demand-side* transparency. In supply-side transparency, transparency is supplied by the information provider in two ways: it is either supplied *voluntarily*, as a means to increase information receivers' trust or increase information providers' accountability (Lodge 2004), or it is supplied *coercively*, as a means of complying with legal obligations. In demand-side transparency, transparency is provided in response to demands and public requests, by providing information which is otherwise inaccessible (Fox 2007).

The legal obligations of information providers to supply transparency fall into three categories of *mandatory* transparency, *discretionary* transparency, and *involuntary* transparency (Shkabatur 2012). Mandatory transparency refers to policies that oblige actors to disclose specific information, e.g., Freedom of Information Act. Discretionary transparency refers to policies that oblige actors to publish some information, but do not specify what exactly should be disclosed, e.g., the website *data.gov* where federal agencies place online high-value datasets of their choice. Involuntary transparency refers to regulatory responses to whistle-blowers and information leaks. This last type of supply-side transparency is also classified as *non-agent-controlled transparency* (NACT) (Lindstedt and Naurin 2010), where free independent third-party actors, such as the press, disclose information by wilfully investigating and reporting the activities of an agent. The word agent in this context clearly refers to the role of an information provider. On the other hand, mandatory transparency and discretionary transparency are *agent-controlled transparency* (ACT), where information is disclosed by an agent in response to some requirements on the agent, such as Freedom of Information acts or personal demands, to make some information about its activities available.

Demand-side transparency can also fall into two categories of *legal* demands for transparency and *personal* demands for transparency. The first category, legal demands for transparency, denotes transparency requirements which are based on laws and regulations, such as Freedom of Information laws. It is important to recognise that such demand-side transparency creates mandatory transparency on the supply-side as well. The second category, personal demands for transparency, denotes transparency requirements which are personal and as a result, place no obligations on the supply-side to provide transparency. Both categories of demand-side transparency are agent-controlled, because the information provider has control over the amount of information that it discloses.

Apart from the supply-side and demand-side transparency, medium-instilled transparency should also be considered. Frequently, the medium used to relay information between an information provider and an information receiver may lead to unwanted transparency as a result of information leakage. As such, this kind of transparency is categorised as non-agent-controlled, because the information provider has no control over the volume of disclosed information. Figure 3.3 summarises the discussions above.

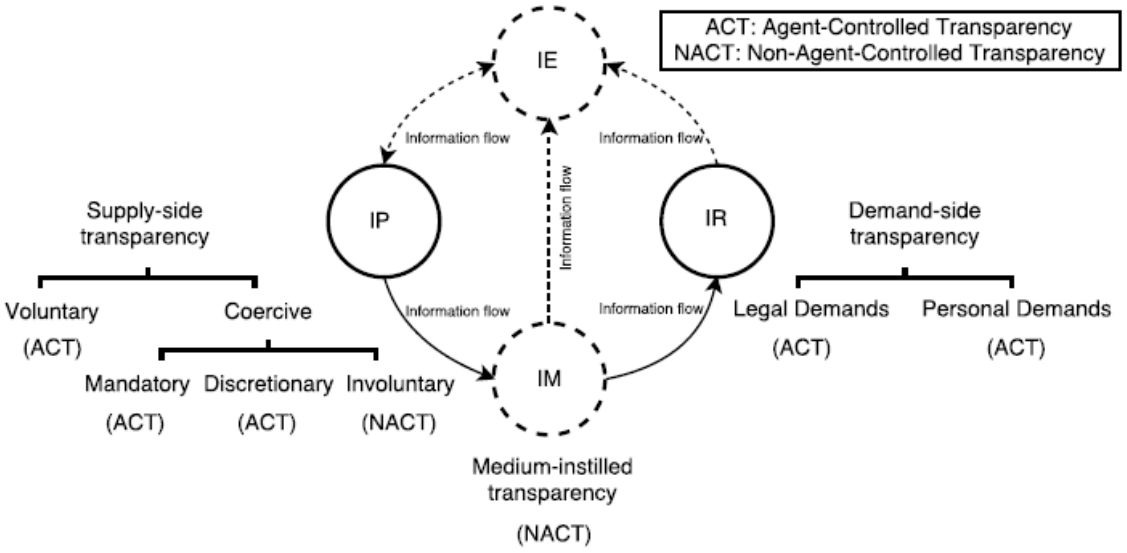


Figure 3.3: Transparency Actors Wheel with transparency classification

Based on Transparency Actors Wheel reference model, five different levels of transparency can be identified, as follows:

- Level 1 – No Transparency: If IP only sends TUI information to IR, either through IM or directly, and does not send any TRI information, then one can say that there is no transparency achieved. In this case, only IP knows about TRI.

- Level 2 – Unilateral Transparency: If IP sends TRI information along with TUI information to IM, but IM does not reveal TRI information to IR and only sends TUI information to IR, then one can say a unilateral level of transparency is achieved. In this case, it is still only the IP who knows about TRI, but this information is also stored in IM. It should be noted, however, that certain laws and regulations may oblige IM owners to reveal this information and make it transparent, which means the unilateral level of transparency will no longer be maintained. Furthermore, in this model of transparency, unilateral transparency can never be reached if there is no IM.
- Level 3 – Bilateral Transparency: If IP sends TRI information along with TUI information to the IR, either through IM or directly, then one can say bilateral transparency is achieved. In this case, only IP and IR know about TRI.
- Level 4 – Trilateral Transparency: If IP sends TRI information along with TUI information to IR, either through IM or directly, and one of IP, IM or IR also sends them to IE, then one can say trilateral transparency is achieved. In this case, IP, IR and IE know about TRI.
- Level 5 – Full Transparency: If IP sends TRI information along with TUI information to IR, either through IM or directly, and probably one of IP, IM or IR also sends the IE, and at the same time they make it accessible to the general public (including IE), then one can say full transparency is achieved. In this case, potentially everyone knows about TRI.

Being in different contexts where transparency requirements arise necessitates different appropriate levels of transparency. Therefore, it is important to investigate which level of transparency is needed in every situation based on the context of that situation.

The identification of different levels of transparency based on the stakeholders' type in Transparency Actors Wheel leads to another aspect of transparency, which is to analyse if the right level of transparency has been reached. IP and IR have a *required level of transparency*, which is the level of transparency they need, and an *achieved level of transparency*, which is the level of transparency they actually get. As a result, three outcomes are possible:

- Transparency Shortage: Transparency shortage happens when the achieved level of transparency is lower than the required level of transparency. This can lead to conflicts of interest in the level of transparency.
- Transparency Coverage: Transparency coverage happens when the achieved level of transparency is equal to the required level of transparency. This is the optimal solution which helps toward joint optimisation in business information systems.

- Transparency Abundance: Transparency abundance happens when the achieved level of transparency is higher than the required level of transparency. This can also lead to conflicts of interest in the level of transparency.

It is sometimes the case that IP, IR, and possibly IE (i.e., when IE is a social actor) have different transparency requirements. This can lead to conflicts of interest in the level of transparency that each entity requires. This is further elaborated by providing the following examples:

> *Example 1:* Suppose a company is using a cloud service, and for safety and security reasons, they would like to know where their stored files are hosted and how they are encrypted. Therefore they use the cloud service provider platform to get this information from them. The client company may not be willing to use the cloud services if the geographical location of their servers poses a threat to their security. In this example, IP is the cloud service provider, IR is the client company, IE is the server location and IM is the cloud service provider platform. The level of transparency the client company is looking for is bilateral transparency, or probably any level higher than that, i.e., the server location becomes public. If, for example, the cloud service provider refuses to provide such information to the client company, then the level of transparency the cloud service provider is offering is no transparency. On the client company's side, this leads to transparency shortage.
>
> *Example 2:* Suppose a government agency is investigating a case and needs more information about a suspect. The government agency contacts an email service provider to collect some information about that suspect's correspondence. In this example, IP is the email service provider, IR is the government agency, IE is the suspect and IM is the telephone. The level of transparency the government agency is looking for is bilateral transparency, and not any level higher or lower than that. If, for example, regulations on the email service provider side oblige it to reveal such exchange of information to the suspect as well, then the level of transparency the email service provider needs is trilateral transparency. On the government agency's side, this leads to transparency abundance.

These examples illustrate the possible conflicts of interest that may arise between different actors and how these conflicts can lead to transparency shortage or abundance. Furthermore, such conflicts can apparently lead to less accountability (as in example 1) or less trust (as in example 2).

3.2 Reference Model 2: Transparency Depth Pyramid (Meaningful Transparency)

Transparency requirements can be divided into three main categories (Bannister and Connolly 2011), which represent how meaningful the provided transparency is. Primarily, these categories are meant to deal with three questions and provide answers to them:

- Data transparency, or questions relating to data, content, and information: These questions primarily answer what information is needed and who are the stakeholders in the context of transparency. For example, in an online mail service platform, data transparency reveals whether secure mails are encrypted, or how many attachments an email may have.
- Process transparency, or questions relating to processes, behaviours and interactions: These questions primarily answer how something is performed in the context of transparency. For example, in an online mail service platform, process transparency reveals how secure mails are encrypted, or how attachments are scanned for viruses.
- Policy transparency, or questions relating to intentions, policies and decision making: These questions primarily answer why an action is performed in the context of transparency. For example, in an online mail service platform, policy transparency reveals why the number of attachments is limited, or why encryption is needed for delivering secure mail.

Bannister and Connolly (2011) point out that process transparency usually requires data transparency, and policy transparency usually requires data and process transparency. For example, revealing why encryption is required for the delivery of secure mail reveals the fact that secure mails are encrypted, and may also reveal some information about the process of mail encryption.

Another classification of transparency is proposed by Stuart et al. (2012). Based on this classification, transparency can be categorised as identity transparency, which makes transparent the identity of information exchangers, content transparency, which makes transparent the content and the changes to the content, and interaction transparency, which makes transparent the actions performed during the interaction to a third party observer. This thesis argues that the first two types of transparency, i.e., identity transparency and content transparency, fall into the category of data transparency, as identity and content are data, while interaction transparency falls into the category of process transparency, since interactions reveals a process of information exchange.

Proceeding from data transparency to process transparency and policy transparency gives depth to transparency, and the deeper transparency is provided, the more meaningful the information becomes to its stakeholders. Such a shift in transparency provision can lead to positive side effects, such as more trust. For example, it has been shown that stakeholders will trust a recommender

system more and act upon its recommendations when it provides explanations why it has suggested a particular recommendation to them (Sinha and Swearingen 2002).

Disclosing the 'why' will help build trust between information receivers and information providers. For example, and as stated earlier, stakeholders will trust a recommender system more when it provides explanations why it has made a specific recommendation (Sinha and Swearingen 2002). It will also prevent a practice known as "window dressing", which is manipulating information by readjusting the composition of information. Revealing the reasoning makes it possible for stakeholders to spot possible flaws and to identify whether the line of reasoning results in outcomes that match the disclosed data. The same argument applies for disclosing the 'how', but at a lower level, since the intentions of information providers remain hidden and only processes are disclosed.

Disclosing the 'how' will prevent data cooking as well. Making the processes of providing information transparent to stakeholders means that stakeholders will know where the information is originated from, how it is represented, and how raw information is mediated before it reaches them. As highly mediated information provides greater chances for information misrepresentation and manipulation (Michener and Bersch 2011), it can potentially lead to a suboptimal information flow (Ruppert t al. 2013), which, in turn, can jeopardise transparency.

A systematic approach aiming for providing meaningful transparency should therefore enable the engineering of transparency to distinguish amongst data transparency, process transparency, and policy transparency. Furthermore, requirements engineers also need to be informed about other regulations and policies that can affect the disclosure of information. They need to find the answers to the following questions in order to engineer the meaningfulness and depth of transparency.

- **Does the disclosed information reveal processes and policies? How does such disclosure help stakeholders in their decision making?**

Transparency is often defined as the extent to which one entity discloses relevant information about its own decision processes, procedures, performance, and functioning (Curtin and Meijer 2006). In order to provide process and policy transparency, requirements engineers should analyse the disclosed information and categorise them accordingly. The processes should be linked to data, should provide procedures upon request to avoid information overload, and should be presented clearly in a systematic way, e.g., chronologically. Policies should be linked to data, should provide reasons upon request to avoid information overload, and should be presented semantically, e.g., on a cause and effect basis. Feedback loops may be utilised to inform requirements engineers of any discrepancies between data and processes/policies, and of outdated or emerging requirements.

- **Does the disclosed information reveal stakeholders' identity information? What anonymity regulations exist that must be considered in engineering transparency requirements?**

Concerning data transparency, it is important to know whether it reveals identity, self, or hidden information, or that the data contains none of these elements. Revealing identity information can diminish, if not demolish, stakeholders' anonymity where it is also a requirement of the stakeholders to remain anonymous. For example, in forums where people are expected to openly criticise an organisation's policies, transparency requirements must be governed by anonymity regulations.

- **Does the disclosed information reveal stakeholders' self information? What privacy regulations exist that must be considered in engineering transparency requirements?**

This is where transparency intersects with privacy and may threaten privacy (Meijer 2009). Revealing self information can endanger stakeholders' privacy requirements. Therefore, requirements engineers must ensure, at early stages of system analysis (Cappelli et al. 2010), that revealed data complies with privacy regulations by the systematic analysis of the disclosed data.

- **Does the disclosed information reveal stakeholders' hidden information? What secrecy regulations exist that must be considered in engineering transparency requirements?**

Revealing stakeholders' hidden information is in conflict with secrecy practices. Some organisations, such as for-profit organisations, maintain a level of secrecy in order to have the market advantage over their competitors. However, Bok (1989) suggests that while organisations are justified to keep their secrets, the justifications should be made public and transparent. Requirements engineers must review the secrecy policies of organisations as a measure against the disclosure of hidden information, while they should compose and disclose the justifications for such secrecy.

Figure 3.4 summarises the discussion by proposing Transparency Depth Pyramid, which shows a bottom-up structure for providing meaningful transparency. At the data level, there are personal, hidden, and identity information and other types of data-oriented information which may need to be regulated by privacy, secrecy, and anonymity regulations and other general regulations that might exist for the exchanged data, collectively referred to as data regulations. At the process level, there are processes, behaviours, interactions, and procedures, all of which denote how an action is performed or how a process works, and they can be regulated by process regulations. At the policy level, there are policies, intentions, goals, and schemes, all of which denote why an action is done or why a policy is in place, and they can be regulated by policy regulations.

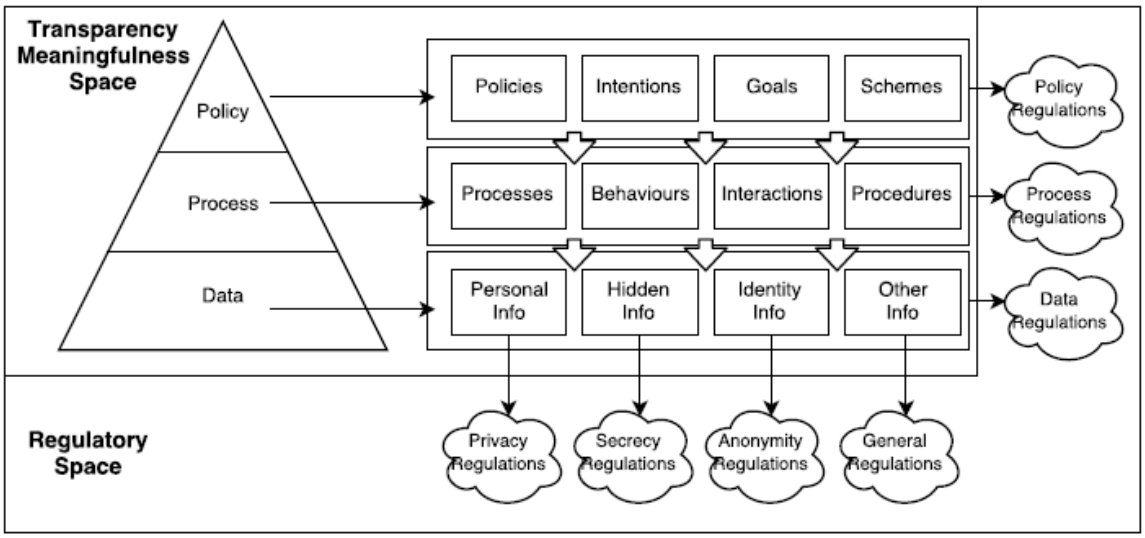


Figure 3.4: Transparency Depth Pyramid (meaningful transparency)

This reference model is further elaborated by providing the following examples:

> *Example 1:* Suppose a cloud service platform informs their customer that their information is being transferred to a new server (i.e., providing data to the customers). Some customers might be happy with this information, while others may want to know why their information is being transferred to another server. They may want to know, for example, whether this is being done for higher speed, higher security, or higher availability on the new server (i.e., they need policies and not just data). Failing to provide a more meaningful level of information to the customers (in this case, failing to provide 'why') may adversely affect customer satisfaction or customer trust in the cloud service platform.
>
> *Example 2:* Suppose a government agency needs to access a suspect's correspondence on an email service provider. The government agency asks the email service provider to provide them with this information (i.e., providing data on their request) while they cannot, for national security reasons, provide further information as why they need this information and how they are going to use it. Therefore, because of certain secrecy regulations, any attempt from the email service provider to get such information from the government agency is bound to fail.

These examples illustrate how the meaningfulness of information in an information exchange can be important to stakeholders and can introduce possible side effects, while also showing that there can be limitations and restrictions to information meaningfulness under certain circumstances.

3.3 Reference Model 3: Transparency Achievement Spectrum (Useful Transparency)

Useful transparency can only be achieved when it enables stakeholders to make decisions based on the provided information and act upon them. For example, in the sociological and psychological sense, transparency is defined as gaining information and knowledge about the environment in order to prepare actions and decisions (Frentrup and Theuvsen 2006). However, there are many steps between information availability to information actionability to be catered for. This section of the thesis discusses these steps towards achieving useful transparency.

3.3.1 Information Availability

Information availability is the first step in achieving useful transparency. Obviously, no transparency is achieved if information providers withhold information from relevant stakeholders. While making information available to relevant stakeholders, information providers should ensure that information quality is maintained to avoid problems such as wrong information, biased information, incomplete information, and information overload (Kolstad and Wiig 2009). Correctness (Mitchell 1998), completeness (Griffith 2006), and timeliness (Grimmelikhuijsen 2012) are amongst these information qualities. It has been noted that information disclosure alone may defeat the notion of transparency, because it can be obfuscating instead of enlightening (Rawlins 2008a). Therefore, other steps are necessary to ensure a useful transparency is achieved.

3.3.2 Information Interpretation

Information interpretation is the second step in achieving useful transparency. In many cases, the information provided by organisations and governments is in such forms that are not comprehensible by relevant stakeholders. These forms can include cluttered tables, complicated charts, crowded figures, and lengthy texts. End-User Licence Agreements and privacy policies are two examples of such incomprehensible forms of information which need interpretation for the common reader. Therefore, it is usually essential for information providers, or mediators involved in transparency provision such as journalists and reporters, to interpret the information in a way that can be easily understood by information receivers.

Several studies highlight the importance of interpreting the provided information. For example, it is argued by Stirton and Lodge (2001) that a public service is called transparent when they inform stakeholders as well as explain their decisions to them. Also, in their open learner model proposed by Tanimoto (2005), the author states that to achieve a useful transparency, providing an interpretive mechanism is necessary to translate the information from a pedagogical perspective (i.e., the information provider's perspective) to a learner's perspective (i.e., the information receiver's perspective) in order to make the information comprehensible.

Since information interpretation can be affected by its mediators, it is essential that mediators present a truthful view of information to information receivers if transparency requirements are to be met. In any case, it has been suggested that the number of mediators should be kept to a minimum, and information receivers have better access the information straight from the source rather than from mediators, in order to reduce information bias (Van der Cruijsen and Eijffinger 2010). This, however, may affect information interpretability. Therefore, there is a need to find a trade-off between the presence of mediators and their effect on the interpreted information.

Furthermore, given the probable diversity in information receivers' cognitive abilities, requirements engineers may actually have to find several different methods of information interpretation and representation, each of which suiting a different set of information receivers. These methods can then be used during requirements validation, and further when the software system is being tested to verify the success of information interpretation from information receivers' point of view. For example, requirements engineers may validate and test the use of charts and tables to present information systematically (e.g., similar to arrival and departure tables at airports), the use of different colours each with its own meaning (e.g., similar to those used in food industry on products labels), the use of a ranking or rating system to enhance comparison capabilities (e.g., similar to university rankings), and audio-visual aids to decrease reading and learning overhead (e.g., token displays with voice announcement).

3.3.3 Information Accessibility

Information accessibility is the third step in achieving useful transparency. While information availability and interpretation are provided by information providers, information accessibility focuses on the ability of information receivers to access information. Sometimes referred to as information visibility (Michener and Bersch 2011), it is the degree to which information can be easily located by information receivers.

Several studies address information accessibility. For example, it is discussed that to achieve transparency, society members should have access to high-quality information (Williams 2000). Furthermore, Kaufmann and Bellver (2005) believe that transparency is not fully achieved unless the general public are aware of information availability and know how to access such information.

It should be noted that mere information availability does not guarantee its access (Michener and Bersch 2011). Therefore, requirements engineers must ensure the information is comfortably accessible by information receivers upon request. Furthermore, from the information receivers' point of view, inaccessible information and unavailable information cannot be distinguished from each other in several cases, because when they cannot access the information they may simply

conclude that it is not available from information providers. For example, this is the case with lengthy terms and conditions and privacy policies, which usually make it difficult for their readers to locate and access the information they need. Therefore, requirements engineers should investigate whether information availability requests are, in reality, difficulties in information accessibility.

3.3.4 Information Perception

Information perception is the fourth step in achieving useful transparency. It refers to information receivers' perception of transparency once they have accessed the provided information. It acts at the cognitive level of these stakeholders and is therefore difficult to assess (Tagiuri et al. 1955). Furthermore, individual and psychological factors, such as confirmation bias, can influence the perceived level of transparency, as opposed to the actual level of transparency (Van der Cruijsen and Eijffinger 2010).

Several issues must be noted in dealing with information receivers' perception of information. If information receiver's perception of transparency does not match that of the information providers, useful transparency may fail to be achieved. Furthermore, if the provided information fails to change the already confirmed perception of an information receiver about the information provider, transparency is still not achieved. Changing people's perception is not an easy task, and it needs continuous exposure to structured information which utilises their information processing methods (Kearney 1994) and constant social interactions with the people (Swann and Hill 1982). Since perception is subjective, different people perceive the same information in different ways and they respond to information according to their own perception (Svenson 1979).

As a possible solution, transparency engineering may overcome perceptual obstacles over time, by putting importance on information receivers' feedback (Ali et al. 2012), which may also help in building trust relationships with these stakeholders (Moghaddam et al. 2009), which in turn may result in altered information receivers' perception of information providers. There is also a need for more studies by relevant communities to address the lack of metrics for evaluating information perception related to transparency.

3.3.5 Information Understandability

Information understandability is the fifth step in achieving useful transparency. Obviously, information accessibility and information perception are necessary conditions for transparency, but insufficient on their own (Michener and Bersch 2011). Therefore, for achieving useful transparency, information should also be understood and comprehended by information receivers. Therefore, understandability is sometimes considered as one of the two crucial dimensions of transparency (Holzner and Holzner 2006).

Some studies have mentioned information understandability as one of the steps towards useful transparency. For example, it is pointed out that transparency can only be useful when it enhances understanding, not just increasing the flow of information (Wall 1996). The same notion is stated by Etzioni (2010), who argues that regulations on transparency must be enforced by governments to make available information more understandable to the public, because without such understanding, disclosed information will provide little de facto transparency.

From a transparency engineering perspective, the peculiarities discussed in information interpretation applies here as well, but the focus changes from information providers to information receivers. Furthermore, understanding is a complicated, personal experience (Collins et al. 1992), which does not necessarily relate to information interpretation. For example, while all students in a classroom receive the same information from a lecturer, their understanding of the subject (even technical subjects which leave little room for personal interpretations) may vary greatly. Therefore, requirements engineers can choose the simplest representation of information, or allow information receivers to choose from various representations of information the one which maximises their understanding. Furthermore, culture, language, and cognitive abilities can impact understanding and learning (Cole et al. 1971), and must be considered during transparency provision. Finally, requirements engineers should provide a continuous feedback loop (Ali et al. 2012) to information receivers in order to ensure the interpreted information intended by information providers matches, at least closely, the understood information by information receivers, and then plan for software system adaptation accordingly.

3.3.6 Information Acceptance

Information acceptance is the sixth step in achieving useful transparency. It implies either information receivers' perception of information matches their beliefs, in which case the new information confirms it, or that their perception of information does not match their beliefs, but the information changes it nonetheless. If information is not accepted by stakeholders for any reason (personal or otherwise), then useful transparency provision may not be achieved.

While several studies consider information acceptance as an important step in achieving transparency (Gower 2006, Wall 1996), there are no models or theories tailoring it systematically for transparency. However, several models and theories of individual acceptance, such as the theory of planned behaviour, the theory of reasoned action, and social cognitive theory already exist, which have been extended to suit other fields of study, such as information technology (Venkatesh et al. 2003). Similar research must be conducted in the engineering of transparency requirements.

Similar to information perception, information acceptance acts at the cognitive level of stakeholders. Therefore, it is essential that different disciplines, such as psychology, be consulted and collaborated with in order to provide a holistic view of such cognitive aspects of transparency.

3.3.7 Information Actionability

Information actionability is the seventh and last step in achieving useful transparency. Sometimes referred to as informed decision making, information actionability emphasises that transparency becomes useful when the provided information to information receivers enables them to act upon it, make informed decisions, and therefore make use of the information. Information that does not change perceptions, or does not help decision making, or cannot be acted upon, does not constitute useful transparency. In other words, useful transparency should be able to alter something in the outside world.

Information actionability has been argued in some studies. For example, it is argued that transparency is achieved when decision makers receive the information essential to make sound decisions (Simon 2006). Similarly, it is argued that information availability and accessibility are not enough to reach transparency, and it is necessary for information receivers to do something they find important and valuable based on the provided information (Harrison et al. 2010). In the same fashion, Scauer (2011) also emphasises the importance of information usability, i.e., using the obtained information by information receivers for performing an action or making a decision.

Improper actions and partial or misled decisions are possible symptoms where useful transparency has failed to be achieved. They can alert information providers and requirements engineers to revise their transparency policies and transparency provision channels and techniques in an attempt to find loopholes and deficiencies. Furthermore, requirements engineers can also use reverse engineering on information receivers' actions and decisions based on the provided information in order to understand whether the information has served its purpose well, i.e., used in achieving useful transparency.

Figure 3.5 illustrates Transparency Achievement Spectrum, which illustrates several steps required to be fulfilled in order to achieve useful transparency, along with an example of an influential factor in each step.

This reference model is further elaborated by providing the following example:

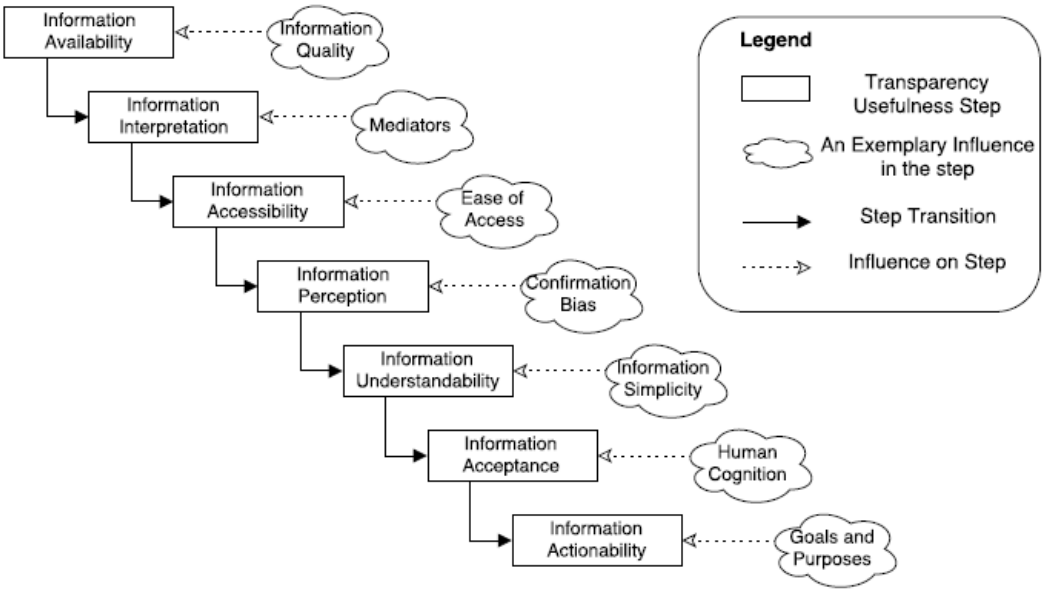


Figure 3.5: Transparency Achievement Spectrum (useful transparency)

Example: Suppose a cloud service provider puts some information online about their newly updated terms and conditions, making it available to all their customers. Before such transparency can be deemed as useful, the cloud service platform should also guarantee the following aspects of information. First, they should make sure that the information can be interpreted by their customers, meaning that they should refrain from using jargons and technical terms as much as possible, and should provide clear definitions to these terms when they are used in the text. They should also ensure that the link to the newly updated terms and conditions is accessible by everyone using a few clicks, while the link itself should be clearly visible on the website. For more accessibility, they may decide to provide the newly updated terms and conditions to their customers by emailing them the link or the full text. Then there is the issue of information perception, which means the cloud service platform should ensure what they mean in the terms and conditions are what the customers understand from the text. They should also ensure the information in the newly updated terms and conditions are understood and also accepted by the customers. If, for any reason, the customers fail in believing the information in the newly updated terms and conditions, they may stop using the cloud service or otherwise, it may seriously affect their trust in the cloud service provider. Finally, such information should help the customers in making a decision (e.g., whether to continue to use the cloud service or not), otherwise reading the whole newly updated terms and conditions, and the provided transparency, will not be useful to them.

This example illustrates how transparency usefulness in an information exchange can be difficult to achieve, and what steps there are that need to be taken in order to achieve useful transparency.

3.3.8 Transparency Usefulness and Transparency Meaningfulness

It is essential for requirements engineers to recognise the difference between meaningful transparency and useful transparency. While meaningful transparency argues that information receivers must know the actions and reasons behind the provided information (e.g., as expressed by Griffith (2006)), useful transparency discusses that information provision should lead to information receivers' actionability and help in their decision making processes, or at least to a change in their perception of the information provider (e.g., as expressed by Scauer (2011)). Therefore, meaningful transparency can be considered as a static property of transparency with regards to the information disclosed, and useful transparency can be thought of as a dynamic property of transparency.

3.4 Reference Model 4: Information Quality in Transparency

Information quality in transparency is a crucial facet, as without it, transparency can hardly be achieved. The literature on transparency does discuss the importance of information quality and provides some facets for it (Griffith 2006, Rawlins 2008). However, there is currently a lack of research on how these information quality dimensions should be fulfilled and by which stakeholders, and how their fulfilment can be assured. In the following, four categories of information quality are discussed, which can be used in transparency and the dimensions associated with them, borrowed from the work of Kahn et al. (2002):

- **Sound information** represents the quality of the information supplied by the information provider, and consists of the following information quality dimensions: *free-of-error*, *concise representation*, *completeness*, and *consistent representation*.
- **Dependable information** represents the quality of the service in providing information by the information provider, and consists of the following information quality dimensions: *timeliness* and *security*.
- **Useful information** represents the meeting/exceeding of the information receiver's expectations in the supplied information quality, and consists of the following information quality dimensions: *appropriate amount*, *relevancy*, *understandability*, *interpretability*, and *objectivity*.
- **Usable information** represents the meeting/exceeding of the information receiver's expectations in information provision service, and consists of the following information quality dimensions: *believability*, *accessibility*, *ease of manipulation*, *reputation*, and *value-added*.

In the following, a brief definition for each of the information quality dimension is provided in an alphabetical order. It should be mentioned that these definitions are also adopted from the work of Kahn et al. (2002).

- **Accessibility**: The extent to which information is available, or easily and quickly retrievable.
- **Appropriate Amount**: The extent to which the volume of information is suitable for the task at hand.
- **Believability**: The extent to which information is considered as true and credible.
- **Completeness**: The extent to which information is not missing and is of sufficient breadth and depth for the task at hand.
- **Concise Representation**: The extent to which information is compactly represented.
- **Consistent Representation**: The extent to which information is presented in the same layout.
- **Ease of Manipulation**: The extent to which information is easy to manipulate and apply to different tasks.
- **Free-of-Error**: The extent to which information is accurate and dependable.
- **Interpretability**: The extent to which information is in appropriate languages, symbols, and units, and the definitions are clear.
- **Objectivity**: The extent to which information is unbiased, unprejudiced, and impartial.
- **Relevancy**: The extent to which information is applicable and helpful for the task at hand.
- **Reputation**: The extent to which information is highly regarded in terms of its source or content.
- **Security**: The extent to which access to information is restricted appropriately to maintain its security.
- **Timeliness**: The extent to which information is sufficiently up-to-date for the task at hand.
- **Understandability**: The extent to which information is easily comprehended.
- **Value-Added**: The extent to which information is beneficial and provides advantages from its use.

Kahn et al. (2002) also discuss that two information quality dimensions, interpretability and objectivity, though categorised as useful information, fall between some of these four categories. According to them, objectivity can be categorised in either sound information or useful information, while interpretability can be classified in any of the four categories of sound information, useful information, dependable information, or usable information.

Figure 3.6 illustrates the information quality dimensions and their classifications.

	Conforms to Specifications	Meets or Exceeds Consumer Expectations
Product Quality	Sound Information	Useful Information
	Free-of-error Concise Representation Completeness Consistent Representation	Appropriate Amount Relevancy Understandability Interpretability Objectivity
Service Quality	Dependable Information	Usable Information
	Timeliness Security	Believability Accessibility Ease of Manipulation Reputation Value-Added

Figure 3.6: Information quality dimensions (Kahn et al. 2002)

This reference model is further elaborated by providing the following example:

> *Example:* Suppose a cloud service provider puts a lot of efforts in devising new membership plans for new customers in terms of costs, security levels, number of simultaneous access to the cloud, etc. Even when they achieve to provide meaningful and useful information to the customers, a low quality in the provided information can lead to several issues. For example, incorrect information on the availability of the cloud service may result in several customers trusting the cloud service platform erroneously. In a similar fashion, incomplete information may lead to customers relying on pre-conceptions and outdated information in their decision making which may no longer be valid. Furthermore, when the information is not provided to the customers in a timely manner, the customers may start to look for alternative cloud services, pay subscription fees, and start using them before the information from their current cloud provider becomes available, effectively rendering such information useless. On the other hand, when the provided information does not meet the expectations of the cloud service customers (e.g., it is not relevant, understandable, believable, or accessible), they may stop using the cloud service all together and look for alternative services which meet (or exceed) their informational needs.

This example illustrates how the quality of information can affect information receivers and their decision making processes, and in turn emphasises that any information exchange meant to provide transparency in a meaningful and useful way necessitates information that meets these quality dimension.

3.5 Interdependencies amongst Models

The four reference models for transparency provide a holistic view of transparency facets that need to be considered during transparency provision. These reference models, however, have some inter-dependencies amongst each other as well. In this section, these inter-dependencies are reviewed and reflected upon. A running example will be used in this section to communicate these interdependencies in a more comprehensible fashion. This running example involves a public relations office inside a financial institute who wants to disclose some information about the institute and their financial activities in the past year to the institute's customers and stakeholders through the institute's website. In this example, the financial institute is the information entity, the public relations office is the information provider, customers and stakeholders are information receivers, and the institute website is the information medium.

3.5.1 Inter-dependencies between Information Quality Dimensions and Transparency Actors Wheel

The information quality reference model clearly distinguishes between those quality dimensions which should conform to specifications, and those which should meet (or exceed) the expectations of the consumer. This subsection will discuss how this distinction can be utilised in an effort to identify which stakeholders are involved in the provision of each category of information quality.

The first category of information quality relates to those qualities in the category of product quality which conform to specifications, such as having a concise or consistent representation. These quality dimensions can be fulfilled without the need to involve information receivers, though they might be able to help find problems and issues. Information providers can independently ensure the quality of these dimensions. As the provided information is about an information entity, they are also responsible to guarantee the quality of these dimensions. Information medium, similar to information receiver, is also not involved in this category.

In the running example, four information quality dimensions of being free of errors, completeness, concise and consistent representation can all be guaranteed by the financial institute and also by the public relations office. They can ensure all reports are correct, all figures have a concise and consistent representation and that the complete set of information is reported to the customers.

The second category of information quality relates to those qualities in the category of service quality which conform to specifications, namely security and timeliness. Similar to the first category, both information provider and information entity are involved in ensuring these quality dimensions. However, information medium also plays a role in this category, as it can affect both the timeliness and the security of the provided information. Guaranteeing these information quality dimensions does not involve information receiver, although they can be helpful in finding issues with these quality dimensions.

In the running example, public relations office may not be able to provide timely information if the financial institute does not provide them with the information in a timely manner. The institute's website may also be down, affecting the timeliness of the provided information, or its security might be compromised, affecting the security of the provided information.

The third category of information quality relates to those qualities in the category of product quality which meet or exceed consumer expectations, such as relevancy and interpretability. Information receivers are mainly engaged here, and only they can ensure whether qualities such as relevancy or understandability are achieved. However, two information qualities in this category, interpretability and objectivity, are affected by information provider and information entity as well. Therefore, these two transparency actors are also involved in guaranteeing these information quality dimensions. This is in line with propositions made about the information quality benchmark about interpretability and objectivity being borderline dimensions (Kahn et al. 2002). Information medium, on the other hand, is not involved as it does not affect any of these information quality dimensions.

In the running example, public relations office may interpret the large quantity of data on spread sheets and annual reports in a way that customers understand and make decisions based on it, while the customers decide whether the provided information has an appropriate amount, is relevant to their decision-making processes, and can be easily understood. As the financial institute creates the information, they can affect the objectivity and the interpretation of the provided information.

The fourth category of information quality relates to those qualities in the category of service quality which meet or exceed consumer expectations, such as believability and reputation. Similar to the previous category, information receivers are mainly involved in this category in deciding whether these information quality dimensions are properly met. However, one information quality dimension, accessibility, is also affected by information medium. Therefore, these two transparency actors should be linked to this fourth category.

Figure 3.7 illustrates different categories of information quality dimensions and transparency actors involved in each category.

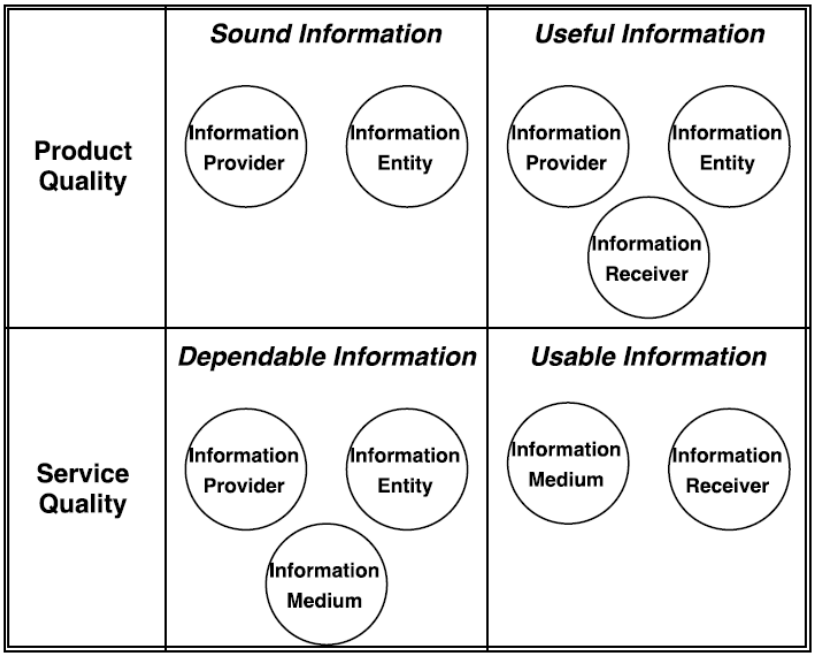


Figure 3.7: Inter-dependencies between quality dimensions and transparency actors

3.5.2 Inter-dependencies between Information Quality Dimensions and Transparency Meaningfulness

As information pieces are present in data, process, and policy, all information quality dimensions are linked to them. Arguably though, the link gets weaker for those quality dimensions which meet or exceed consumer expectations. For instance, there is no difference in checking completeness in data, process, or policy and they all follow the same procedure, while for objectivity, one may argue that it is easier to guarantee data objectivity than process or policy objectivity. Consequently, it can be argued that because of the existence of specifications, there is a stronger link between those information quality dimensions which conform to specifications and data, process, and policy transparency. For those information quality dimensions that meet or exceed consumer expectations, the link is strong with data transparency because it is relatively easy to check data quality, while it gets weak as it moves from data transparency to process transparency, and even weaker with the transition from process transparency to policy transparency, as it is harder to check information quality in processes than data and harder to check information quality in policies than processes.

In the running example, the financial institute may make available all the data, processes, and policies within their organisation. Checking for errors and problems in data documents follows the same standards and procedures as process and policy documents. So is the case for guaranteeing that all these documents have a concise and consistent representation, that they are complete,

disclosed timely and to the intended audience (i.e., security perspective). For customers, on the other hand, it is easier to check whether the data is objective than to check whether the policy is objective, because data documents deal with facts while process and policy documents discuss procedures and goals of the institute which are less tangible to the customers. In the same fashion, documents containing data might be generally more accessible than documents containing processes and policies, might be easier to manipulate as they correspond to spread sheets, fact sheets, charts and graphs, and their added value can be more trusted and relied upon.

Figure 3.8 illustrates information quality dimensions and their links to transparency meaningfulness regarding the strength of the links.

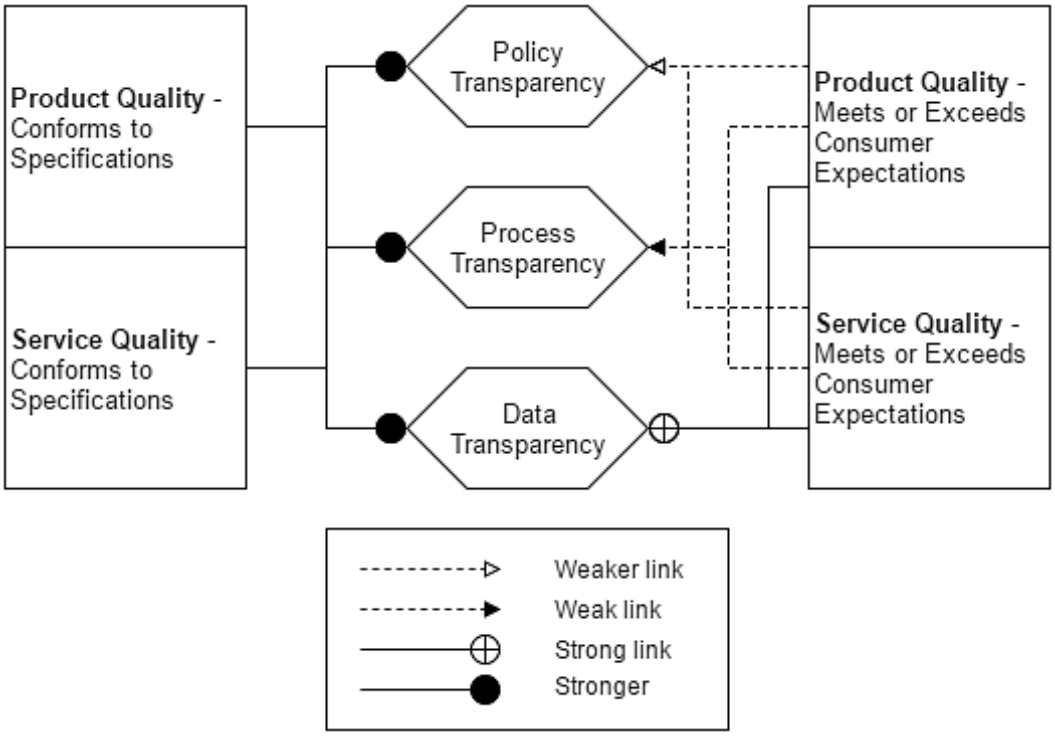


Figure 3.8: Inter-dependencies between information quality dimensions and transparency meaningfulness

3.5.3 Inter-dependencies between Information Quality Dimensions and Transparency Usefulness

Each step in Transparency Achievement Spectrum, which denotes the level of transparency usefulness, can be mapped to one or more information quality dimension, therefore highlighting the interdependencies between the Transparency Achievement Spectrum reference model and information quality in transparency reference model.

Information availability, as the first step in achieving transparency usefulness, is linked to all information quality dimensions related to the information entity and the information provider, i.e.,

free-of-error, concise and consistent representation, completeness, timeliness, and security. This implies that the available information should already meet all the quality dimensions which are expected from the information provider and the information entity. Information interpretation clearly links to interpretability, while information accessibility has a clear link to accessibility.

Information perception has a link to objectivity, as objective information, or the other side of the coin, biased information, can have an influence on an information receiver's perception of the provided information (Pronin et al. 2004). The reputation of the information provider or information entity also plays a key role in an information receiver's perception (Fuller et al. 2007), and is therefore linked to information perception.

Information understandability has a clear link to understandability, but is also linked to appropriate amount of disclosed information, because studies show that too little or too much information can lead to information starvation and information overload, which in turn will affect the level of understandability in the information receiver (Tidline 1999).

Information acceptance has a clear link to believability, and is also linked to the reputation of the information provider or the information entity, as their reputation is crucial to the acceptance of information by information receivers. Information actionability is linked to relevance, as irrelevant information means the information has no role in information receivers' decision making (Streufert 1973). It is also linked to ease of manipulation, since ease of manipulation implies that information is easy to apply to different tasks by an information receiver, which makes the information actionable. It is also linked to value-added characteristic, as added value implies that information is beneficial and provides advantages from its use, which again makes the information actionable.

Figure 3.9 illustrates information quality dimensions and the earliest step in transparency usefulness where they play their roles.

3.5.4 Inter-dependencies between Transparency Usefulness and Transparency Actors

Different transparency actors play their roles in different steps mentioned in Transparency Achievement Spectrum. The information entity is associated with information availability and information interpretation, as they are the owners or creators of information. They are also associated with information perception, as their reputation can help or harm information receivers' perception of the provided information. The same logic applies to the information provider, as they are the source of information provision to information receivers.

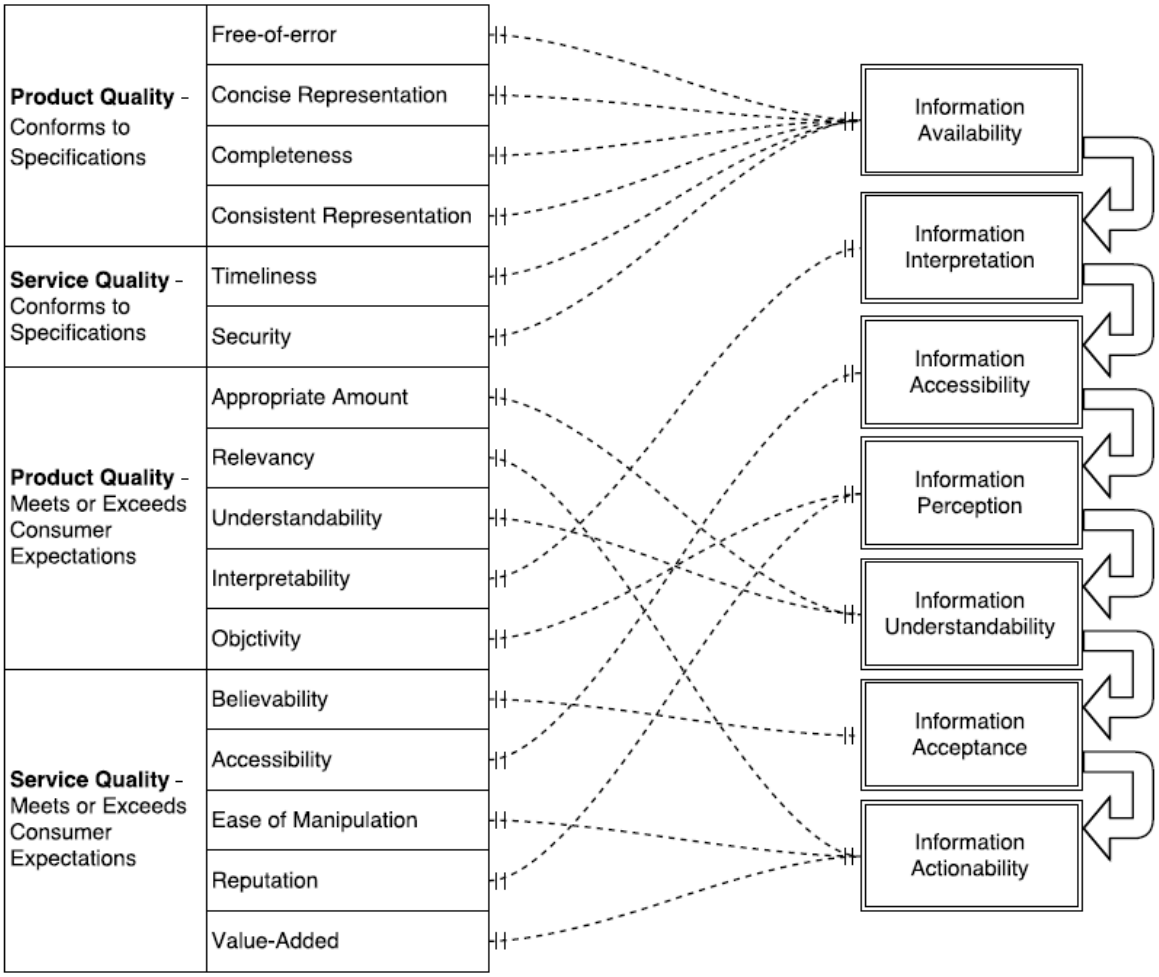


Figure 3.9: Inter-dependencies between quality dimensions and transparency usefulness

The information medium is associated with information availability and accessibility. In the running example, availability is influenced by the institute website if the website is down or experiencing technical difficulties. But even when the information is available on the institute website, a bad design might hinder access to such information. Website design issues, such as poor search facilities or too many clicks before the information becomes accessible to information receivers, can harm the ease of access to information.

The information receiver is associated with information accessibility, because the final access to information can also be determined by the information receiver's skills and capabilities. In the running example, the financial institute information on their website may simply be inaccessible by some stakeholders who do not possess the necessary knowledge to surf the Internet, do not have the necessary technical equipment, or have no access to the Internet.

The information receiver is also associated with information perception and information understanding, as they are the recipients of the provided information, and information is perceived and understood by them. The information receiver is also associated with information acceptability and information actionability, as they should decide whether to trust and accept the information, and whether the information can be used in their decision-making or their tasks at hand.

Figure 3.10 illustrates transparency actors and their potential roles in different steps of transparency usefulness.

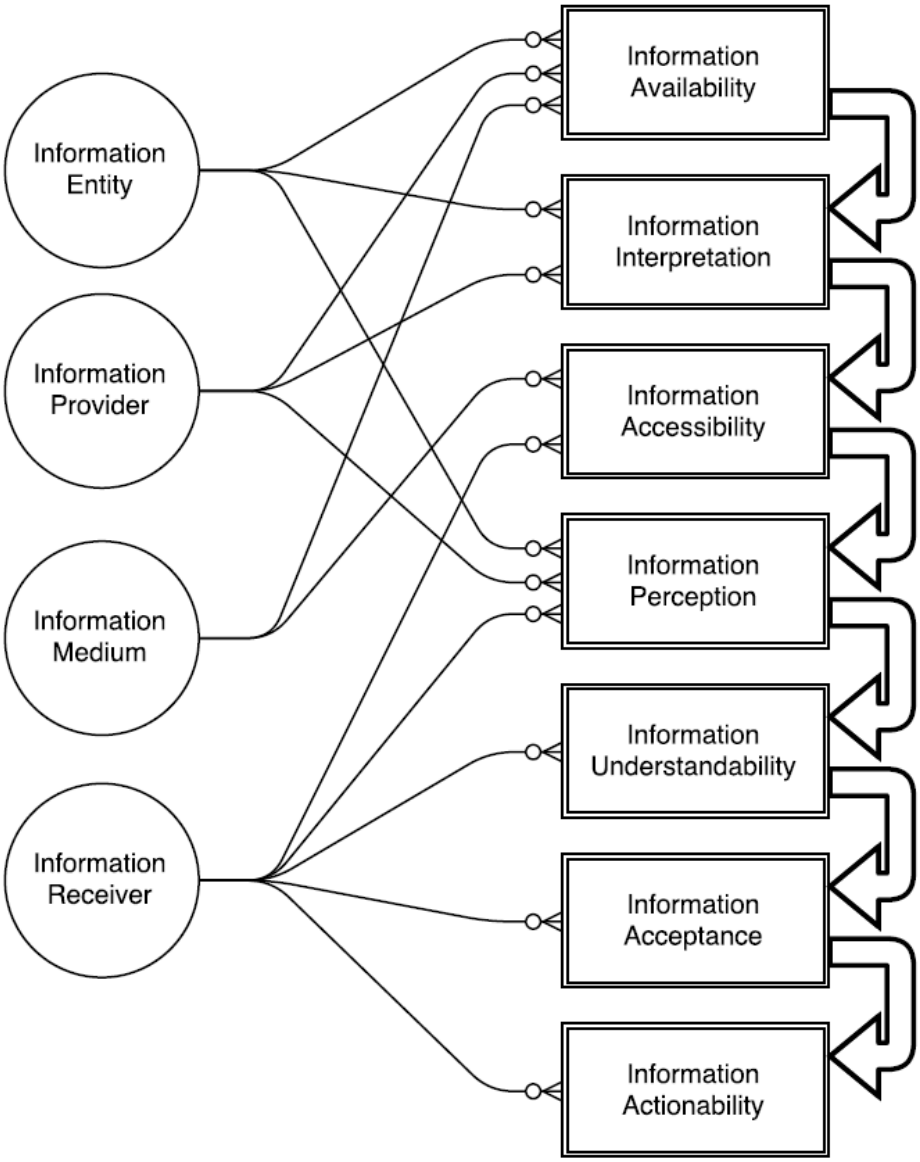


Figure 3.10: Inter-dependencies between transparency usefulness and transparency actors

3.5.5 Inter-dependencies between Transparency Usefulness and Transparency Meaningfulness

Transparency meaningfulness is treated differently in different steps of achieving transparency. In this subsection, these interdependencies are investigated.

Starting with information availability, it is generally the case that information providers tend to disclose their data more than their processes and policies. There could be several reasons behind this. Some information providers may assume that their recipients simply do not need to know about their processes and policies. In the running example, the public relations office may assume that while their customers need to know what financial decisions have been made, they do not need to know how or why they were made. Some information providers might consider such information to be irrelevant to their customers, as they include internal processes. Some may think disclosing such information may cause possible information overload to their customers, leading to more confusion and a decrease in decision-making abilities. Some may even think of such information to be confidential, classified, or unpublishable, as it can decrease their market influence when their competitors also get access to such information.

In terms of information interpretability, information containing data is more interpreted than information containing processes or policies. One reason could be that interpretation is a time-consuming and costly practice (Indjejikian 1991), and therefore information providers prefer to spend their resources on data interpretation. Furthermore, processes and policies may be more straightforward and therefore need no or little interpretation. In the running example, the public relations office might be more inclined to interpret the data containing the price of shares, their increase or decrease compared to previous years, and future predictions for share prices, rather than interpreting how the market dynamics led to an increase or decrease in share prices and why the market dynamics can influence share prices. Furthermore, information containing data is more interpretable than information containing processes and policies, as there is simply more data to be presented than processes or policies.

Information accessibility has a direct relationship with information availability, and therefore data-driven information is generally more accessible than process-driven or policy-driven information.

Information perception is affected by transparency meaningfulness as well, as the data disclosed by information providers is generally easier perceived than processes or policies disclosed by them. This could be partly due to the fact that processes and policies deal with internal processes that are not necessarily well understood by people (Stauss 2000). Also, as already stated, data is usually more interpreted than processes and policies, leading to clearer perceptions.

Similar to information perception, data-driven information is better understood by information receivers than process-driven or policy-driven information. The same reasoning for information perception applies to information understandability as well.

With regards to information acceptance, disclosing only data might be less convincing than disclosing processes and policies leading to that data. Knowing the processes and reasons usually makes the information more credible (Scott 1994) and consequently, more acceptable by information receivers.

Information actionability is also affected by transparency meaningfulness, with disclosure of processes and policies having a more positive effect and being more influential during decision making by information receivers.

Figure 3.11 illustrates how transparency meaningfulness is linked to transparency usefulness in each step.

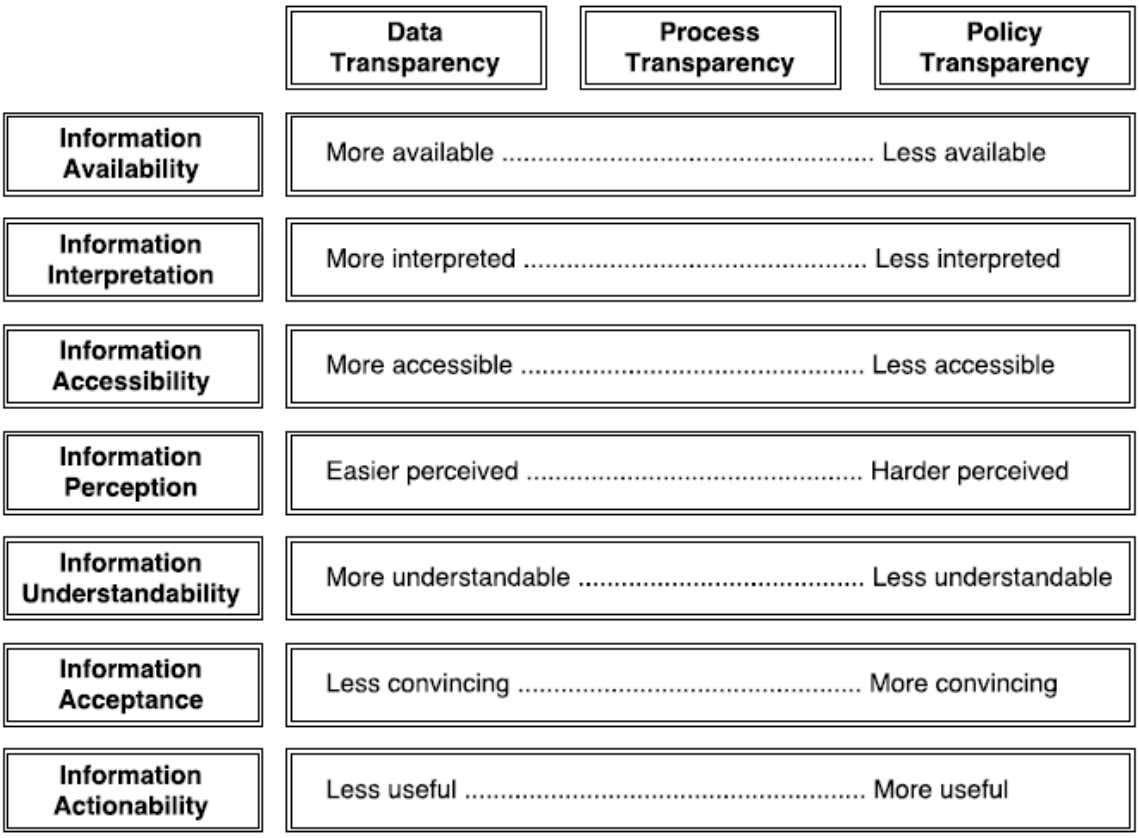


Figure 3.11: Inter-dependencies between transparency usefulness and transparency meaningfulness

3.6 Proof of Concept: UK Freedom of Information Act

As a proof of concept, in this section the UK Freedom of Information Act 2000 (henceforth FOIA), found in *legislation.gov.uk*, is probed. FOIA is officially available in the website of the UK government at the time of publication of this thesis. FOIA is investigated using the four reference models of transparency in order to find out if and how it takes into account the information receiver's (i.e., the public in this case) need for transparency, and the lessons learnt and strengths and weak points found in FOIA are discussed in relation to this investigation. Possible improvements to be considered in newer versions of FOIA are also proposed.

3.6.1 FOIA and Transparency Actors Wheel

FOIA was investigated in search of different actors involved in transparency provision. In FOIA, four actors identified in Transparency Actors Wheel are present. For example, Part I, Section 1(1), reads:

> *"Any person making a request for information to a public authority is entitled (a) to be informed in writing by the public authority whether it holds information of the description specified in the request, and (b) if that is the case, to have that information communicated to him."*

The term "any person" in the above refers to the information receiver and the public authority refers to the information provider. It also mentions that the information should be communicated to the information receiver, therefore acknowledging the presence of an information medium for communication. Information entity is the public office whose information is requested, and an extensive, comprehensive list of them is provided in Schedule 1 of FOIA.

Furthermore, the information which flows amongst different stakeholders is divided into the information which brings about transparency (i.e., transparency-related information) and information held by information provider (i.e., public authority) which does not constitute transparency (i.e., transparency-unrelated information). This can be found in Part I, Section 7(1):

> *"Where a public authority is listed in Schedule 1 only in relation to information of a specified description, nothing in Parts I to V of this Act applies to any other information held by the authority."*

With regards to the transparency classification, FOIA falls into the category of legal demands in demand-side transparency. The reason is that it is the information receiver, and not the information provider, who initiates the transparency provision by demanding certain information. However, as it is already mentioned, such a legal demand in demand-side transparency produces a mandatory supply-side transparency as well.

3.6.2 FOIA and Transparency Depth Pyramid

In FOIA, it is mainly the data which is communicated to the information receiver. Little mention of processes or policies can be found explicitly in FOIA. In Part I, Section 17(7)(a), FOIA states that:

> *"A notice under subsection (1), (3) or (5) must contain particulars of any procedure provided by the public authority for dealing with complaints about the handling of requests for information or state that the authority does not provide such a procedure."*

Furthermore, in Part I, Section 19(3)(b), FOIA states that:

> *"In adopting or reviewing a publication scheme, a public authority shall have regard to the public interest in the publication of reasons for decisions made by the authority."*

With regards to transparency meaningfulness, the following issues must be considered:

- Even when FOIA does not explicitly mention the communication of processes and policies amongst stakeholders, it is conceivable that the information requested by the information receiver may actually contain them. For example, a Freedom of Information request may concern a city council expenditure on a new bridge which may also contain why the decision on building that bridge was made and how it was made in a council meeting.
- In several occasions in FOIA, it has been duly noted that when the requested information will not be available for information receiver, they should be notified of the reasons for such nondisclosure. For example, it is written in FOIA that it is an obligation to notify the information receiver of the reasons for not complying for their preferred method of communication (Part I, Section 11(3)).

3.6.3 FOIA and Transparency Achievement Spectrum

FOIA is mainly concerned with disclosure of information and information availability. This is justified given the fact that FOIA is meant to deal with legal requirements of information receivers, and is not as much concerned with how such information may or may not help their decision making processes, and effectively be actionable to them.

Information availability and information accessibility are the two sides of the same coin, representing two different perspectives of information providers and information receivers. Furthermore, FOIA views information provision as a service (which will be discussed in the next subsection). Therefore, FOIA is also concerned with information accessibility. This can be observed in the title to Part I, which is "Access to Information Held by Public Authorities".

On the other hand, there is no mention in FOIA of information interpretation in a way that can be easily understood by information receivers. Furthermore, FOIA is not concerned with information perception, understandability, acceptance, or actionability. While this is justified, it also means that FOIA does not necessarily result in useful transparency. Information receivers may receive hundred pages of data in forms of spread sheet files and lengthy text files which provide no informational value to them, and in some cases may actually lead to more confusion and possible distrust (O'Reilly 1980). For example, in the Freedom of Information section of the website of the UK parliament (*www.parliament.uk/site-information/foi*), there is a link to transparency publications in which the member of parliaments' expenditures, allowances, and details of finance policies can be found. This obviously satisfies the FOIA regulations, but the provided information is rarely usable for the common audience and needs financial expertise and journalistic endeavours to be understood.

3.6.4 FOIA and Information Quality in Transparency

FOIA is mainly information provider oriented, and as such, there are no mentions of the information quality dimensions that meet or exceed consumer expectations, such as reputation, relevancy, and believability. Furthermore, FOIA is product quality agnostic, as it presupposes that the provided information has the standard and expected quality. Therefore, information quality dimensions such as free-of-error, concise representation, consistent representation, and completeness cannot be found in FOIA either.

It was mentioned earlier that FOIA regards information provision as a service. As such, the two information quality dimensions of timeliness and security can be found in FOIA. As for the timeliness of the requested information, Part I, Section 10(1) states:

> *"Subject to subsections (2) and (3), a public authority must comply with section 1(1) promptly and in any event not later than the twentieth working day following the date of receipt."*

As for the security of the requested information, several loci in Part II of FOIA deal with exemption of information provision. Amongst reasons given by FOIA why certain information cannot be disclosed to the public are, to name a few:

- Information supplied by, or relating to, bodies dealing with security matters
- Information regarding national security
- Information regarding the defence of the UK
- Information whose disclosure may adversely affect the UK international relations, internal relations within the UK, or the UK economy

On the other hand, FOIA mentions some of the offences related to attempts to the alteration or concealment of information, in Part VIII, Section 77:

> *"... Any person to whom this subsection applies is guilty of an offence if he alters, defaces, blocks, erases, destroys or conceals any record held by the public authority, with the intention of preventing the disclosure by that authority of all, or any part, of the information to the communication of which the applicant would have been entitled."*

One can deduce that this article is trying to prevent disinformation or misinformation. However, since several information quality dimensions are not explicitly stated here, or anywhere else in FOIA, it can be concluded that not much attention has been paid to information quality in FOIA other than what was already discussed.

3.6.5 Reflections on FOIA

While investigating FOIA, several observations were formed with regards to stakeholders' transparency requirements. In this subsection, some of these observations are shared and discussed.

3.6.5.1 FOIA is mainly associated with mandatory transparency.

FOIA distinctly states that transparency requirements, where legally and pragmatically possible, must be met even when the information is maintained by actors other than the information provider. In FOIA, Part I, Section 3(2)(a) and 3(2)(b), it is stated that:

> *"For the purpose of this Act, information is held by a public authority if (a) it is held by the authority, otherwise than on behalf of another person, or (b) it is held by another person on behalf of the authority."*

This illustrates the importance of meeting transparency requirements as a legal demand of information receivers (demand-side) and as a legal obligation of information providers (supply-side).

3.6.5.2 No transparency should be managed in the engineering of transparency requirements.

FOIA advocates that no transparency provision is part of transparency management. In fact, about 13 pages of FOIA, which constitute Part II of this act, deal with information which is exempt from disclosure, along with other places in FOIA where transparency request refusals are discussed, such as Part I, Section 17. This implies that any model of transparency should also consider loci where transparency provision is prohibited or limited to certain stakeholders (O'Hara 2011). This is in line with the proposed transparency levels discussed earlier in this chapter, where no transparency is considered as the first level of transparency, and where constructs have been devised to capture the prohibition of information disclosure to certain stakeholders (as will be discussed in Chapter 4).

3.6.5.3 Feedback channels should exist between information providers and information receivers.

FOIA acknowledges that in order for information providers to better understand the information required by information receivers, there needs to be a feedback or communication channel. In FOIA, Part I, Section 1(3)(a) and 1(3)(b) state the need for such a feedback channel:

> *"Where a public authority (a) reasonably requires further information in order to identify and locate the information requested, and (b) has informed the applicant of that requirement, the authority is not obliged to comply with subsection (1) unless it is supplied with that further information."*

Therefore, any tool capturing transparency requirements of stakeholders should also provide them with such a feedback channel.

3.6.5.4 Managing transparency requirements is costly.

Meeting transparency requirements does not occur without a cost. In fact, meeting transparency requirements can be costly, both in terms of money and in terms of time dedicated to become transparent. FOIA acknowledges such costs and discusses the possibility of incurring fees on the information receiver's side in Part I, Sections 9 and 13. The cost of transparency is not only monetary either. It also costs time to comply with Freedom of Information requests, which is reflected in Part I, Section 10 of FOIA.

Such costs could potentially discourage both information receivers and information providers from willingly requesting and providing information. Consequently, automating the process through software tools and techniques could reduce both monetary and time costs in the long run.

3.6.5.5 Transparency is meant to be communicated efficiently.

FOIA observes the communication preferences of different information receivers, and obliges information providers to respect such requirements in Part I, Section 11(1)(a):

> *"Where, on making his request for information, the applicant expresses a preference for communication by any one or more of the following means, namely, (a) the provision to the application of a copy of the information in permanent form or in another form acceptable to the applicant ... the public authority shall so far as reasonably practicable give effect to that preference."*

With the increasing use of digital devices, it is reasonable to think that some of these communication channels could be through digital devices, such as mobile phones, and digital means, such as email. Using computerised tools can help increase the efficiency and expand the reach of transparency.

3.6.5.6 Transparency provision can become vexatious.

According to Part I, Section 14 of FOIA, an information receiver cannot make several subsequent identical or substantially similar transparency requests. The time and money costs, plus the burden it puts on the shoulder of the information provider, in this case the public authority, justify such a prohibition. While this justification is unobjectionable, automating the whole procedure of transparency management (as will be discussed in Chapter 5) could remove this obstacle and satisfy information receivers' constant demands of transparency.

3.6.5.7 Transparency of transparency requirements can also be problematic.

There are instances where being transparent why transparency requirements cannot be met can also be harmful, because that information can also reveal classified information and lead to unwanted transparency. FOIA discusses such refusal of transparency about transparency in Part I, Section 17(4):

> *"A public authority is not obliged to make a statement under subsection (1)(c) or (3) if, or to the extent that, the statement would involve the disclosure of information which would itself be exempt information."*

Therefore, any transparency tool should also represent these peculiarities of transparency, as will be discussed in the next chapter.

3.7 Summary

In this chapter, four reference models for the engineering of transparency requirements in business information systems were presented and discussed. The inter-dependencies amongst these reference models were examined and it was illustrated how they should be considered during the engineering of transparency requirements. The reference models were then utilised in order to investigate FOIA and its strengths and weaknesses from an information receiver's perspective, and to recommend amendments where possible. These reference models together have the potential to capture and manage the peculiarities of transparency requirements, and therefore, they can form a solid foundation for the modelling and analysis of transparency requirements. In the next chapter, this foundation will be used in devising a transparency modelling language, called TranspLan, for the modelling and analysis of transparency requirements in a business information system.

Chapter 4

TranspLan: A Modelling Language for Transparency Requirements in Business Information Systems

"To have another language is to possess a second soul."

Charlemagne

4 TranspLan: A Modelling Language for Transparency Requirements in Business Information Systems

In the previous chapter, four reference models were proposed for transparency requirements, and these reference models were informed by the extensive literature study on transparency in multiple disciplines, including requirements engineering. These reference models provide a critical focus on transparency requirements in a business information system, which is the systematic modelling of transparency requirements. Without a rigorous and systematic model, several benefits related to the engineering of transparency requirements cannot be properly accomplished.

The first benefit is that a transparency model can facilitate a consistent method for eliciting transparency requirements of stakeholders. Second, a transparency model can provide methods for analysing transparency, which could be automated as well. Third, a rigorous transparency model can also make way for automated validation and evaluation of transparency. Such a model, however, does not exist for transparency yet.

Based on the extensive multi-disciplinary literature study on transparency and four transparency reference models proposed, a domain-specific language for the modelling and analysis of transparency requirements in a business information system is devised and proposed in this chapter. This language, which is called TranspLan (TRANSParency LANguage), facilitates different aspects of transparency requirements elicitation, modelling, and analysis. TranspLan modelling language is mathematically defined, a graphical representation is provided for it, and it is enriched with two specification models.

It should be noted that transparency, similar to some other NFR requirements such as privacy, can be context-dependent. This means that stakeholders' transparency requirements may change when the context changes. However, TranspLan modelling language does not explicitly capture contextual information in the modelling and analysis of transparency. That being said, TranspLan has the capability of being furthermore augmented with context information and by adding new constructs to the language. Such augmentation is, however, outside the scale of this thesis and remains a future work on TranspLan modelling language.

The rest of this chapter is structured as follows. In Section 4.1, the transparency language is presented, is formally defined, and its mathematical definition is provided. In Section 4.2, some algorithms for the automated analysis of transparency are proposed. The chapter is concluded and summarised in Section 4.3.

4.1 TranspLan: A Transparency Modelling Language

Before identifying the need for a new modelling language for modelling and analysing transparency requirements in a business information system, attempts were made to augment or modify existing modelling languages in order to make them suitable for such modelling and analysis. As discussed earlier, *i** modelling, which was also proposed by Cappelli et al. (2007) to have the base requirements of transparency modelling, was considered in particular.

Attempts were made to augment this modelling language with the constituents of transparency so that it could also be used for transparency modelling. These attempts, however, failed for several reasons. First, *i** is goal oriented, while transparency is information oriented. That is to say, while *i** modelling focuses mainly on goals and how different tasks can help achieve those goals, transparency focuses on stakeholders and how information is exchanged amongst them. Second, transparency itself is considered a softgoal in *i**, meaning that it is part of a bigger picture in which tasks are conducted to reach other (hard) goals of the actors involved. On the other hand, transparency itself becomes the main focus of any information exchange and other possible goals of actors become inconsequential in this manner. Third, *i** treats information as a resource which circulates amongst different actors and in *i**, resource modelling has little elaboration and therefore little significance. In transparency, however, information plays a vital role and is a central entity. Finally, several fine-grained attributes of transparency with regards to meaningfulness, usefulness, and quality of information could not be modelled using *i**. All these reasons led to this outcome that a new domain-specific modelling language needs to be devised for transparency requirements.

TranspLan is designed in order to help a business information system in the engineering of transparency requirements. TranspLan consists of StakeHolders' Information Exchange Layout Diagram (Shield diagram) for the visual representation of information exchanges amongst stakeholders and their transparency requirements. TranspLan is also accompanied by two descriptive specification models for information elements and stakeholders, called INFOrmation eLEment Transparency Specification (Infolet specification) and Stakeholders' Information Transparency REQuirements Specification (Sitreq specification), respectively. These specification models explain the information elements and the stakeholders with their elicited transparency requirements in the Shield diagram.

4.1.1 Modelling Constituents and Representations

The TranspLan language is mainly built based on three different constituents: stakeholders, information elements, and the relationships between stakeholders and information elements. Relationships can be decomposed using decomposition relations. An information exchange is a

combination of all these constituents and illustrates the flow of information amongst different stakeholders. These constituents are described as follows.

- **Stakeholders** are the people, departments, organisations, etc., which are involved in providing, receiving, or requesting transparency in any information exchange amongst stakeholders. When categorising stakeholders, they are commonly represented as one entity, e.g., Student or Finance Department. However, the exchanged information within an information exchange system may concern *all* the stakeholders within that system, or it may even concern the *public* audience.
- **Information elements** are pieces of information exchanged amongst stakeholders. Stakeholders' transparency requirements affect the way information elements should be formed and presented to other stakeholders. Information elements have a type, which is related to their transparency meaningfulness. These types can be the *data* type, the *process* type, or the *policy* type.
- **Stakeholder-information relationships** exist between stakeholders and information elements, and they describe how the information element is associated with the stakeholder. The *production* relationship denotes that the stakeholder produces the information element for other stakeholders. The *obligation* relationship denotes that the stakeholder provides the information element based on coercive supply or requests the information element based on legal demands. The *optionality* relationship denotes that the stakeholder provides the information element based on voluntary supply or requests the information element based on personal demands. The *restriction* relationship denotes that the information element should not be available to the stakeholder. The *undecidedness* relationship denotes that the relationship between the stakeholder and the information element is not known or decided yet.
- **Decomposition relations** exist between some relationships and can be one of the following: the *and* decomposition relation, the *or* decomposition relation, and the *xor* (exclusive or) decomposition relation.
- **Information exchanges** illustrate the flow of information from an information provider to an information receiver or requester. An information exchange system is a collection of all information exchanges in a business information system.

4.1.2 TranspLan Mathematical Definition

The TranspLan language and its constituents can be defined using the ordinary mathematical language as follows:

Definition 1 (Information element). *Let* $IE = \{ie_1, ie_2, ..., ie_m\}$ *be the set of information elements, and IE_Label and IE_Name be sets of unique labels and names respectively. Every* $ie_i \in IE$ *can be defined as follows:*

$IE = \{ie \mid ie = (ietype, ielabel, iename, ieused) \ \wedge \ ietype \in IE\_type \ \wedge \ ielabel \in IE\_label \ \wedge \ iename \in IE\_name \ \wedge \ ieused \subset ielabel\}$

$IE\_type = \{data, process, policy\}$

Definition 2 (Stakeholder). *Let* $S = \{s_1, s_2, ..., s_n\}$ *be the set of stakeholders,* $IE = \{ie_1, ie_2, ..., ie_m\}$ *be the set of information elements, and* $R = \{r_1, r_2, ..., r_l\}$ *be the set of stakeholder-information relationships. The set of stakeholders and two subsets of S, called PS and RS, can be defined as follows:*

$S = \{s \mid s \ is \ a \ stakeholder\}$

$PS = \{s \mid s \in S \ \wedge \ ie \in IE \ \wedge \ (s, ie, production) \in R\}$

$RS = \{s \mid s \in S \wedge ie \in IE \wedge rt \in \{obligatory, optional, restricted, undecided\} \wedge (s, ie, rt) \in R\}$

Definition 3 (Stakeholder-information relationship). *Let* $R = \{r_1, r_2, ..., r_l\}$ *be the set of relationships where each relationship is between stakeholder* $s_i \in S$ *and information element* $ie_j \in IE$*. Every* $r_i \in R$ *can be defined as follows:*

$R = \{r \mid r = (s, ie, rtype) \ \wedge \ s \in S \ \wedge \ ie \in IE \ \wedge \ rtype \in R\_type\}$

$R\_type = \{production, obligatory, optional, restricted, undecided\}$

Definition 4 (Decomposition relation). *Let* $Rel = \{rel_1, rel_2, ...rel_k\}$ *be the set of relations where each relation is between two or more relationships* $R_1, R_2, ..., R_j \in R$*. Every* $Rel_i \in Rel$ *can be defined as follows:*

$Rel = \{rel \mid rel = (r_1, r_2, .., r_j, reltype) \ \wedge \ r_1, r_2, .., r_j \in R \ \wedge \ reltype \in Rel\_type\}$

$Rel\_type = \{and, or, xor\}$

Definition 5 (Information exchange). *Let* $IEX = \{iex_1, iex_2, ..., iex_t\}$ *be the set of information exchanges amongst stakeholders where one stakeholder* $s \in PS$ *produces some information elements* $IESet \subset IE$ *that is received or requested by a group of other stakeholders* $RSSet \subset RS$ *and* $s \notin RSSet$*. Every information exchange* iex_i *can be defined as follows:*

$IEX = \{iex \mid iex = ((s_i, ie_i, r_i), (s_j, ie_i, r_j)) \ \wedge \ s_i \in PS \ \wedge \ s_j \in RS \ \wedge \ r_i = production \ \wedge \ (s_i, ie_i, r_i), (s_j, ie_i, r_j) \in R \ \}$

4.1.3 Shield Diagram

The Shield diagram is the graphical representation of the TranspLan language. The constituents of the TranspLan language can be illustrated in the Shield diagram as follows.

Stakeholders are illustrated in one of the four following ways.

- One stakeholder can be illustrated by a circle with the stakeholder's name inside the circle.
- All stakeholders within an information exchange system can be shown by two nested circles, labelled *All*. This is mainly for the purpose of facilitating a more efficient, clutter-free, visual design.
- The previous notion is further enriched by the *exclusion* notation, which uses brackets inside the two nested circles with an *All* label to refer to those stakeholders who are excluded from the information exchange. For example, two nested circles with the label '*All [Supervisor]*' will indicate that information is received by or requested by all stakeholders inside the information exchange system, except the supervisor.
- Three nested circles, labelled *Public*, are also utilised in this diagram to refer to the public, i.e., all stakeholders inside and outside the information exchange system under study.

Information elements are illustrated by a three-part rectangle. In the left-side part, the type of information element is written. This type shows the meaningfulness of the information element in the transparency setting, and can hold one of the following values, or it can be left empty if the nature of the information is unknown during the diagram design.

- *Data* illustrates an information element containing only data.
- *Process* illustrates an information element containing processes (and possibly data).
- *Policy* illustrates an information element containing policies (and possibly processes and data).

The middle part of the information element is used for the information element label and information element name. The label is a unique tag that can be used to identify the information element. The right-side part is used to list all the other information element tags which use, partly or completely, the current information element. This can be used to track how information travels and can also be used to check whether information is received by stakeholders who are not meant to receive it.

Stakeholder-information relationships are illustrated by either simple lines, dotted arrows, or double lines, and always connect stakeholders to information elements.

- *Simple lines* imply the production of information by a stakeholder.
- *Dotted arrows with a black head* show obligatory information flow that arises either from coercive information provision, or legal information requests.
- *Dotted arrows with a white head* denote optional information flow that is the result of voluntary information provision or personal information demands.
- *Dotted arrows with a circle head* illustrate information flows whose nature (i.e., obligatory, optional) is undecided at the time of diagram design.
- *Double lines* indicate that the information element is not meant for the specified stakeholder and must be hidden from them.

Arrows are intentionally chosen to be dotted in order to emphasise that such information flow may or may not serve its transparency purpose because its usefulness must be decided through complicated procedures and involvement with stakeholders which simply cannot be captured through such diagrams. For this reason, two specifications are introduced and used, as described in the next subsections.

Decomposition relations describe the relationship amongst relationships. Relationships of any kind can have the following relations amongst them.

- *And* relation is the default relation.
- *Or* relation is shown by a line amongst relationships.
- *Xor* (exclusive or) relation is shown by double lines amongst relationships.

Information exchange system is illustrated by a rectangle divided into four parts and is illustrated as follows.

- The top left part is reserved for the information exchange system name.
- The top right part is used to write extra notes regarding the information exchange system.
- The bottom left part is used to list all the stakeholders in the information exchange system, including two predefined *All* and *Public* stakeholders.
- The bottom right part is the main part and is used to draw information exchanges amongst the stakeholders, using the notation described above.

Figure 4.1 illustrates the summary of the aforementioned building blocks used in a Shield diagram.

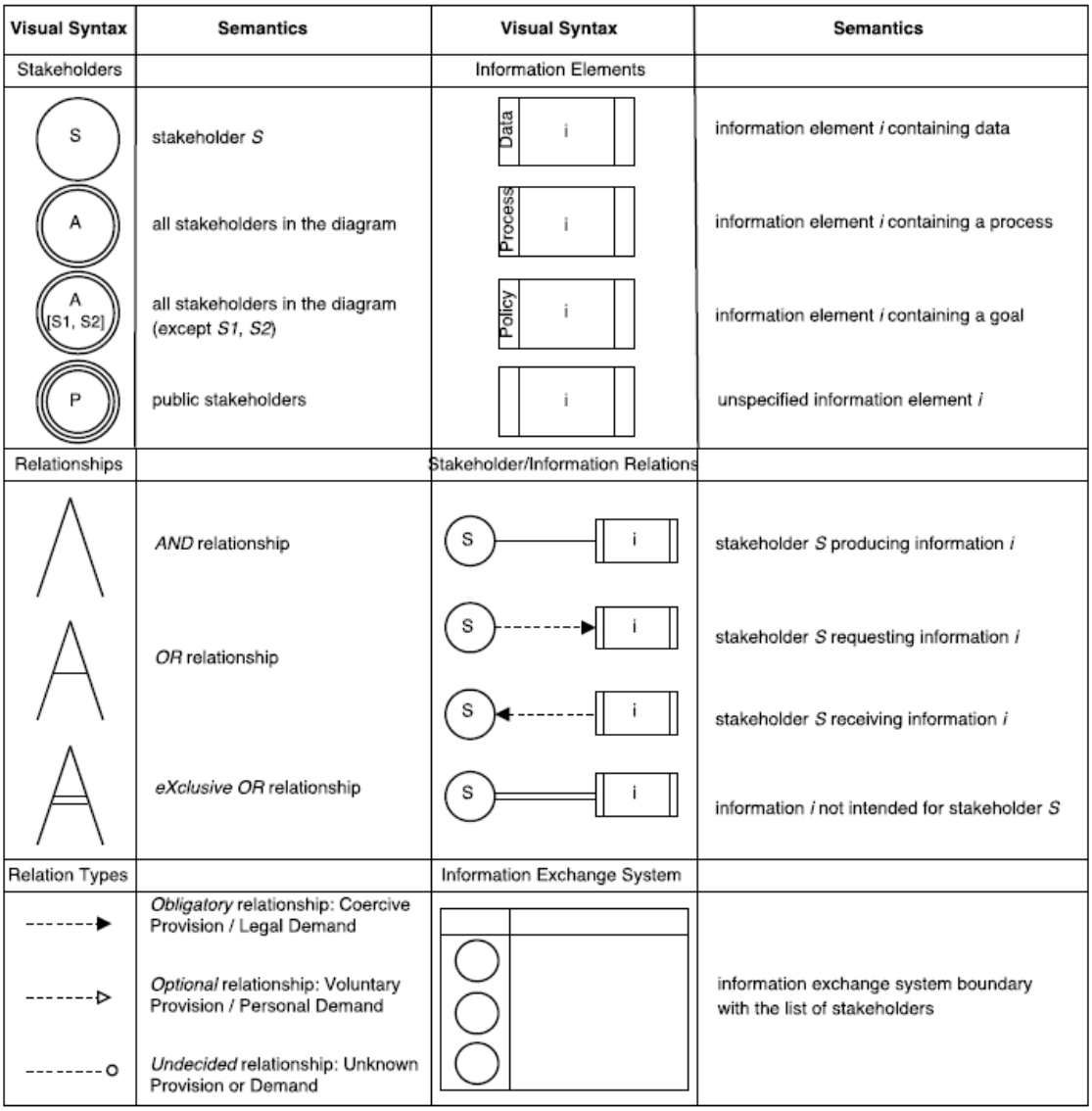


Figure 4.1: Building blocks of Shield and their interpretations

4.1.4 Sitreq Specification

Every stakeholder in the Shield diagram is accompanied by Stakeholder's Information Transparency REQuirements Specification (Sitreq), as illustrated in Figure 4.2. Sitreq is a descriptive tool for stakeholders and their transparency requirements in the Shield diagram. Sitreq explains how stakeholders are related to certain information elements, their transparency requirements on those information elements, and other stakeholders involved in the process.

Stakeholder's Information Transparency REQuirements Specification (Sitreq)						
Stakeholder's Name: *Stakeholder's Name*						
IE Label	**IE Name**	**Relationship**	**Requirement Description**	**Transparency Requirement Type**	**Transparency Meaningfulness Type**	**Stakeholders Involved**
IE label	*IE name*	*Relationship type*	*A brief description of the stakeholder's requirements regarding the IE*	*The transparency requirement of the stakeholder regarding the IE*	*The meaningfulness type requirement regarding the IE*	*List of stakeholders in this information exchange*

Figure 4.2: Stakeholder's Information Transparency REQuirements Specification (Sitreq)

4.1.5 Infolet Specification

Every information element in the Shield diagram is accompanied by an INFOrmation eLEment Transparency Specification (Infolet), as illustrated in Figure 4.3. Infolet is a descriptive tool for information exchanges in the Shield diagram. It describes each information element (IE) in the diagram, providing more in-depth information on them. Infolet is meant to capture all the four reference models of transparency, along with general modelling information required for each IE, as follows. The numbers on parentheses illustrate the corresponding segments in Infolet.

INFOrmation eLEment Transparency Specification (Infolet)

Information Element Label, Name, Description, Inter-relations and Type (Transparency Meaningfulness)

① Information Element Label A unique label for IE identification	② Information Element Name A name selected for the IE	③ Information Element Type IE type can be selected from: {Data, Process, Policy}

④ **Information Element Description**

A brief description of IE and its content

⑤ **List of Other Information Elements Using This Information Element**

A list of IE labels and names which use part of all of the current IE

Information Element Stakeholders Classification and Their Information Provision/Request/Restriction Type (Transparency Stakeholders)

⑥ **Information Element Creator/Authority**

Information entity responsible for creating, producing, and rendering IE

⑦ **Information Element Provider**

Stakeholder who provides the information is listed.

⑧ **List of Stakeholders Receiving Information Element and Information Element Provision Type**

Stakeholders who receive the information are listed
IE provision type can be selected from: {Coercive, Voluntary}

⑨ **List of Stakeholders Requesting Information Element and Information Element Request Type**

Stakeholders who request the information are listed
IE request type can be selected from: {Legal, Personal}

⑩ **List of Stakeholders with Restricted Access to Information Element and Restriction Type**

Stakeholders who cannot access the information are listed
Restriction type can be selected from: {Secrecy, Privacy, Anonymity, Other}

Information Element Quality Control (Transparency Quality)

⑪ **Information Element Quality Control (Sound, Dependable, Useful, Usable)**

◯ Free of Error	◯ Concise Rep.	◯ Completeness	◯ Consistent Rep.	
◯ Timeliness	◯ Security			
◯ App. Amount	◯ Relevancy	◯ Understandability	◯ Objectivity	◯ Interpretability
◯ Accessibility	◯ Believability	◯ Ease of Manipulation	◯ Reputation	◯ Value-added

IE qualities are checked when these qualities are met.

Information Element Level of Achievement (Transparency Usefulness)

⑫ **Information Element Level of Achievement**

◯ Information Availability (Information is made available to the stakeholders)
◯ Information Interpretation (Information is appropriately interpreted for the stakeholders)
◯ Information Accessibility (Information is easily accessible by the stakeholders)
◯ Information Perception (Information is perceived credible by the stakeholders)
◯ Information Understandability (Information is comprehended by the stakeholders)
◯ Information Acceptance (Information is believed and accepted by the stakeholders)
◯ Information Actionability (Information helps stakeholders in their informed decision-making)

IE level of achievement is checked.

Information Element Additional Data

⑬ **Information Element Notes**

Further notes about IE, samples, links, etc.

Figure 4.3: INFOrmation eLEment Transparency Specificatin (Infolet)

1. General modelling requirements (1, 2, 4, 5, 13)
2. Transparency Depth Pyramid (3)
3. Transparency Actors Wheel (6, 7, 8, 9, 10)
4. Transparency Information Quality (11)
5. Transparency Achievement Spectrum (12)

4.1.6 How TranspLan Links to Transparency Reference Models

TranspLan links to the four reference models as follows:

1. The actors in Transparency Actors Wheel and their transparency requirements are captured through Sitreq specifications. Furthermore, the information flow amongst them is captured by the Shield diagram. As these actors create, provide, or receive information, they must also be linked to the information pieces, and this is captured by Infolet specifications (items 6 to 10) along with the provision type or request type.
2. Transparency meaningfulness, when it is a requirement of a stakeholder, is captured by Sitreq specifications, and when it is provided in runtime to a stakeholder, is captured by Infolet specifications and also by the Shield diagram.
3. Transparency usefulness is captured by Infolet specifications (item 12) because it is related to information elements.
4. Information quality dimensions are captured by Infolet specifications (item 11) because they are also related to information elements.

4.2 Transparency Requirements Analysis

The modelling language, TranspLan, and its components, the Shield diagram and Sitreq and Infolet specifications, provide a viable solution for addressing several problems that a business information system may encounter during transparency provision, because they enable automated transparency analysis and tool support. The automated analysis enables algorithmic investigation of transparency in order to identify issues such as transparency shortage or abundance in an information exchange system and amongst stakeholders. In the following subsections, several algorithms are provided for the analysis of transparency requirements.

4.2.1 Transparency Meaningfulness Mismatch

Transparency meaningfulness mismatch happens when the level of meaningfulness provided by a stakeholder does not match with the level that is requested by another stakeholder. Failure in reaching the required transparency level (e.g., disclosing the actions without giving the rationale behind them) may reduce accountability, while exceeding the required transparency level (e.g., disclosing the reasons for a particular action when only the data obtained from the action is needed) may introduce various workarounds in the business information system (Strong et al. 1997). The following algorithm (Algorithm 1) finds and lists all information elements where there is a transparency meaningfulness mismatch.

Examples: An employee is asked through an email to send their bank account details to the finance department of their organisation (i.e., they are provided with "data"). However, the employee needs to know why this information has been requested (i.e., they need "policy"). Another employee has been asked to complete an online form through an email and complete instructions on how to fill in the form has been provided (i.e., they are provided with "process"). However, the employee has already filled in the same online form several times and needs not be reminded every time of the process (i.e., they only need "data"). Both cases are examples of transparency mismatch.

```
foreach iex((s_i , ie_i , r_i),(s_j , ie_i , r_j)) ∈ InformationExchange do
    Open(s_i.Sitreq);
    Open(s_j.Sitreq);
    p_tmt = s_i.ie_i.TransparencyMeaningfulnessType;
    r_tmt = s_j.ie_i.TransparencyMeaningfulnessType;
    if (p_tmt=data and r_tmt !=data) or (p_tmt=process and
     r_tmt=policy) then
        Print("Reaching the required transparency level failed!");
        ProduceError(Transparency_Mismatch_Error);
    end
    if (p_tmt=policy and r_tmt!=policy) or (p_tmt=process and
     r_tmt=data) then
        Print("The required transparency level is exceeded!");
        ProduceError(Transparency_Mismatch_Error);
    end
end
```

Algorithm 1: Transparency Mismatch Detection

4.2.2 Transparency Leakage

Transparency leakage refers to the availability of information elements to stakeholders who initially were not meant to receive that information because of the restricted nature of other stakeholders' transparency requirements. Transparency leakage can produce several adverse effects, e.g., it can affect stakeholders' trust in the business information system negatively and it can influence trading behaviour and market efficiency in financial systems (Brunnermeier 2005). The following algorithm (Algorithm 2) finds and lists the instances where transparency leakage has occurred.

Example: A human resources report includes a list of employees who have been working fewer hours than they should. The report is meant for high level managers, and not for the employees of the organisation. In particular, it must not be viewed by the employees whose names appear in the list. However, if the report is accidentally put in the public domain and allows employees to access it, it leads to transparency leakage.

```
foreach r (s , ie , rtype) ∈ R do
    if (r.rtype = restricted) then
        foreach ielabel ∈ ie.ieused do
            if (r (s , ielabel , rtype).rtype != restricted) then
                Print(s, " has restricted access in ", ie, " but unrestricted
                  access in ", ieused, "."));
                ProduceError(Transparency_Leakage_Error);
            end
        end
    end
end
```

Algorithm 2: Transparency Leakage Detection

4.2.3 Information Overload (Infobesity or Infoxication)

Information overload, sometimes referred to as infobesity (Morris 2003) or infoxication (Ignacio Aguaded 2014), happens when more information is given to a consumer than they need. Investigating the four reference models for transparency, it can be observed that Transparency Depth Pyramid can capture information overload. Infobesity can happen both horizontally across the model, i.e., disclosing too much data than one needs or disclosing too much process than one needs. It can also happen vertically along the model, i.e., disclosing processes and policies when one only needs data, or disclosing policies when one only needs data and processes. The latter case also leads to transparency meaningfulness mismatch, which was discussed in Algorithm 1. The following algorithm (Algorithm 3) captures such instances of information overload.

Example: An employee of an organisation receives several work-related emails per hour, and they have to answer them all. However, they cannot cope with the amount of information they get, and sometimes miss certain emails as a result. The employee may have to develop certain coping strategies, e.g., prioritising, multitasking, satisficing, refusing, queuing, and delegating (Savolainen 2007, Bawden and Robinson 2009), but the main problem, i.e., information overload, remains unsolved.

```
foreach iex((s_i , ie_i , r_i),(s_j , ie_i , r_j)) ∈ InformationExchange do
    Open(s_i.Sitreq);
    Open(s_j.Sitreq);
    p_tmt = s_i.ie_i.TransparencyMeaningfulnessType;
    r_tmt = s_j.ie_i.TransparencyMeaningfulnessType;
    if (p_tmt=policy and r_tmt!=policy) or (p_tmt=process and
     r_tmt=data) then
        Print("The required transparency level is exceeded!");
        ProduceError(Information_Overload);
    end
    if (p_tmt=policy and r_tmt=policy) or (p_tmt=process and
     r_tmt=process) or (p_tmt=data and r_tmt=data) then
        Open(ie_i.Infolet);
        if (ie_i.Information_Acionability.Checked = False) and
         (ie_i.AppropriateAmount.Checked = False) then
            Print("Information overload possible to happen!");
            ProduceWarning(Information_Overload);
        end
    end
end
```

Algorithm 3: Transparency leading to information overload

4.2.4 Information Starvation (Inforexia)

Information starvation, also referred to as inforexia (in contrast with infobesity), happens when less information is given to a consumer than they need. Amongst other adverse effects, it has been shown to be the source of several problems in the workplace (Lopp 2007). Similar to infobesity, it can be observed that Transparency Depth Pyramid can capture information starvation. Inforexia can also happen both horizontally across the model, i.e., disclosing too little data than one needs or too little policy than one needs. It can also happen vertically along the model, i.e., disclosing only data when one needs processes and policies, or disclosing processes when one needs policies. The latter case also leads to transparency meaningfulness mismatch, which was discussed in Algorithm 1. The following algorithm (Algorithm 4) captures such instances of information starvation.

Example: A customer is in the process of buying a car. They need certain information before they can decide whether to buy a particular car (e.g., the price, the number and amount of instalments, the final calculated price, and possible mileage restrictions). If they do not have access to all the information they need and some of their questions remain unanswered, then information starvation will happen, which will impair their decision making.

foreach $iex((s_i\ ,\ ie_i\ ,\ r_i),(s_j\ ,\ ie_i\ ,\ r_j)) \in InformationExchange$ **do**
  $Open(s_i.Sitreq)$;
  $Open(s_j.Sitreq)$;
  $p\_tmt = s_i.ie_i.TransparencyMeaningfulnessType$;
  $r\_tmt = s_j.ie_i.TransparencyMeaningfulnessType$;
  if *(p_tmt=data and r_tmt !=data) or (p_tmt=process and r_tmt=policy)* **then**
    Print("Reaching the required transparency level failed!");
    ProduceError(Information_Starvation);
  end
  if *(p_tmt=policy and r_tmt=policy) or (p_tmt=process and r_tmt=process) or (p_tmt=data and r_tmt=data)* **then**
    $Open(ie_i.Infolet)$;
    if $(ie_i.Information\_Acionability.Checked = False)$ *and* $(ie_i.Completeness.Checked = False)$ **then**
      Print("Information starvation possible to happen!");
      ProduceWarning(Information_Starvation);
    end
  end
end

Algorithm 4: Transparency leading to information starvation

4.2.5 Detecting Bias

Bias is the process in which a person seeks information to confirm a preconceived belief. Bias happens because human beings have a tendency to avoid information which can disprove their already held beliefs and throw their decisions into question. In other words, bias allows people to see the world around them the way they want to see it.

Bias is typically the result of one of the three preformed sources (Vaughan 2013):

- Bias source 1: Information processing shortcuts, in which people make educated guesses instead of fully considering the information.
- Bias source 2: Social influences or beliefs, which assume that something is true because their belief system tells them so.
- Bias source 3: Motivational factors, which lead people to search for information which supports their current ideas.

The first source, therefore, is about holding, or having access to, incomplete information, while the second and third sources are mainly about existing beliefs which can affect new information acceptability. Their difference, however, is in the deliberateness of the bias, because while the second type of bias source is unintentional and subconscious, the third one is intentional and self-serving. Looking at the four reference models of transparency, it can be observed that bias has to do both with information quality and with information acceptance, which is a step in transparency achievement. The following algorithm (Algorithm 5) captures bias which arises from transparency. Please note that in the second and third type of bias source, the information does not reach the actionable stage because it is not accepted by the information receiver.

```
foreach ie_i ∈ InformationElement do
    Open(ie_i.Infolet);
    if (ie_i.FreeOfError.Checked =
     False) or (ie_i.Completeness.Checked =
     False) or (ie_i.Objectivity.Checked = False) then
        Print("Information might lead to bias with source type 1!");
        ProduceWarning(Informational_Bias);
    end
    if (ie_i.InformationUnderstandability.Checked =
     True) and (ie_i.InformationAcceptanc.Checked =
     False) and (ie_i.Belivability.Checked = False) then
        Print("Information not accepted, probably because of bias source
          type 2 or 3!");
        ProduceWarning(Information_Rejection_Because_of_Bias);
    end
end
```

Algorithm 5: Transparency leading to bias, and bias leading to rejection of information

4.2.6 Information Asymmetry

Information asymmetry refers to the condition in which one party has access to information while another party does not. One way to cause information asymmetry is for information providers to restrain information (or part of it) from information receivers. Information asymmetry can also happen when different information receivers have different amounts of information received by them. Information asymmetry has been shown to have an adverse effect on information consumers (Aboody and Lev 2000, Blomqvist 1991). The following algorithm (Algorithm 6) captures information asymmetry which causes failed or incomplete transparency.

Example: An insurance company may talk hours about the benefits of a new service, while deliberately refraining from discussing its long-term costs or limitations. Also, when different people watch different news networks or read different newspapers, the information they obtain will vary from one another. Both are examples of information asymmetry.

```
foreach ie_i ∈ InformationElement do
    Open(ie_i.Infolet);
    if (ie_i.Completeness.Checked = False) then
        Print("Information asymmetry will happen as a result of
         incomplete information.");
        ProduceError(Information_Asymmetry);
    end
end
foreach s_i ∈ Stakeholder do
    Open(s_i.Sitreq);
    foreach s_j ∈ Stakeholder do
        Open(s_i.Sitreq);
        if (s_i.InformationMedium) ≠ s_j.InformationMedium) then
            Print("Information asymmetry might happen as a result of
             possible different exposure to information.");
            ProduceWarning(Information_Asymmetry);
        end
    end
end
```

Algorithm 6: Information assymetry leading to failed or incomplete transparency

4.2.7 Unidirectional and Bidirectional Transparency

Unidirectional transparency, also called static transparency, occurs when information flows exist only from the information provider to the information receiver, with no information flow back to the information provider from the information receiver in the form of comments, corrections, suggestions, etc. (Hultman and Axelsson 2007, Vaccaro and Madsen 2009b). Bidirectional transparency, also called dynamic transparency, occurs when information flow exists in both directions from and to the information provider and information receiver (Hultman and Axelsson 2007, Vaccaro and Madsen 2009b). As discussed earlier, unidirectional transparency, e.g., in the form of computer-mediated transparency, has the potential to threaten trust (Meijer 2009). TranspLan can spot unidirectional transparency and therefore, makes requirements engineers aware of its existence. The following algorithm (Algorithm 7) captures unidirectional transparency occurrences in an information exchange system.

Example: A university lecturer marks their students' assignments and provides comments on their assignments to them. However, he does not get any feedback on their marking and comments from the students. Consequently, the lecturer might think that everything is satisfactory and he does not deem it as necessary to modify their marking process or the depth and breadth of their comments.

```
foreach s_k.iex_i ∈ InformationExchange do
    TestVariable = 0;
    foreach s_l.iex_j ∈ InformationExchange do
        if (s_k ∈ iex_i.PS and s_l ∈ iex_i.RS and s_l ∈ iex_j.PS and s_k ∈
          iex_j.RS) then
            TestVariable = 1;
        end
    end
    if (TestVariable = 0) then
        Print("There is a unidirectional transparency between s_k and sl.");
        ProduceWarning(Unidirectional_Transparency);
    end
end
```

Algorithm 7: Spotting unidirectional and bidirectional transparency amongst stakeholders

4.2.8 Social, Target, and Organisational Transparency

The literature on transparency discusses three types of transparency, as follows (do Prado Leite and Cappelli 2010):

- Social transparency, which aims at the general public
- Target transparency, which aims at the consumers of a certain service or product
- Organisational transparency, which aims at an organisation's stakeholders

TranspLan can capture the first two types of transparency, based on the structure of its information exchanges. Organisational transparency, on the other hand, can only be captured through TranspLan if an information exchange system is modelled for each and every one of its stakeholders, but there is no algorithmic analysis which can capture that in TranspLan. The following algorithm (Algorithm 8) captures social and target transparency occurrences in an information exchange system.

Example: A charity organisation publishes their annual tax review and their total sales income on the website of the organisation for the general public in order to achieve social transparency. The same organisation also provides a portal for their gift aid donors and regular registered donors to track how their monetary and commodity donations have been spent on the cause of the charity, therefore attempting to achieve target transparency. Assuming that the charity organisation puts enough information for all its stakeholders on its website, organisational transparency is also achieved.

```
foreach iex_i ∈ InformationExchange do
    if iex_i.s_j = Public then
        Print("Social transparency has been spotted in iex_i.");
        Continue;
    end
    else
        Print("Target transparency has been spotted in iex_i.");
    end
end
```

Algorithm 8: Spotting social and target transparency in the business information system

4.2.9 Opaque and Clear Transparency

In another categorisation of transparency, two faces of transparency are discussed (Fox 2007). One is opaque transparency, which is providing information which is not clearly understandable, and the other is clear transparency, its opposite. TranspLan can capture these two types of transparency as well, thanks to its fine-grained information quality dimensions and Transparency Achievement Spectrum. The following algorithm (Algorithm 9) captures opaque and clear transparency in an information exchange system.

Example: A tour agency provides a travel brochure for its customers, which specifies travel destinations, accommodation opportunities, prices, and so on. However, the travel brochure is not clear in terms of its service fees and commissions which may vary based on the number of passengers, the chosen destination, and the selected travel type. Such opaque transparency may actually hinder potential customers from further investigation and from choosing the mentioned travel agency as their service provider.

```
foreach iex_i ∈ InformationExchange do
    Open(ie_i.Infolet);
    if ie_i.understandability.Checked =
     False or ie_i.InformationUnderstandability.Checked = Flase then
        Print("The provided transparency is opaque transparency in ie_i.");
        ProduceError(Opaque_Transparency);
    end
    else
        Print("The provided transparency is clear transparency in ie_i.");
    end
end
```

Algorithm 9: Identifying clear and opaque transparency in information elements

4.3 Summary

In this chapter, TranspLan, a domain-specific language for the modelling and analysis of transparency, was proposed. TranspLan is based on the four reference models of transparency which were proposed in the previous chapter. It uses a graphical language and provides several benefits for transparency engineering, including automated reasoning. Several reasoning algorithms were proposed for TranspLan, which can be automated for use in a business information system. In the next chapter, .a method for the elicitation, evaluation, and adaptation of transparency requirements will be proposed which utilises three concepts of crowdsourcing, structured feedback acquisition, and social adaptation for the engineering of transparency requirements.

Chapter 5

A Novel Approach to Engineering Transparency Requirements in Business Information Systems

"Nothing is particularly hard
if you divide it into small jobs."

Henry Ford

5 A Novel Approach to Engineering Transparency Requirements in Business Information Systems

In the previous chapter, a language for the modelling and analysis of transparency requirements in a business information system was proposed. This language can be used as a tool for the elicitation, clarification, and even evolution of transparency requirements. However, the utilisation of the language by itself is not enough to perform these requirements engineering actions. For example, the language itself does not specify how requirements should be elicited, which stakeholders should be involved, and how conflicting transparency requirements should be managed.

The current requirements engineering methods might be able to capture transparency requirements of stakeholders, but they are not tailored to do so, and therefore, they fall short of addressing some of the peculiarities and nuances related to the engineering of transparency requirements. For example, the transparency modelling language specifies several aspects of transparency with regards to the information quality dimensions. However, it can be argued that not all these dimensions can be simultaneously acquired from the stakeholders, as they may not be even aware of some of them. Similarly, when transparency fails to be achieved, current methods may fail in addressing what exactly causes such failure. Therefore, a new approach is needed to consider these peculiarities and address them accordingly.

Two of the main activities in requirements engineering are requirements elicitation and requirements evolution. With regards to elicitation, eliciting transparency requirements can be a difficult task, as information related to transparency may be intermixed with general information requests which are not related to transparency. Furthermore, the difficulty increases as it should be made clear what information to reveal, how this disclosure of information should be regulated considering other information-related non-functional requirements, such as privacy requirements, and to whom such information should be revealed, amongst other concerns related to transparency. For example, not every request of information from a website should be replied to by posting the requested information publicly on the website, because it can lead to information overload, information misuse, breaches of security, etc.

Another issue regarding the engineering of transparency requirements is their evolution over time. Initially, transparency requirements can be elicited in the early stages of software development, to be embedded in the system-to-be. However, transparency requirements may change over time, e.g., as certain pieces of information may no longer be needed to be transparent because they are well-known by the stakeholders. Consequently, business information systems should be able to adapt to

such changes. Let us assume that, in a Human Resources (HR) website, a pop-up window opens up when they ask the employee for a certain piece of information, explaining (and therefore being transparent) why that piece of information is needed by the HR and how it can help them in their decision-making process. Some employees, however, may be uninterested to know the rationale behind such information requests (which may cause information overload for them), while others, once they have read the information, may never want to read the same explanation again with every HR request for the same piece of information (which may cause unnecessary transparency).

Stakeholders in a business information system can also have different roles within their business environment. However, transparency requirements often vary not only at the role level but also at the individual level. Therefore, it is inevitable that more stakeholders should be actively engaged (e.g., through the utilisation of crowdsourcing) during the elicitation process for the discovery of their heterogeneous requirements, and their voices should also be heard for the evolution of the business information system.

In this chapter, the use of crowdsourcing (Hosseini et al. 2014a, Hosseini et al. 2015c), structured feedback acquisition (Sherief et al. 2015), and social adaptation (Ali et al. 2012) is proposed for the purpose of the elicitation and evolution of transparency requirements of stakeholders in a business information system. Crowdsourcing facilitates an approach to engage a wide set of stakeholders during these two phases of software development. Structured feedback assists the understandability and analysability of the acquired feedback in a crowdsourcing platform. Social adaptation aids the evolution of the business information system by considering users' feedback as the main driving force in planning and leading adaptation. Then, a novel approach is proposed for the engineering of transparency requirements in a business information system. The approach covers the whole life cycle of transparency requirements, from elicitation to evolution.

The rest of the chapter is structured as follows. In Section 5.1, three concepts of crowdsourcing, structured feedback, and social adaptation are briefly introduced and it is explained why these concepts can be utilised for a more effective engineering of transparency requirements. In Section 5.2, the feasibility of utilising these three concepts in the engineering of transparency requirements is elaborated. In Section 5.3, it is discussed how crowdsourcing can be utilised in transparency engineering. In Section 5.4, it is explained how structured feedback can help the process of transparency engineering. In Section 5.5, it is illustrated how transparency engineering can benefit from social adaptation techniques. In Section 5.6, the approach to the engineering of transparency requirements is proposed. In Section 5.7, the challenges of applying these three concepts in the engineering of transparency requirements are discussed. The chapter is concluded in Section 5.8.

5.1 A Brief Introduction to Crowdsourcing, Structured Feedback and Social Adaptation

Crowdsourcing is commonly defined as harnessing the collective power of a usually large, diverse group of people through an open call (Hosseini et al. 2014a). A thorough literature review on the topic of crowdsourcing reveals that crowdsourcing has four main constituents, i.e., the crowd, the crowdsourcer, the crowdsourced task, and the crowdsourcing platform (Hosseini et al. 2015d). Each constituent of crowdsourcing has features and characteristics which can be considered in an engineering method involving crowdsourcing.

Crowdsourcing potentials have been investigated in general requirements engineering activities. For instance, the effects of several crowdsourcing features (Hosseini et al. 2014b, Hosseini et al. 2015d) have been studied in requirements elicitation (Hosseini et al. 2014a), and a crowd-centric requirements engineering method has been proposed which leads to requirements with higher quality and increased user satisfaction (Snijders et al. 2014).

The use of crowdsourcing in enhancing transparency has been already investigated, and is advocated to be important in examining through the information which is provided by official disclosures, hacks, and mashups (Brito 2008). In accordance with this, crowdsourcing can be utilised in the engineering of transparency requirements in the same fashion. This is because transparency requirements are mostly at the individual level, and involving a larger number of stakeholders ensures more transparency requirements are elicited. Furthermore, crowdsourcing can be seen as one solution to ensure bidirectional or dynamic transparency (Hultman and Axelsson 2007, Vaccaro and Madsen 2009b), in which transparency recipients also participate in the transparency requirements specification and prioritisation by interacting with transparency providers by means of social platform activities, such as commenting, liking, etc. (DiStaso and Bortree 2012).

Structured feedback is the type of feedback which is provided in a form which makes it easier to aggregate, process, analyse, and evaluate. Structured feedback allows requirements engineers to avoid inappropriate or irrelevant feedback that is sometimes provided in open-text feedback forms, and also helps feedback providers to focus on those aspects of feedback which are useful, relevant, and appropriate for the software system to be collected. It can be presented to feedback providers in the form of tick boxes, radio buttons, drop-down menus, item lists, multiple-choice options, etc.

Structured feedback has been investigated in crowdsourcing activities as a method of managing the large quantities of acquired feedback from the crowd. For example, the use of structured feedback in crowdsourcing activities has been explored (Xu et al. 2014) and several categories for structuring user feedback in crowd-based requirements engineering have been proposed (Sherief et al. 2015).

In accordance with this, structured feedback can be used to elicit and refine users' transparency requirements. This is further facilitated by the fine-grained attributes of transparency which are reflected in its four reference models. Nonetheless, it should be noticed that open-text feedback is still necessary to capture the feelings and thoughts of users about their transparency requirements.

Social adaptation advocates that users' feedback should be regarded as the main driving force in planning and helping software system adaptation (Ali et al. 2012), in contrast to self-adaptation, which attempts to adapt the software system by autonomously monitoring and reacting to changes in the environment. Consequently, social adaptation is considered as a means of facilitating software system evolution by responding to the collective judgement of users.

Repetitive elicitation and analysis of social feedback is essential to keep the software system updated (Ali et al. 2012). This is because of the dynamic nature of users' trends and experience, contexts of use, and the improving technology, which makes traditional one-step software system designs partly ineffective. Therefore, embedding social adaptation in a method requires that method to be able to incorporate an iterative feedback acquisition process.

Social adaptation is an appropriate choice to be considered for the engineering of transparency requirements because these requirements are often volatile. For example, they often change over time, and different stakeholders may require different levels of details with regards to information, or they may need various representations for the same information to help them in their understanding of the information. Furthermore, the transparency requirements of stakeholders may change when their other requirements change. For example, it is shown that as users' level of trust in an organisation increases, their transparency requirements from that organisation may decrease (Menéndez-Viso 2009). To this end, the power of social adaptation, through crowdsourcing and structured feedback acquisition, can be utilised to adapt and evolve the business information system to meet the transparency requirements of its stakeholders.

5.2 Crowdsourcing, Structured Feedback Acquisition, and Social Adaptation in the Engineering of Transparency Requirements

In this section, the potentials of introducing three concepts of crowdsourcing, structured feedback acquisition, and social adaptation are investigated in engineering the transparency requirements of stakeholders in a business information system. The aim of this section is to determine whether the engineering of transparency requirements is going to benefit from applying these concepts.

5.2.1 Crowdsourcing

Crowdsourcing problems have been classified into five categories of 1) opinion-based problems, 2) basic problems, 3) complex problems, 4) competition-type problems, and 5) collaborative fundraising problems (Hosseini et al. 2015e). Based on the specifications provided for each crowdsourcing problem type, it can be argued that the utilisation of crowdsourcing for transparency requirements elicitation can be categorised as and is most similar to "opinion-based problems". In this problem type, there are no right or wrong answers, no expertise is required in general, and the crowd (i.e., information receivers) simply perform the crowdsourced task (i.e., stating their transparency requirements by providing feedback) to crowdsourcers (i.e., requirements engineers) in a crowdsourcing platform (i.e., the feedback platform). To address this problem type properly, a set of crowd, crowdsourcer, and crowdsourcing platform features should be selected (Hosseini et al. 2015e). The recommended features for crowdsourcing such tasks can be found in Table 5.1.

Table 5.1: List of recommended features for crowdsourcing opinion-based tasks, such as the engineering of transparency requirements

Crowdsourcing Features for Opinion-Based Tasks	
Crowd Features	*Diversity*
	Largeness
	Motivation
Crowdsourcer Features	*Financial Incentives*
	Social Incentives
	Entertainment Incentives
	Open Call
	Privacy Provision
	Feedback Provision
Crowdsourcing Platform Features	*Task Broadcast*
	Authentication
	Payment Mechanism
	Quality Threshold
	Quantity Threshold
	Platform Misuse Management
	Ease of Use
	Attraction
	Feedback Loops

Feature selection in crowdsourcing activities should be performed cautiously to avoid unwanted feature interactions that may cause problems, e.g., one crowdsourcing feature hindering or excluding the functionality or existence of another crowdsourcing feature. To investigate this, the crowdsourcing feature interaction models were used, which detected no potential conflicts amongst the features, as the selected features support each other or co-exist with each other (Hosseini et al. 2015f). The feature interactions between the features listed in Table 5.1 are illustrated in Figure 5.1.

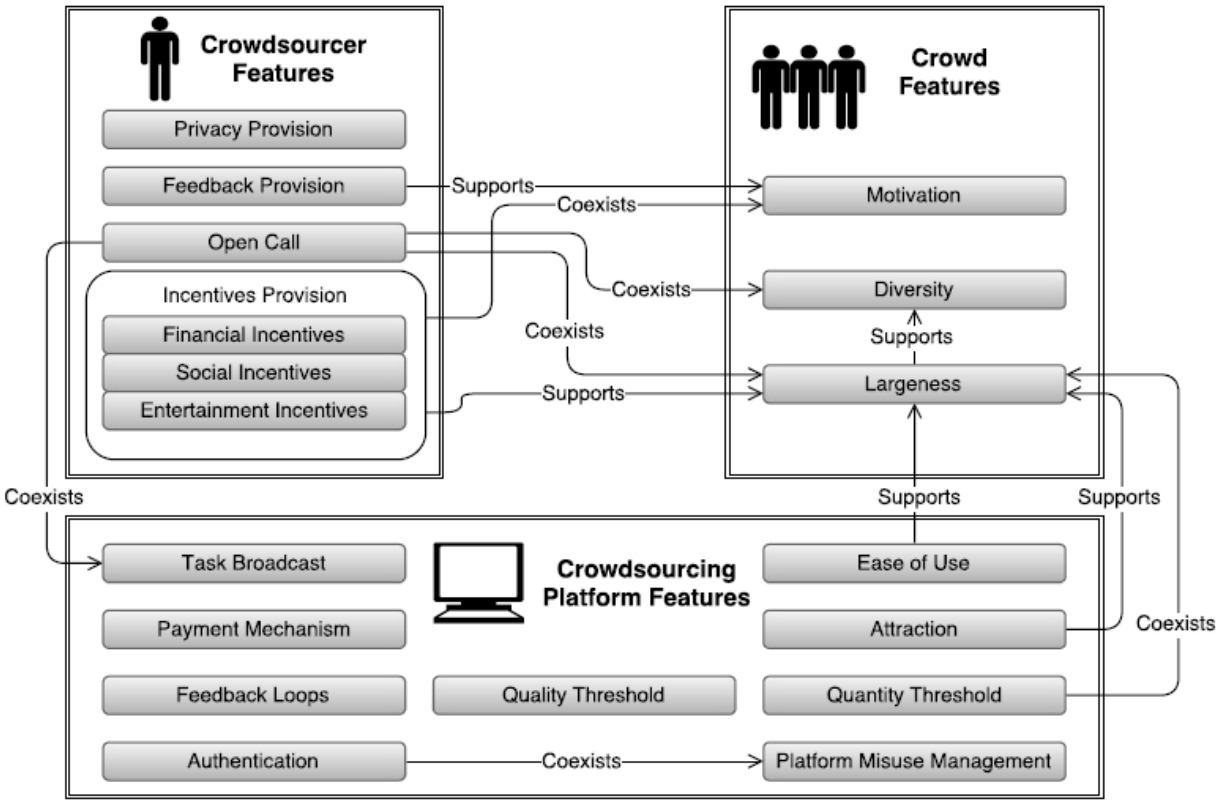


Figure 5.1: Crowdsourcing feature interactions for the engineering of transparency requirements

Moreover, some of the features could potentially affect the quality of the obtained information via feedback, or could affect the performance of the engaged crowd. Some effects of the application of crowdsourcing on requirements elicitation has been already discussed (Hosseini et al. 2015c), illustrating that crowdsourcing can have a positive effect on several information quality dimensions (Kahn et al. 2002), such as increasing accuracy and relevance, while it also introduces benefits and challenges to other requirements elicitation activities, as illustrated in Figure 5.2.

5.2.2 Structured Feedback

Given the several facets that transparency has, i.e., transparency stakeholders, transparency usefulness, transparency meaningfulness, and information quality in transparency, it becomes an arduous task for requirements engineers to analyse users' feedback in order to find whether users' transparency requirements have been properly met. This is because there are several facets of transparency which may be involved in the success or failure of transparency provision, and extracting or deducing them from users' feedback can be time-consuming. Any simplistic approach toward feedback on transparency, such as asking users whether the provided information meets their transparency requirements, is also destined for failure, as the answer will not highlight where and how the requirement expectation has failed (or succeeded).

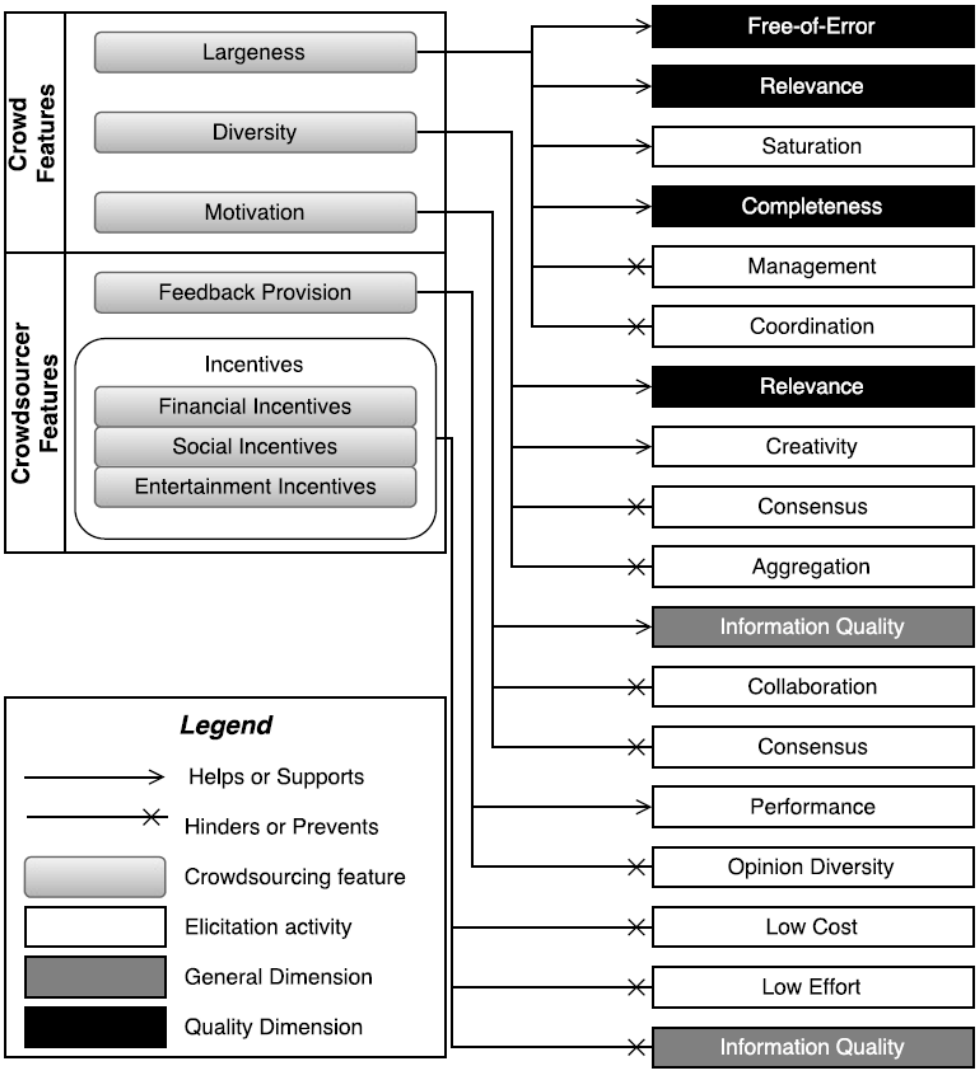


Figure 5.2: Quality measures related to crowdsourcing features in the engineering of transparency requirements

Since transparency facets are fine-grained, structured feedback can be useful during the engineering of transparency requirements as a means of obtaining users' transparency requirements. Structured feedback has been shown to provide more analysable results in a shorter time and with fewer misinterpretations (Sherief et al. 2015). Furthermore, structured feedback can be utilised to identify the exact loci where transparency requirements have failed (or succeeded).

5.2.3 Social Adaptation

As stated earlier, because transparency requirements may change over time, the business information system has to evolve in order to adapt itself to new transparency requirements of its stakeholders. The power of the stakeholders can be harnessed through social adaptation to inform the system of such new requirements, and to decide, through argumentation and negotiation of the stakeholders, which alternative is the best for meeting these new requirements (Ali et al. 2012). Such alternatives may include, amongst others:

- Alternatives in the time of providing transparency
- Alternatives in the level of details for providing transparency
- Alternatives in the representation method of information
- Alternatives in the source of information

Giving the stakeholders the ability to participate and determine the alternatives which the business information system should choose through social adaptation has several positive side-effects as well, e.g., increasing trust, legitimacy, fairness, and accountability (Deverka et al. 2012).

5.3 Applying Crowdsourcing in the Engineering of Transparency Requirements

In this section, it will be reviewed how crowdsourcing can facilitate the engineering of transparency requirements through the four reference models proposed for transparency.

5.3.1 Crowdsourcing and Transparency Actors Wheel

The identified actors in Transparency Actors Wheel can be mapped to different pillars of crowdsourcing (Hosseini et al. 2014b), as follows:

- Information providers can be mapped to crowdsourcers. Information providers may be individuals, organisations, and governmental institutions which aim to be transparent, possibly as a regulatory requirement, by disclosing the alleged information about their stored data, their activities, and their policies to other individuals, organisations, and governmental institutions.
- Information receivers can be mapped to crowd members. They may be the individuals, organisations, and governmental institutions which receive or request information and need transparency.
- Information medium can be mapped to the crowdsourcing platform. This can be the website or platform where the information requests are managed, and information is made available for access by those who need it.
- The act of information provision can be mapped to the crowdsourced task.

Crowdsourcing has the potential to identify the relevant stakeholders, e.g., through tools such as StakeRare (Lim and Finkelstein 2012) and StakeSource (Lim et al. 2010). Moreover, it has the potential to identify the relevant media as well. Thus, it can be utilised in Transparency Actors Wheel for the following, as summarised in Figure 5.3:

- Identification of information providers: The crowd can identify whether the information is provided by the right information provider, and whether there are alternative sources where

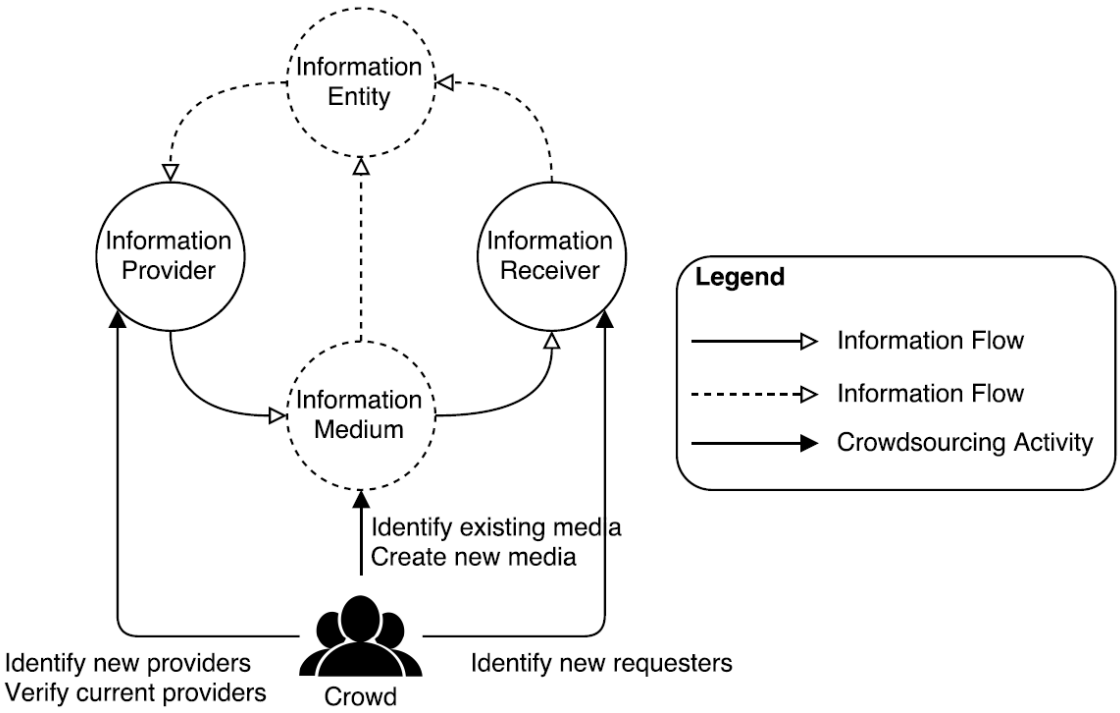


Figure 5.3: Crowdsourcing and Transparency Actors Wheel

information can be obtained from. The latter, for example, has been acknowledged in Section 2(21)1 of the UK Freedom of Information Act as a way to make information exempt from provision by public authorities (FOIA 2000).

- Identification and creation of information mediums: The crowd can identify different information mediums through which information is channelled. This can lead to more information availability, which facilitates the first step towards useful transparency. They can also propagate information in new information mediums, e.g., social media and personal blogs, and help increase availability and accessibility of information to other information receivers.
- Identification of other information receivers: The crowd can identify other stakeholders who need access to the same information, thus spreading transparency to other stakeholders.

5.3.2 Crowdsourcing and Transparency Depth Pyramid

Crowdsourcing can help information providers to provide and information receivers to reach the level of transparency meaningfulness that they need. This is especially important if the level of transparency meaningfulness specified by information providers does not initially match the level required by information receivers.

For example, members of the parliament in several countries publish their expenditure on designated websites for the people and media to know and investigate (data transparency). The information, however, is usually in the form of large, read-only spread sheets (or similar) which is

generally difficult to comprehend for the general public. Furthermore, the information may not show how the expenditure was done in term of who approved of it, where it was spent, etc. (process transparency), and also may not reveal why the expenditure was necessary and what results it achieved (policy transparency). Even when all the information is provided, it might be all together and not separated categorically, leading to information overload in some stakeholders and consequently, failure in transparency provision.

Crowdsourcing can help transparency meaningfulness in two ways. First, crowd members can annotate the information provided by information providers and identify information pieces as data, process or policy information. As different people may annotate information differently, a simple majority role can be applied for the final visible annotation to other stakeholders. Second, crowd members can notify information providers when any part of data, process, or policy is missing, therefore enriching the information as well. The notification is facilitated by crowd members requesting more transparency on a particular piece of information and when no other crowd member can find the requested piece of information for their peers, as illustrated in Figure 5.4.

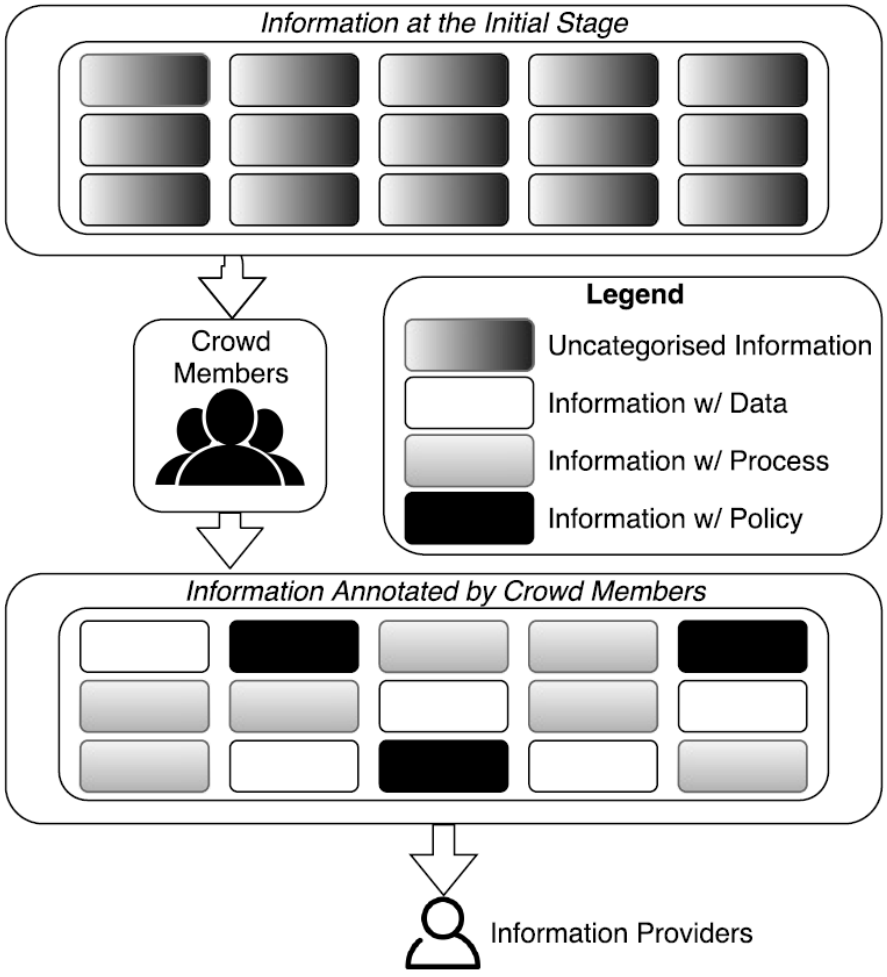


Figure 5.4: Crowdsourcing and Transparency Depth Pyramid

5.3.3 Crowdsourcing and Transparency Achievement Spectrum

According to Transparency Achievement Spectrum, seven steps should be taken in order to achieve useful transparency. Crowdsourcing can be utilised in each step in order to achieve the final step, where transparency helps the crowd members to make informed decisions and act upon the information. Regarding each step, crowdsourcing can be utilised in the following ways:

- Information availability: The crowd can help information providers in identifying loci where the requested information is not available, e.g., by spotting places in a document where part (or all) of the information is missing. The crowd can also disseminate information through different media, such as the social media, to help it reach a wider set of stakeholders.
- Information interpretation: The crowd can interpret information to forms understandable to other crowd members with different understanding capabilities (e.g., by interpreting information for people with disabilities), can help interpret formal interpreters (e.g., by helping news agencies in their understanding of the regional contexts where an event has happened and a news piece is being produced), and can compare interpretations with each other to identify possible discrepancies of the actual information (e.g., by comparing two pieces of news and their interpretations on two different news agency websites).
- Information accessibility: The crowd can identify issues in the ease of access to information, e.g., when too many clicks are needed to access the information or when information is presented in a now obsolete electronic format. Similar to information availability, the crowd can also make the information more easily accessible by sharing it on new media.
- Information perception: The crowd can share their perception of the received information, and thus help information providers to better understand how their information, in its current representation and format, is perceived by information receivers, and whether the perceived information matches the intended perception they want information receivers to hold. Such mismatch can also drive the information providers to elicit information receivers' expectations through their feedback and represent information in a way that minimises the perception gap (Tesch et al. 2005).
- Information understandability: The crowd can help raise the understandability of the information by highlighting places where information has ambiguities, discrepancies, etc. As different stakeholders have different understanding capabilities, a larger crowd can spot more understandability problems than a smaller crowd. For example, the crowd can restate their understanding of the provided information, preferably through the use of controlled vocabulary when possible, to compare and contrast them with other people's understanding of the same piece of information, effectively pinpointing the places of ambiguity.

- Information acceptance: The crowd can contribute their reasons leading to acceptance, and perhaps more importantly, refusal of the provided information. Knowing the underlying reasons why information is accepted or refused by its intended stakeholders is a crucial factor for information providers in transparency provision. For example, if a news agency understands the reasons behind refusing to acknowledge their news article is the lack of reputation of their source of news, they will replace their news source with a more reputable one. Since information acceptance depends on data such as people's experience and expertise and on the context where information is being provided (Watts 2015), eliciting these data would also enrich information providers' understanding of why information is accepted or refused by the stakeholders.
- Information actionability: The crowd can explain how the information helped them in their decision-making processes, facilitated embarking on an action, or changed their views and perspectives on a given topic to which the information is related. The statement of such reasons helps other information receivers in their decision-making processes, and also helps information providers to understand the application of their transparency, facilitating future information provision as well. For example, when a bank knows that its customers used the new information about reductions in interest to transfer their money from their bank to other banks, their will take measures to reduce the effects on future transparency provision, while it helps other customers to probably take similar decisions as well.

A summary of different steps in Transparency Achievement Spectrum and the relevant crowdsourcing activity can be found in Table 5.2.

Table 5.2: Crowdsourcing and Transparency Achievement Spectrum

Transparency Achievement Spectrum	Crowdsourcing Activity
Information Availability	Spotting unavailable and non-existent information and sharing information
Information Interpretation	Creating, comparing, and aiding in information interpretations
Information Accessibility	Spotting difficulties in information access and sharing information
Information perception	Perception sharing and comparison and feedback on expectations
Information Understandability	Spotting ambiguities and differences in understanding information
Information Acceptance	Sharing reasons of information acceptance and refusal
Information Actionability	Sharing how and why information was (not) useful and actionable

5.3.4 Crowdsourcing and Information Quality in Transparency

Information quality is divided into four groups (Kahn et al. 2002) and crowdsourcing plays different roles in each of these categories:

- Product quality dimensions conforming to specifications: These quality dimensions are *free-of-error*, *concise representation*, *completeness*, and *consistent representation*. Information providers can independently guarantee these quality dimensions. However, the crowd can help find inconsistencies and imprecisions in the provided information with relation to these quality dimensions.
- Service quality dimensions conforming to specification: These quality dimensions are *timeliness* and *security*. These quality dimensions can also be guaranteed independent of the involvement of the crowd. The crowd can be utilised in this category to identify problems and notify information providers.
- Product quality dimensions meeting or exceeding consumer expectations: These quality dimensions are *appropriate amount*, *relevancy*, *understandability*, *interpretability*, and *objectivity*. These quality dimensions cannot be independently decided by information providers and the involvement of the crowd is crucial to guarantee whether these qualities have been met.
- Service quality dimensions meeting and exceeding consumer expectations: These quality dimensions are *believability*, *accessibility*, *ease of manipulation*, *reputation*, and *value-added*. Similar to the previous category, these quality dimensions need crowd involvement as only information receivers can identify the meeting or exceeding of their expectations on these quality dimensions.

A summary of different information quality dimensions and the relevant crowdsourcing activity can be found in Table 5.3.

Table 5.3: Crowdsourcing and information quality in transparency

Information Quality Dimension	Crowdsourcing Activity
Product Quality – Conforming to Specifications	Finding inconsistencies and imprecisions and reporting to information providers
Service Quality – Conforming to Specifications	Finding problems with service provisions and reporting them to information providers
Product Quality – Meeting or Exceeding Consumer Expectations	Ensuring quality dimensions are met by actively engaging with information providers
Service Quality – Meeting or Exceeding Consumer Expectations	Ensuring quality dimensions are met by actively engaging with information providers

5.4 Applying Structured Feedback in the Engineering of Transparency Requirements

User feedback and its structure have been discussed in crowd-based requirements engineering (Sherief et al. 2015). Structured feedback can be a useful tool in the elicitation and analysis of the crowd members' transparency requirements. Structured feedback can be obtained in a way that pinpoints the exact locus of transparency success or failure. The locus can be related to any of the reference models in transparency which relates to information, as follows:

- Structured feedback for transparency meaningfulness: The feedback can consist of the level of transparency required (data, process or policy) and the level of transparency obtained, therefore highlighting incompatibilities.
- Structured feedback for transparency usefulness: The feedback can consist of the last step of transparency usefulness reached, and why the higher step has failed to be achieved.
- Structured feedback for information quality in transparency: The feedback can consist of tick boxes for all quality dimensions achieved.

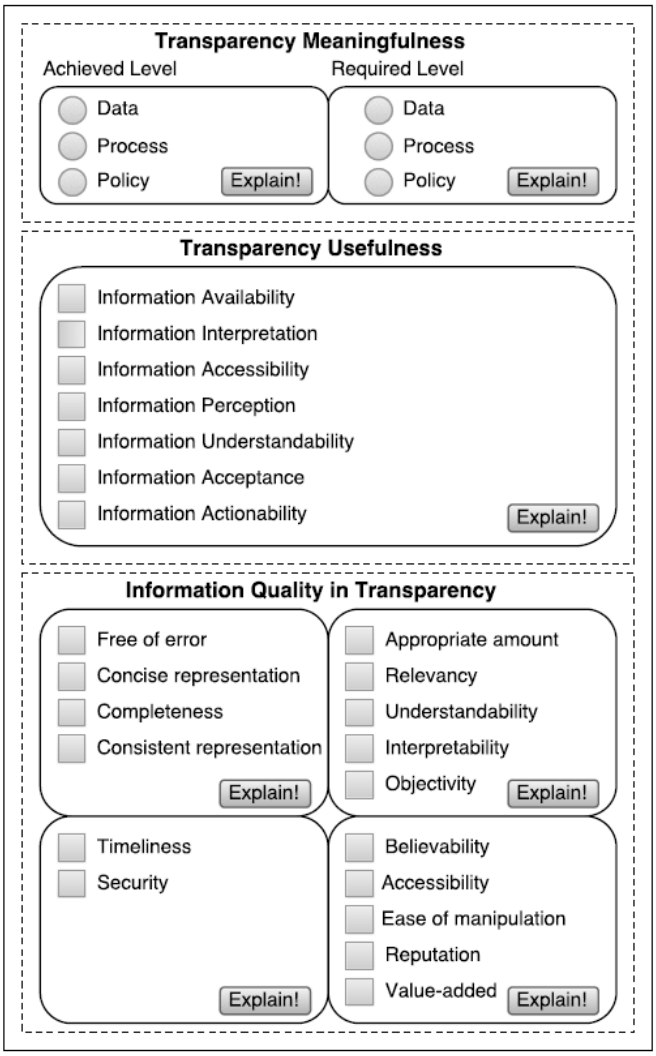


Figure 5.5: A guideline for feedback elements and their structure for the engineering of transparency requirements

A requirements engineer's guideline for the design of such structured feedback elements with regards to transparency requirements is specified in Figure 5.5. It should be noted that the guideline is by no means the final design of the feedback acquisition form, as it is not written in a crowd-friendly language. The guideline is only meant to highlight the structure of the feedback and illustrate the convenience of such a design because of the well-formulated facets of transparency. The final design should be presented in a way that matches stakeholders' everyday language capabilities. For example, asking for "believability" might be phrased as "Do you believe in this piece of information?", and asking for "information actionability" might be phrased as "Does this information help you to perform an action which otherwise you could not perform or make an informed decision which otherwise you would not make?"

Furthermore, structured feedback can be used for stakeholders' identification and medium discovery. Here, the feedback can consist of stakeholders' names and their roles in providing or receiving the information, and names of the media and links to them where the required information is channelled.

The use of structured feedback helps to pinpoint those transparency facets which have not been fulfilled, and every facet needs to be dealt with in a unique manner. For example, failure in providing transparency meaningfulness leads to new forms of information disclosure in which the process leading to the disclosure of information or the policy based on which information disclosure happens is also disclosed. On the other hand, failure in providing timely information does not lead to new forms of information disclosure, but to information disclosure that happens when a stakeholder needs that information.

Finally, it is advocated that the feedback platform should still facilitate the elicitation of users' transparency requirements through users' comments in a free-form format. This will help users to explain their choices, and add anything they find valuable for requirements engineers in their analysis. Devising methods to link extracted information from free-form comments to the existing constituents of transparency in the structured feedback will constitute future research.

5.5 Applying Social Adaptation in the Engineering of Transparency Requirements

Social adaptation proposes a continuous obtaining and analysis of social feedback to keep the software system adaptation in place (Ali et al. 2012). As a result, it is advocated that social adaptation can be utilised alongside crowdsourcing and structured feedback for a better management of transparency requirements. For this purpose, the MAPE loop (Jacob et al. 2004) is utilised along with the concept of social adaptation, as illustrated in Figure 5.6.

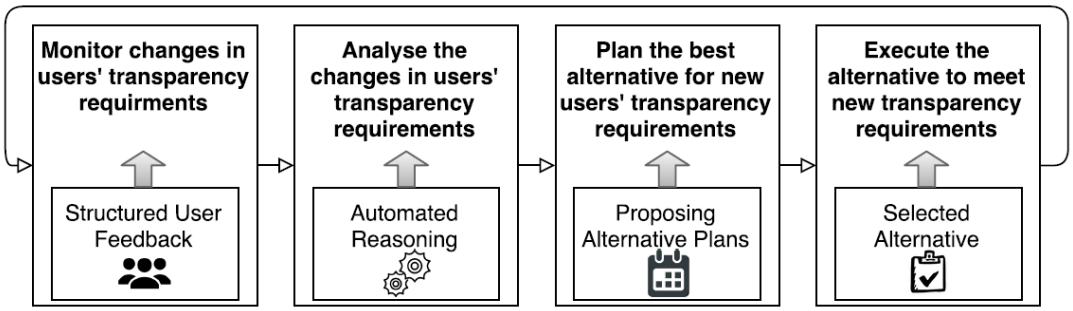


Figure 5.6: Social adaptation and MAPE loop in the engineering of transparency requirements

One of the main issues to be considered in transparency engineering is dealing with individualistic transparency requirements. As every individual has their own transparency requirements, it is ideally the case that the engineering of transparency requirements captures every individual's needs as stated in their feedback.

A possible solution, which is already in practice in production and industrial engineering, is mass customisation (Da Silveira et al. 2001). Mass customisation is "the ability to provide individually-designed products and services to every customer through high process flexibility and integration". Unlike industrial products, informational products are generally easier for mass customisation once a business information system has the stakeholder's transparency requirements through feedback. Amongst other things, the mass customisation of informational products should mainly deal with the answers to the following questions:

- What information to disclose and what information not to disclose, including the level of details
- When to disclose the information, i.e., adhering to timeliness
- Who to disclose the information to, i.e., knowing the relevant stakeholders
- How to disclose the information, i.e., the method of representation
- Where to disclose the information, i.e., the choice of the medium

Once these questions are answered, generating an informational report covering the necessary details, eliminating the unwanted bits, and presenting it to the relevant stakeholders will not be a difficult task and it will target the level of transparency that the stakeholder desires. That being said, the use of social adaptation and the MAPE loop should still be considered for every individual as well. Because while different stakeholders have different transparency requirements, the transparency requirements of one individual is also subject to change as the context changes or as the time passes.

5.5.1 Phase One: Monitoring

Stakeholders' transparency requirements change as time passes and as they are situated in different contexts, and their existing requirements become obsolete as they obtain the information they need, replaced by new transparency requirements (or by none, as once they obtain the information they need, they might not want to get the same information again). Monitoring these changes is the first step in ensuring that stakeholders' transparency requirements are appropriately met, and such monitoring requires constant feedback, preferably in a structured form, from each engaged stakeholder. The output of the monitoring phase will be a list of changes in a stakeholder's preferences.

The monitoring phase aims to utilise the power and wisdom of the crowd through structured feedback for social adaptation. It is denoted that for the wisdom of the crowd to work, four aspects of crowd diversity, independence amongst crowd members, decentralisation, and aggregation of the crowd knowledge must be considered (Surowiecki 2005). However, each of these aspects introduce their own benefits and challenges (Hosseini et al. 2015g) which must be addressed by requirements engineers in any requirements monitoring framework used in this phase.

There are frameworks for monitoring requirements in enterprise systems (Robinson 2005, Robinson 2006), which may also be used for monitoring transparency requirements. However, the involvement of the users through social adaptation means that users become monitors and their feedback can act as triggers for system behaviour changes. For transparency requirements, this change means changes in the volume of information, its representation, its disclosure time, etc.

5.5.2 Phase Two: Analysis

The analysis of transparency requirements should be performed individually for each stakeholder. When the obtained feedback is structured, the difficulties of such individual analysis are alleviated. Furthermore, the structured feedback facilitates the automated analysis of users' feedback, based on which several alternatives for adaptation can be proposed.

Automated reasoning should be utilised during the analysis phase. In order to perform automated reasoning (Ryan and Sennett 2012) on transparency requirements, the following two steps are needed:

- transparency requirements should be expressed in a formal language, and
- automated algorithmic manipulations should be applied on the formal language used for transparency requirements

There are several frameworks for automated requirements analysis, e.g., the goal-structured analysis framework (Duffy et al. 1995). However, there is a need for a domain-specific modelling language for transparency and its automated analysis. To this end, TranspLan was proposed as a domain-specific modelling language for transparency requirements in business information systems.

5.5.3 Phase Three: Planning

The third step in socially adapting the business information system to new transparency requirements of its users is planning the best alternative. Planning includes a careful consideration of the possible alternatives and selecting the one that satisfices users' transparency needs (Chung and do Prado Leite 2009).

The utilisation of recommender systems is advocated for finding the best alternative for meeting users' transparency requirements. The recommender system, however, should be designed considering that users' requirements and interests change over time, and it should understand users' needs at different stages (Konstan and Riedl 2012). Furthermore, it is advocated that user profiling should be considered when possible. User profiling will help the recommender system understand what users find interesting and uninteresting (Middleton et al. 2001, Middleton et al. 2004) in transparency, and the recommender system can use this data, along with users' feedback, to plan for the best alternative which meets users' new transparency requirements.

5.5.4 Phase Four: Execution

Execution for change should be done in a way that does not affect the current performance of the business information system. It should be noted that unlike privacy requirements which need to be constantly met, most transparency requirements are transient, meaning that once they are met, the stakeholders may no longer be interested in the same information. This does not remove their transparency requirements; it only shifts their transparency requirements towards new information based on the information and/or stakeholders' context of use.

5.6 The Conceptual Framework and the STREAM Method

Based on the concepts discussed above, an initial conceptual framework is presented for applying three concepts of crowdsourcing, structured feedback, and social adaptation in the engineering of transparency requirements. The framework is illustrated in Figure 5.7.

Based on the conceptual framework proposed above, a more detailed method of engineering transparency requirements in a business information system is proposed. Stakeholders' Transparency Requirements Elicitation and Analysis Method (*Stream*) is a novel approach in order to manage stakeholders' transparency requirements. The method utilises the bespoke Shield diagram and Sitreq and Infolet specifications in the TranspLan modelling language for transparency

requirements elicitation, analysis, and evaluation. This method relies heavily on feedback from stakeholders, because as stated, transparency requirements cannot be predefined and engineered without proper feedback from involved stakeholders. The Stream method is illustrated in Figure 5.8.

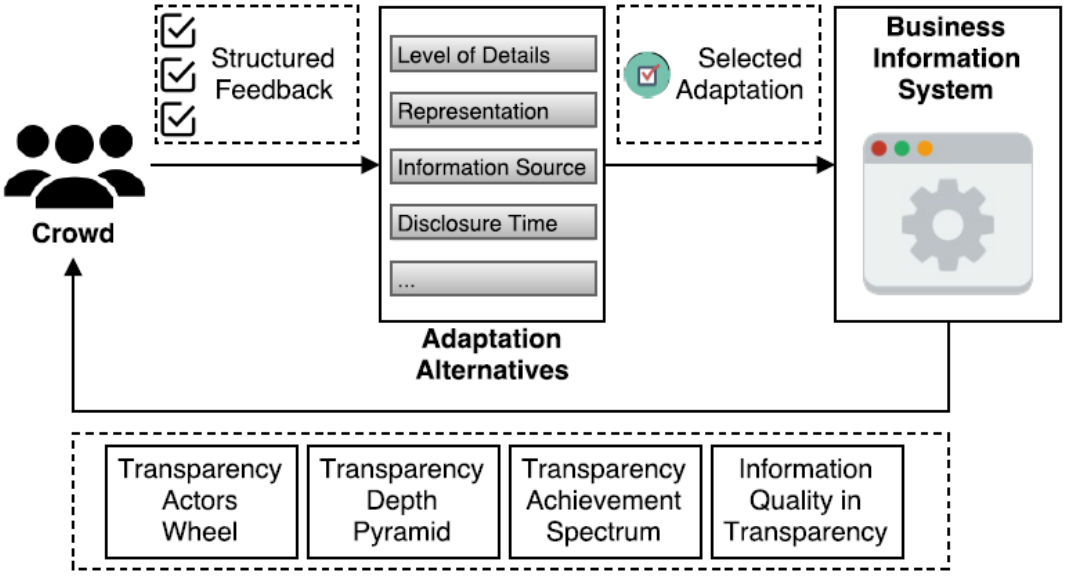


Figure 5.7: An overview of the conceptual framework for crowdsourcing transparency requirements through structured feedback and social adaptation

In the first phase of Stream method, transparency requirements are elicited from any formal specification for information exchanges within the business information system. Stakeholders may also be engaged during this phase to get their initial transparency requirements elicited. In the second phase, the transparency model is built, consisting of the Shield diagram and Sitreq and Infolet specifications. The third phase is the analysis of the transparency model. The diagram and specifications together can point out several gaps and inconsistencies in the transparency requirements. When all these issues are extracted, the fourth phase begins, where stakeholders are contacted in order to clarify all the gaps in transparency requirements. In the fifth phase, the transparency model is updated and re-analysed for further possible gaps and inconsistencies, and if any is found, the stakeholders are once again contacted for clarification purposes. The sixth phase starts when the transparency model is completed and all issues are resolved. In this phase, the transparency model is evaluated by stakeholders against their transparency requirements and feedback is provided to them. The feedback loop allows stakeholders to express their emergent transparency requirements so that the transparency model can be updated continuously.

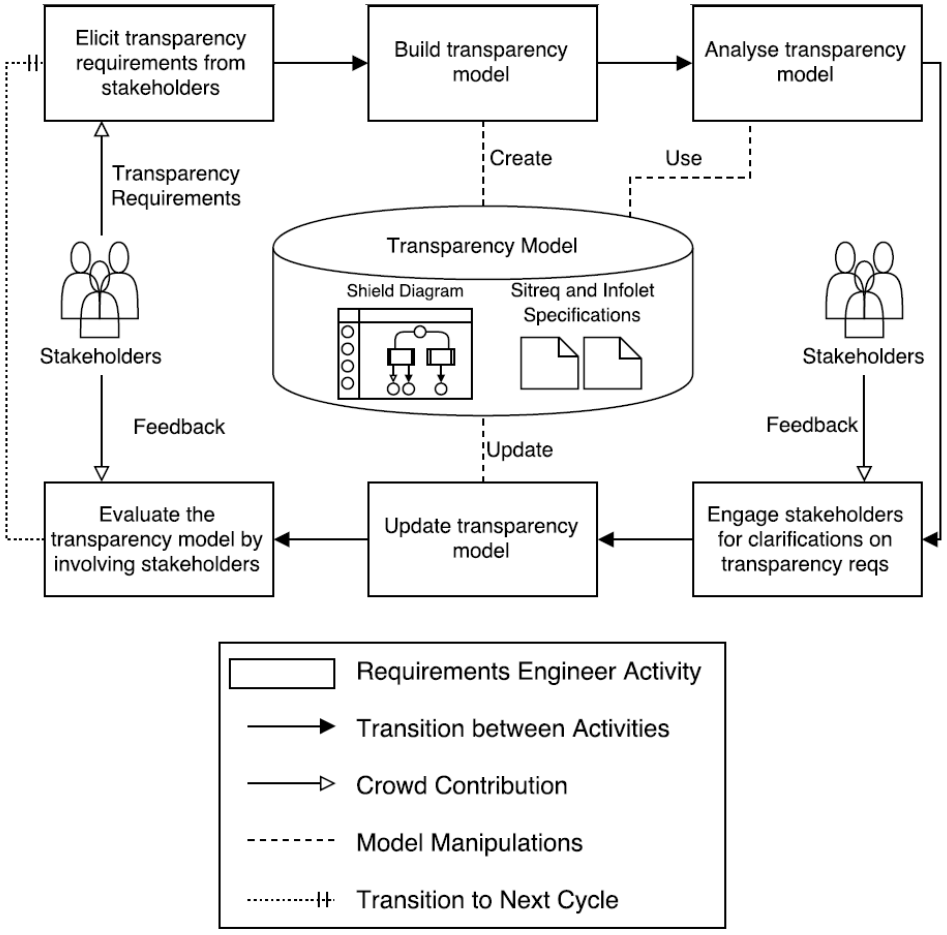


Figure 5.8: Stakeholders' Transparency Requirements Elicitation and Analysis Method (STREAM)

5.7 Challenges

Despite the several benefits that the utilisation of crowdsourcing, structured feedback, and social adaptation in the engineering of transparency requirements introduces, some challenges also arise as a consequence. In this section, these challenges are elaborated. Furthermore, possible solutions are proposed for these challenges where applicable.

5.7.1 Challenges Related to Crowdsourcing

While the integration of crowdsourcing principles in the engineering of transparency requirements brings about several benefits, it also introduces challenges that requirements engineers should consider. Apart from the general challenges of crowdsourcing, such as the recruitment and retention of the right crowd, aggregation of crowd's contributions, and quality assurance of crowd's contribution (Doan et al. 2011), there are challenges which are related specifically to the utilisation of crowdsourcing in the engineering of transparency requirements.

One challenge in crowdsourcing transparency requirements is the "transparency of transparency requirements". From a requirements engineering point of view, it means that crowd members may refrain from expressing their transparency requirements once they know their requirements can be

observed (and probably judged) by other crowd members, given that the involved crowd are usually bound by shared interests and work within certain boundaries, e.g., inside a business information system. For example, a university student may want to know how their objections to the marking process and their grades are handled by the university. They may, however, do not express their transparency requirement when they know their objection can also be viewed by their unit leaders. To remove this obstacle, requirements engineers may need to consider anonymising transparency requirements based on users' preferences. Anonymity, however, introduces its own challenges of reduced credibility and reliability of the crowd, and mechanisms are needed for assigning trust levels to crowd members along with the anonymisation of their transparency requirements (Backes et al. 2010). Therefore, maintaining the balance between anonymity and the transparency of transparency requirements can become a paradoxical challenge itself.

Another challenge in crowdsourcing transparency requirements is related to the management of argumentations and negotiations amongst several stakeholders. Since transparency requirements are individualistic, managing such a diverse set of requirements elicited from the large number of stakeholders brought together through crowdsourcing becomes a major problem when argumentation frameworks are utilised (Serrano and do Prado Leite 2011). In the same fashion, the prioritisation of such diverse, individualistic transparency requirements for a large crowd of stakeholders, and the prioritisation between transparency requirements and other functional and non-functional requirements of the crowd remain a challenge.

The uncertainty in the way transparency requirements could evolve is another challenge. If transparency is adopted as a fully crowd-centric decision, the management of expectations becomes a necessity. Pragmatically, certain transparency-related decisions are highly inter-related to other requirements of the business. A blended approach (i.e., centralised vs. distributed) to managing those expectations could benefit from other domains, such as the Wiki and user-generated content, and also from participatory decision making (Kaner 2014). This means that the system for acquiring transparency requirements from the crowd is by itself a system to engineer, with its complex networks of stakeholders and meta-requirements. For instance, in one previous research (Hosseini et al. 2015g), enterprise managers preferred to apply crowdsourcing of their staff and customers' requirements at the initial exploratory stages and then centralise the aggregation and the decision-making process.

Finally, crowdsourcing benefits could be easily compromised when the tasks given to the crowd do not fit their expertise and areas of interest. Thus, crowd clustering should be done not only based on their roles in the organisation, but also based on the personal skills and interests. For example,

incentivising the crowd to give credible and truthful information is a complex decision (Almaliki et al. 2015). Some crowd members may be incentivised by tangible or monetary rewards, while others may have intrinsic interests in achieving meaningful and useful transparency. Also, some personality types are idealistic, while others are more pragmatic and their perceptions of transparency could differ. User modelling is also a part of this process and one might need to do that from the perspective of transparency as a driving concept.

5.7.2 Challenges Related to Structured Feedback

Similar to crowdsourcing, the use of structured feedback in the engineering of transparency requirements can introduce some challenges. One challenge is related to the design of structured feedback in a way that elicits the real requirements of the stakeholders. While structured feedback makes the analysis process easier and faster, it may also limit users' ability to express their transparency requirements in two ways. First, users may choose options which do not represent their intended requirements. The cause of this might be the tacit knowledge of users about their transparency requirements. When this is the case, however, structured knowledge may help the conversion of tacit knowledge to explicit knowledge (Herschel et al. 2001). Second, the choice of multiple options may demotivate users from further explanations through comment bubbles and open-text boxes, which leads to incomplete requirements elicitation.

Another challenge relates to the representation of the structured feedback to the user. With free-form comments, users are given the freedom to express themselves in their own style of writing and self-expression. With structured feedback, it is the opposite, as users have to read through options and choose the one they deem the fittest. As different people's perception and understanding of words are different, and language proficiencies vary depending on things such as culture and personality, several representations might be needed, depending on the user, to ensure the structured feedback is representative of users' perceptions of their transparency requirements.

The ontology of the structured feedback on transparency is another challenge which should be managed. Ontology will help to direct the acquisition process, as some elements might be necessary only once other elements exist. For example, feedback reporting a lack of transparency may not include an element asking the quality of the provided information. Such dependencies amongst feedback elements and feedback patterns are to be explored. In addition, the structure of transparency feedback depends on some characteristics of the policies, goals, and procedures which it is about. Hence, the feedback structure could be adaptive to reflect those characteristics. For example, feedback on transparency related to critical requirements could have components different from feedback related to non-critical or trivial requirements.

Another challenge relates to giving the crowd the ability to shape their feedback over time and identify elements which were not thought of by designers. This is in accordance with the adoption of an open approach to elicit and update transparency requirements. Thus, the structure of the feedback needs to be fluid and extensible. This is similar to the case when the voting systems allow people to add options.

5.7.3 Challenges Related to Social Adaptation

Social adaptation may also pose some challenges which should be addressed during the engineering of transparency requirements. One challenge is related to the selection and application of the adaptation method. As several stakeholders are involved during the adaptation process, when individualistic adaptations are not available to manage individualistic transparency requirements and general consensus is needed as part of the social adaptation process, a careful multi-stakeholder decision-making process should be applied to ensure the most suitable adaptation is chosen.

Another challenge during social adaptation is related to the use of automated reasoning. As the time changes, it can be argued that the internal logic of the automated reasoning should change as well. In other words, the automated reasoning should have a dynamic nature rather than a static nature. This ensures that the automated reasoning will stand the test of time.

The aggregation of user feedback into a collective judgement is a design option and a challenge by itself, i.e., there is not a right or wrong strategy for it. While some democratic systems take into account the disadvantaged groups of users and minorities, others may adhere to the opinion of the majority. For this reason, more insights from sociology might be needed to manage this challenge.

Finally, the transparency in feedback aggregation methods and collective decision forming is another challenge during social adaptation, i.e., it should be transparent to the engaged stakeholders during social adaptation how their individual feedback is aggregated, how collective decisions are made based on the aggregated feedback, and how these decisions drive the adaptation process. This might require that requirements engineers try to visualise and explain how recommendations are made (Tintarev and Masthoff 2012).

5.8 Summary

In this chapter, the use of crowdsourcing and social adaptation through structured feedback acquisition for the engineering of transparency requirements was studied. It was argued that such utilisation will provide several benefits. First, crowdsourcing provides the solid ground for the engagement of the crowd in the identification and improvement of transparency requirements, stretching the involvement from ordinary users to potentially everyone who is interested in

contributing to the evolution and enhancement of the business information system with regards to transparency requirements. Second, structured feedback assists requirements engineers to pinpoint the exact loci where transparency requirements have failed or succeeded, and it also assists the automated analysis of these requirements. Third, social adaptation provides a perpetual user engagement and the selection of the best alternatives to adapt the business information system to its ever-changing transparency requirements. Then, the Stream method was proposed for the engineering of transparency requirements, which benefits from the modelling language which was proposed in the previous chapter. The challenges of utilising the three concepts of crowdsourcing, structured feedback, and social adaptation were also discussed. In the next chapter, the evaluation of the TranspLan language and a part of the Stream method will be presented.

Chapter 6

Evaluation of TranspLan and Stream

"Never promise more than you can perform."

Publilius Syrus

6 Evaluation of TranspLan and Stream

In the previous two chapters of this thesis, the following concepts were presented as part of the contribution of that chapter:

- Chapter 4 introduced TranspLan, a modelling language for the modelling and analysis of transparency requirements, and
- Chapter 5 introduced Stream, a method for the elicitation and adaptation of transparency requirements.

This chapter aims to evaluate the TranspLan language and the Stream method. It is acknowledged that a complete evaluation of them will take a more detailed study and a longer time, which is not in the scale of this thesis. Considering this, the following evaluations are conducted:

1. TranspLan will be evaluated via a real-world scenario as a case study for a fictional university assignment marking process. This evaluation is aimed at assessing the usefulness of the modelling language in the modelling and analysis of transparency requirements of stakeholders in a business information system.
2. TranspLan will also be evaluated from the quality point of view, using a quality framework in order to show whether the language follows quality standards of modelling languages. This evaluation is aimed at assessing the quality of the modelling language from the requirements engineers' perspective.
3. The feedback acquisition section of the Stream method will also be evaluated. The reason for selecting this section of the method is its essentiality. Stream relies heavily on stakeholders' feedback both in the elicitation part and in the adaptation part, and without proper feedback, the business information system will fail in providing meaningful and useful transparency to its stakeholders.

All these evaluations are conducted using three different case studies. Using a case study is the preferred method to a formal experiment or a survey when an investigator is attempting to establish a pilot method to evaluate the impact it could make (Kitchenham et al. 1995, Runeson and Höst 2009). A case study is also preferred when the impact of the investigated method or tool can be evaluated at a high level. This occurs when throughout the investigation, several detailed changes may happen which are challenging to trace and assess (Kitchenham et al. 1995, Kitchenham 1996). This is the case in the evaluations of TranspLan and Stream, because they involve several detailed constituents for the engineering of transparency in a business information system, and the existence of such constituents makes it difficult to trace and assess the impact of the method at the

constituent level. In addition, the time limit, the scope of the thesis, and available resources play a role in adopting a case study approach in the evaluation.

A proper case study needs a proper study design. Most of the case studies follow a similar design (e.g., the designs recommended by Kitchenham et al. (2002) and Wohlin et al. (2012)). But the design nature of a case study is that it is flexible, and therefore several iterations over its steps are possible if and when they are needed (Andersson and Runeson 2007). For example, data collection can happen at several times if the amount of collected data is insufficient for the analysis of the study. However, the case study should have a specific aim identified before the case study is conducted (Runeson and Höst 2009). Furthermore, Yin (2013) identifies five components of a research design for case studies:

1. A study question or questions,
2. Its propositions (if there are any),
3. Its unit or units of analysis,
4. The logic associating the data to the propositions, and
5. The criteria for interpreting the findings.

For each case study in this chapter, the study question or questions are stated along with the section for case study aim and question(s), the unit or units of analysis are specified in the section for study design and conduct, and the logic linking the data to the propositions and the criteria for interpreting the results are expressed during the analysis of the case study.

The rest of the chapter is as follows. Section 6.1 and 6.2 will be dedicated to the evaluation of TranspLan. Section 6.3 will discuss the evaluation of the feedback acquisition section in the Stream method. Section 6.4 will summarise this chapter.

6.1 Evaluation of TranspLan: Part 1

In the first part of the evaluation of TranspLan, a case study involving the university assignment marking process is used.

6.1.1 Case Study Aim and Question

The aim of conducting this evaluation case study was to assess the extent of usefulness of TranspLan in providing a systematic and effective engineering approach for the modelling and analysis of transparency requirements in a business information system. In particular, the case study aims at finding how TranspLan is systematic and effective in the way it helps requirements engineers in the identification of stakeholders' transparency requirements and in the way it helps stakeholders to be able to spot and communicate their transparency requirements to requirements engineers.

Based on the case study aim, the case study question can be formulated as follows:

1. How useful is TranspLan to stakeholders and requirements engineers in capturing, modelling, and analysing transparency requirements of different stakeholders?

This evaluation case study has the following propositions:

a) TranspLan as a modelling language can be used to elicit transparency requirements.
b) TranspLan as a modelling language can be used to model transparency requirements.
c) TranspLan as a modelling language can be used to analyse transparency requirements.

6.1.2 Study Design and Conduct

In order to conduct the case study in the first part of the evaluation of TranspLan, a scenario was first developed. The scenario was about the assignment marking process of a fictional university in which several stakeholders, e.g., students, first and second markers, and external examiners, were involved and in which several information pieces (or information elements) were produced by certain stakeholders and received or requested (i.e., used) by other stakeholders in the information exchange system. The scenario was given to domain experts for an initial confirmation and to remove any possible discrepancies and mistakes. The unit of analysis in this case study was therefore the collection of stakeholders in the scenario of university marking process.

Based on the built scenario, an initial model of transparency was built by the investigator using TranspLan (See Appendix One Part 4). The built model consisted of a Shield Diagram (See Appendix One Part 4.1), seven Sitreq specifications (See Appendix One Part 4.2), and 14 Infolet specifications (See Appendix One Part 4.3).

Next, for each stakeholder type identified in the scenario, one participant was invited to take part in the interview. The interview attempted to identify the role of the stakeholders, the information pieces they produced, and the information pieces they received or requested. It was also meant to clarify and elicit some of the missing data that was encountered during the initial construction of the transparency model (See Appendix One Part 5 for the interview outcome and Appendix One Part 9 for the interview questions).

The transparency model was then updated based on the elicited transparency requirements of stakeholders (See Appendix One Part 6) and the suggested analyses were performed. When an analysis outcome pointed to a problem in transparency provision, the involved stakeholders were contacted and the results were discussed with them, and then the transparency model was updated accordingly.

6.1.3 University Marking Process Specification

For the modelling and analysis of transparency requirements, the following marking process specification was used, which concerns university students' examinations and assignments assessment and the marking process. The specification was elicited from university officials involving module leaders and teaching programme leaders.

> Specification: During and at the end of each semester, **students'** understanding of a unit is evaluated by a combination of coursework and exams, hereby called *assignment*. The *marking* is generally performed by two markers. The **first marker** is the unit leader by default, and the **second marker** performs marking for quality assurance purposes. The marking is performed using a *marking scheme* provided by the **university** as a general guideline. *Feedback on assignments* is also provided by the first marker to students. Besides, students may ask the first marker to give them *statistics about markings*. Sometimes, an **external examiner** is also involved in the marking process by marking the assignments in order to evaluate the quality of the marking performed by the first and second marker. The external examiner also provides *feedback on marking* of the first and second marker. Furthermore, a **teaching committee** is in charge of reviewing all the markings and *accepting* or *refusing* them.
>
> If any inconsistencies arise between the two markers, or between the two markers and the external examiner, then an **exam board** will *review the markings* and decide the final marking. The exam board also investigates *students' complaints* about their marks, which must not be disclosed to the unit leader, and investigates the *marking refusal* if the teaching committee refuses the marking. The exam board decision on students' marking will be final.

6.1.4 Building the Initial Transparency Model

Based on the university marking process specification, seven stakeholders (marked in the specification as bold) and 14 information elements (marked in the specification as italics) were identified (See Appendix One Parts 2 and 3). The information about stakeholders, information elements, and the possible relationships amongst them were used to build the initial transparency model (See Appendix One Part 4). This initial transparency model consisted of the Shield diagram and the Sitreq and Infolet specifications. It was observed that the initial model suffers from several gaps related to transparency provision. For example, some data regarding the nature of the information elements and regarding the relationship amongst stakeholders and information elements was missing and needed to be elicited from the stakeholders.

6.1.5 Conducting the Initial Analysis

After building the initial transparency model, several gaps and issues in transparency provision were identified by the investigator, which were discovered by the analysis of the transparency model. These issues were revealed through the process of constructing the model and were as follows:

- The analysis of Sitreq specifications revealed that several transparency meaningfulness types were missing, i.e., the level of transparency meaningfulness (i.e., data, process, or policy) required by the stakeholders was unknown. For example, it was unknown whether the student's complaint consists of only data (e.g., the date of the complaint, the name, and the study year), or it consists of processes (e.g., how the complaint is made) and policies (e.g., why the complaint is made) (see Appendix One, Section 4.2.1). Furthermore, some Infolet specifications missed the same information, meaning that the level of transparency some information elements provide was not investigated, irrespective of the stakeholders' requirements For example, it was unclear whether the feedback provided for assignments would contain processes and policies rather than only data (see Appendix One, Section 4.3.4)
- The analysis of Sitreq specifications also showed that several transparency provision types were missing, i.e., whether the transparency is coercive or voluntary supply, or legal or personal demand, could not be identified. For example, it was unclear whether the marking statistics requested by the student was requested as a personal demand or as a legal demand, the latter meaning that the first marker has some legal obligations to provide these statistics to the student (see Appendix One, Section 4.2.1).
- The use of Infolet specifications helped the detection of negligence in information quality controls for information elements. Initially, none of the information elements were tested in terms of the information quality dimensions (e.g., see Appendix One, Section 4.3.1). Therefore, it was one of the reasons that made it necessary to get stakeholders' opinions and feedback on the quality of the provided information.
- The use of Infolet specifications also facilitated the discovery of inattention to transparency usefulness. Initially, it was unclear for all information elements whether the provided information is actually useful for the information receiver, meaning that they could make informed decisions based on them or act upon them (e.g., see Appendix One, Section 4.3.1). This was another reason that made it necessary to get stakeholders' opinions and feedback on the quality of the provided information.

6.1.6 Conducting the Interviews

With the initial transparency model ready and the initial analysis available, the interview phase began. One stakeholder in each role was identified and invited to take part in the study. In general, seven interviews were conducted. All the interviews were audio recorded. On average, each interview took 38 minutes, collecting four hours and 26 minutes of interview material in total.

Each participant in the interview was considered an expert in their own domain, as they played the role in their daily lives. That is to say, the person interviewed as a student was also a student in their real life, and the person interviewed as the external examiner had experience in being an external examiner in their real life. In three following cases, a representative of the identified stakeholder who was familiar with the topic at hand was interviewed. In the case of university, the deputy dean of the education was consulted and interviewed on behalf of the academic services. In the case of the exam board and the teaching committee, one member of each was interviewed.

The interviews followed a semi-structured interview format in which the interviewer has a list of certain questions to ask, while they can ask more questions based on the answers given by the interviewee in order to clarify ideas and follow up on certain concepts. The questions mainly involved the role they played, the information elements they produced, received, or requested, and the clarifications of information quality dimensions and the information element level of reach. The transparency model was used during the interviews as an aiding material. The complete list of questions asked can be found in Appendix One Part 9.

6.1.7 Updating the Transparency Model

After consulting with the stakeholders and eliminating the gaps in transparency provision, the transparency model was updated and analysed once again to ensure no inconsistencies have remained. The updated Shield diagram is illustrated in Figure 6.1, and an instance of Infolet specification and an instance of Sitreq specification are illustrated in Figure 6.2 and Figure 6.3, respectively. The complete analysis including all initial and final Shield diagrams, Sitreq specifications, and Infolet specifications can be found in Appendix One.

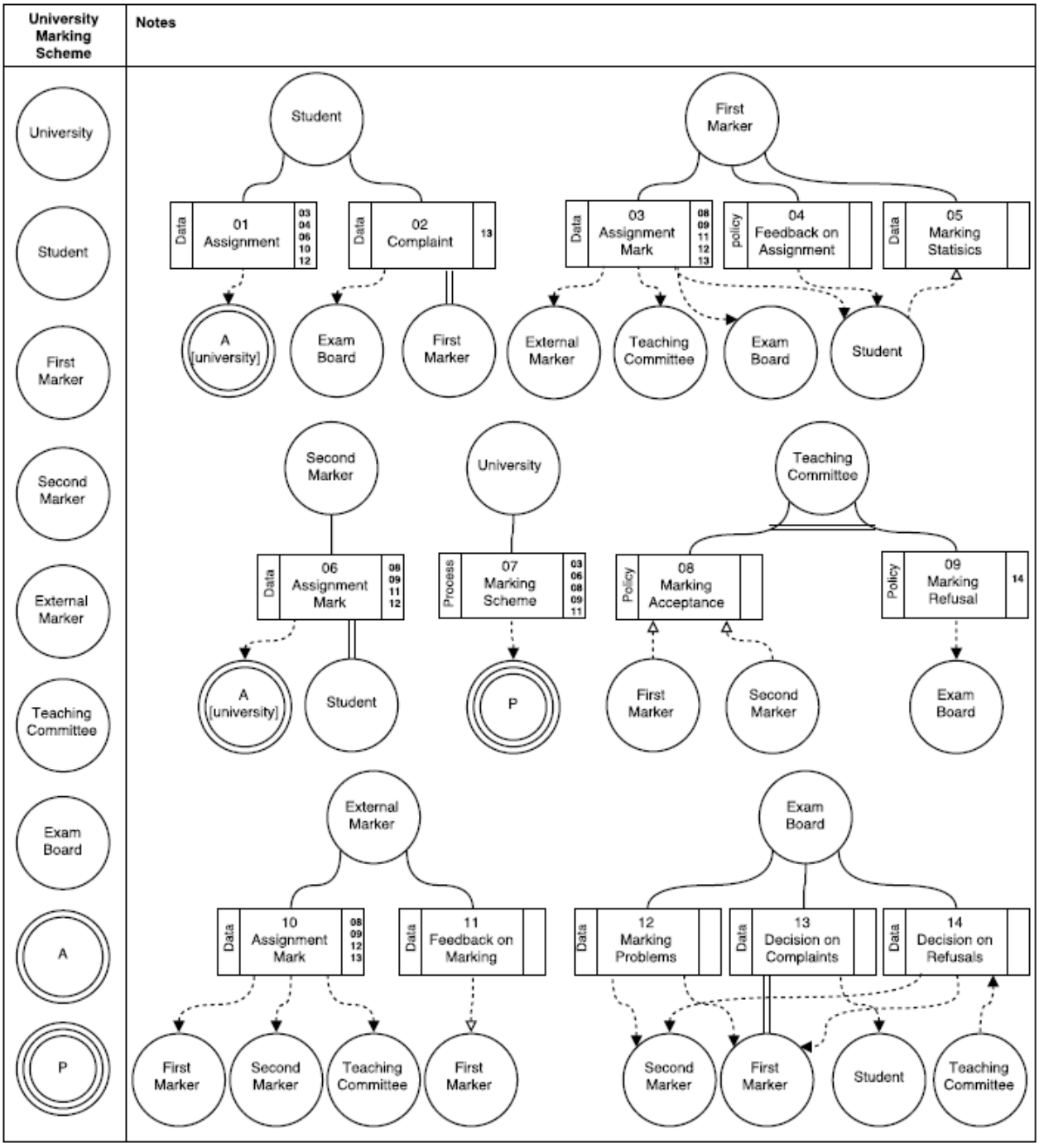


Figure 6.1: The complete Shield diagram for the case study

Stakeholder's Information Transparency REQuirements Specification (Sitreq)						
Stakeholder's Name: Student						
IE Label	**IE Name**	**Relationship**	**Requirement Description**	**Transparency Requirement Type**	**Transparency Meaningfulness Type**	**Stakeholders Involved**
01	Assignment	Producer	Assignment should be handled by different stakeholders	Coercive	Data	All except university
02	Complaint	Producer	Complaint is hidden from the first marker	Restricted	N/A	First marker
02	Complaint	Producer	Complaint should be handled by the exam board	Coercive	Data	Exam board
03	Assignment mark	Receiver	First marker provides the mark to the student	Coercive	Data	First marker
04	Feedback on assignment	Receiver	First marker sends feedback on marking	Coercive	Policy	First marker
05	Marking statistics	Requester	Student wants the statistical figures	Personal	Data	First marker
06	Assignment mark	Receiver	Second marker should not provide the mark to student	Restricted	N/A	Second marker
07	Marking scheme	Receiver	Student has public access to marking scheme	Legal	Process	University
13	Decision on Complaint	Receiver	Student gets exam board's decision on their complaint	Coercive	Data	Exam board

Figure 6.2: A sample of Sitreq specification for the case study

INFOrmation eLEment Transparency Specification (Infolet)

① Information Element (IE) Label	② Information Element (IE) Name	③ Information Element (IE) Type
02	Complaint	Data

④ Information Element Description

This information element contains data about students' complaints on their grades. The complaint uses an online form provided by the university on their unit's webpage, and can be accessed only by the exam board. The form is also available offline.

⑤ List of Other Information Elements Using This Information Element

13: Decision on Complaints

⑥ Information Element Creator/Authority

Student

⑦ Information Element Provider

Student

⑧ List of Stakeholders Receiving Information Element and Information Element Provision Type

Exam Board: Coercive

⑨ List of Stakeholders Requesting Information Element and Information Element Request Type

N/A

⑩ List of Stakeholders with Restricted Access to Information Element and Restriction Type

First Marker: Restricted

⑪ Information Element Quality Control (Sound, Dependable, Useful, Usable)

☑ Free of Error	◯ Concise Rep.	☑ Completeness	☑ Consistent Rep.	
☑ Timeliness	☑ Security			
☑ App. Amount	☑ Relevancy	☑ Understandability	◯ Objectivity	☑ Interpretability
☑ Accessibility	☑ Believability	☑ Ease of Manipulation	☑ Reputation	☑ Value-added

⑫ Information Element Level of Achievement

- ☑ Information Availability (Information is made available to the stakeholders)
- ☑ Information Interpretation (Information is appropriately interpreted for the stakeholders)
- ☑ Information Accessibility (Information is easily accessible by the stakeholders)
- ☑ Information Perception (Information is perceived credible by the stakeholders)
- ☑ Information Understandability (Information is comprehended by the stakeholders)
- ☑ Information Acceptance (Information is believed and accepted by the stakeholders)
- ☑ Information Actionability (Information helps stakeholders in their informed decision-making)

⑬ Information Element Notes

The sample form for filing a complaint can be accessed on the following link.

Figure 6.3: A sample of Infolet specification for the case study

6.1.8 Analysis of the Transparency Model

As the next step, the proposed algorithms in Chapter 4 on TranspLan were applied on Sitreq and Infolet specifications. These algorithms highlighted problems in transparency provision which, in certain cases, needed more consultation from the interviewees for further clarifications, and in certain cases led to updating the transparency model. The algorithms were applied manually, by going through the algorithms line by line and applying them on the model. No automated piece of software or application was developed for this purpose, as this did not fit in the scale of this thesis.

The results of running these algorithms are discussed below:

- Running the first algorithmic analysis on transparency mismatch detection revealed issues in transparency provision. For example, while the first marker's feedback on assignments contained the spotting and revealing of the mistakes students had made on their assignments (i.e., 'data'), students requested that the first marker also emphasises on why they think one solution is wrong and how these mistakes could be avoided (i.e., 'policy').
- Running the second algorithmic analysis on transparency leakage detection revealed problems in transparency provision. For example, the students did not want their complaints to be seen by the first marker. The exam board, however, provided the first marker with their decisions on complaints, literally revealing the complaints to the first marker. While this is not a privacy issue or a security problem, it can put pressure on students and probably discourage them from making further complaints.
- Running the third algorithmic analysis on information overload revealed no problems in transparency provision. All the information in circulation in this information system helped their stakeholders in decision-making and no information provider offered more information than needed in terms of meaningfulness, e.g., providing policy when data was needed.
- Running the fourth algorithmic analysis on information starvation revealed problems in transparency provision. For example, the first marker's feedback on assignments contained only 'data' such as students' errors in the assignment, while students requested 'policy' information such as why their answers were wrong and how such mistakes could be avoided.
- Running the fifth algorithmic analysis on bias detection revealed problems which needed to be addressed by requirements engineers. For example, several information elements, such as the assignment marks and feedback on assignments provided by different markers, were considered not to be objective, while students (especially those complaining on their marks) believed that the assignment marking processes were error-prone. This means that in these cases, transparency could lead to the detection of possible bias in information providers.

- Running the sixth algorithmic analysis on information asymmetry revealed no problems in transparency provision, as all information elements were considered to be complete. This only means that in the case of provided information, the information provider and the information receiver have access to the same amount of information. On the other hand, for those information elements which are hidden by the information provider, this algorithm cannot capture information asymmetry.
- Running the seventh algorithmic analysis on unidirectional and bidirectional transparency revealed some instances of unidirectional transparency. For example, there was a unidirectional transparency between the external examiner and the teaching committee, where the external examiner provided assignment marks to the teaching committee, but the teaching committee did not provide any information back to the external examiner. In cases where the external examiner would be interested in the outcome of their marking, e.g., in the form of feedback, this could lead to adverse effects such as information starvation.
- Running the eighth algorithmic analysis on social and target transparency revealed the only instance of social transparency to be the marking scheme provided by the university. This is because the marking scheme is the only information element which is available to the public. The rest of the transparency provision types in this business information system are categorised as target transparency, because they are aimed at the consumers of that specific information element. The value of such analysis lies in the awareness of requirements engineers to make more or less information available to the general public (based on the content of information, context of transparency provision, and public interest in the exchanged information).
- Running the ninth algorithmic analysis on opaque and clear transparency revealed no instances of opaque transparency. This is because all information elements were considered to be understandable by their stakeholders.

6.1.9 Discussion

In the light of the obtained results, the study question can now be answered as follows:

1) **How useful is TranspLan to stakeholders and requirements engineers in capturing, modelling, and analysing transparency requirements of different stakeholders?** The case study illustrated the potentials of TranspLan in eliciting, modelling, and analysing the transparency requirements of stakeholders in a business information system. The Shield diagram and Sitreq and Infolet specifications could be used in order to elicit, clarify, and update transparency requirements, because requirements engineers could easily find gaps in these specifications, which would then lead them to stakeholders in order to fill in those

gaps and consequently, better understand those transparency requirements. The modelling of transparency requirements was successfully conducted using TranspLan and the proposed analyses led to the identification of some transparency problems. The outcome of these analyses could then be used in order to refine transparency requirements of different stakeholders, e.g., by introducing new information exchanges amongst stakeholders or increasing the level of meaningfulness or the quality of the provided information.

While the case study provided an answer to the question at hand, it should also be noted that more research will be needed in several diverse scenarios before a final decisive answer to the usefulness of TranspLan in the modelling and analysis of transparency requirements can be obtained.

6.1.10 Threats to Validity

In this study, seven participants, each of them being an expert in their role, were interviewed. The interviews were semi-structured to allow for a more flexible question and answer session and to allow the interviewees to fully express themselves. The interviews were also assisted by the transparency model. The transparency model was analysed both on its own merit and by the use of the algorithms. The investigator also confirmed the results of the case study with the domain experts. Nonetheless, and similar to other empirical studies, this study also involved some threats to validity. These threats are listed below:

- For each role identified in the case study, only one person was interviewed. This could lead to circumstances where one stakeholder's transparency requirements in a certain role does not reflect other stakeholders' transparency requirements in the same role. However, the study did not aim to provide a unified transparency perspective across all stakeholders and across the university, and focussed more on the individual level. Therefore, it can be concluded that at the individual level, the case study is valid and useful.
- Transparency requirements are usually transient and short-lived, meaning that once certain information is provided to a particular stakeholder, their need for that particular information may no longer be valid. As a result, the built transparency model cannot remain in a static state and must be dynamically updated. However, it is obvious that the transparency model itself cannot capture the dynamic nature of transparency requirements and must be embedded in a method where such dynamicity exists. Therefore, this does not limit the applicability and usefulness of the TranspLan modelling language. Furthermore, the language can accommodate such dynamic changes through iterations, and by the use of analytical algorithms, it can be ensured that transparency requirements are continuously met during their life cycles in a business information system.

6.1.11 Lessons Learned

The study revealed a great potential for the use of TranspLan in the engineering of transparency requirements of stakeholders in a business information system, while it also highlighted peculiarities and difficulties. Some of these peculiarities and difficulties are the importance of acknowledging and differentiating between individual-level and role-level transparency (i.e., tailored and targeted transparency (Kreuter and Wray 2003)), the necessity of constant feedback from stakeholders on their transparency requirements, and the dynamic nature of transparency requirements which must be acknowledged and accommodated for.

6.2 Evaluation of TranspLan: Part 2

In the second part of the evaluation of TranspLan, another case study involving asking requirements engineers to do modelling and scenario building is used. Unlike the first case study, which focused on the usefulness of the TranspLan modelling language in depicting transparency requirements and clarifying and assessing them, the second case study concentrates on its quality and fitness. The main aim of this second evaluation is to investigate the perspective of the requirements engineers in terms of the quality of the transparency modelling language in capturing, modelling, and analysing transparency requirements as well as its quality for the management of these requirements.

A generic framework has been developed for discussing the quality of models in general (Krogstie et al. 1995, Krogstie and Solvberg 2000, Krogstie et al. 2006). This framework, called SEQUAL, focuses on a modelling language quality as a means to achieve models with high quality (Krostie 2003). The main concepts used in this framework are as follows:

- *G* is a set of organisational goals of the modelling task.
- *L* is the set of all possible statements in a language according to graphemes, vocabulary, and syntax used in the modelling language.
- *D* is the domain, or the set of all statements that can be stated about the situation at hand.
- *M* is the externalised model, or the set of all statements in someone's model of part of the perceived reality written in a language.
- *K* is the relevant explicit knowledge of the set of stakeholders involved in modelling.
- *I* is the social actor interpretation, or the set of all statements that the audience thinks an externalised knowledge consists of.
- *T* is the technical actor interpretation, or the statements in the model as interpreted by different model activators or modelling tools.

Based on these definitions, quality types are defined as follows:

- **Physical quality** relates to the basic quality goals on the physical level that are externalised, that the knowledge *K* of the domain *D* of some social actor has been externalised by the use of a modelling language and internalised, and that the externalised model *M* is persistent and available, and so the audience can make sense of it.
- **Empirical quality** deals with predictable error frequencies identified when a model is read or written by different users through coding and visualisation, and by Human Computer Interaction (HCI) ergonomics for documentation and modelling tools.
- **Syntactic quality** is the correspondence between the model *M* and the language extension *L* of the language in which the model is written.
- **Semantic quality** is the correspondence between the model *M* and the domain *D*. The framework contains two semantic goals: validity, meaning that all statements made in the model are correct relative to the domain, and completeness, meaning that the model contains all statements which are found in the domain.
- **Perceived semantic quality** is the similar correspondence between the audience interpretation *I* of a model *M*, their current knowledge *K* of the domain *D*, and what can actually be checked during quality control.
- **Social pragmatic quality** is the correspondence between the model *M* and the audience's interpretation of that correspondence *I*. Social pragmatic quality refers to the extent to which people understand the model.
- **Technical pragmatic quality** refers to the extent to which tools can be constructed to understand the models.
- **Social quality** aims to find agreement amongst audience members' interpretations (*I*).
- **Organisational quality** of the model corresponds to the premise that all statements in the model either directly or indirectly contribute to fulfilling the goals of modelling (i.e., organisational goal validity) and that all goals of modelling are addressed through the model (i.e., organisational goal completeness).

In the following, the framework's main concepts are defined in correspondence to TranspLan:

- In TranspLan, *G* denotes the organisational goals related to providing meaningful and useful transparency to its relevant stakeholders through quality information. In other words, *G* denotes why this modelling of transparency requirements is being conducted in the business information system.

- In TranspLan, *L* is defined by five sets of information elements, stakeholders, stakeholder-information relationships, decomposition relations, and information exchanges. These five sets and their corresponding symbols or graphemes in Shield diagram are defined and explained in TranspLan mathematically.
- In TranspLan, *D* denotes all possible information exchanges amongst various stakeholders which are involved in transparency provision and request.
- *M*, *K*, *I*, and *T* are defined based on stakeholders' model of part of the perceived reality, their relevant knowledge, their interpretation of the model, and the technical actor's interpretation respectively.

Based on the quality criteria discussed above, TranspLan quality can be divided into observational quality types and non-observational quality types. The observational quality types must be evaluated by observing the usage of the language, while the non-observational quality types can be evaluated independent from its usage in a real-world scenario. The observational quality types are:

1) Empirical quality,
2) Social pragmatic quality,
3) Social quality, and
4) Perceived semantic quality.

The non-observational quality types are:

1) Physical quality,
2) Syntactic quality,
3) Semantic quality,
4) Organisational quality, and
5) Technical pragmatic quality.

In order to find out the observational quality types of TranspLan, an empirical study was conducted, which will be discussed in the next sections of this chapter. After that, the non-observational quality types of TranspLan will be discussed following the method used by Krogstie (2003).

6.2.1 Case Study Aim and Questions

The aim of conducting this evaluation case study was to assess the extent of quality of TranspLan in providing a systematic and effective engineering approach for the modelling and analysis of transparency requirements in a business information system. In particular, the case study aims at finding how TranspLan is systematic and effective in the way it helps requirements engineers in the

modelling and analysis of stakeholders' transparency requirements and in the way it helps requirements engineers to be able to spot and elicit transparency requirements of stakeholders.

Based on the case study aim, the case study question can be formulated as follows:

1) How much empirical quality, social pragmatic quality, social quality, and perceived semantic quality does TranspLan modelling language have?

This evaluation case study has the following propositions:

a) TranspLan modelling language has certain qualities that can be systematically evaluated.
b) TranspLan qualities make it suitable to be utilised by requirements engineers in the engineering of transparency requirements.

6.2.2 Study Design and Conduct

In order to conduct the case study in the second part of the evaluation of TranspLan, it was divided into an observational and a non-observational evaluation. For the observational part, which is the empirical part of the evaluation, 12 experts in software modelling were recruited, with a minimum of three, a maximum of 14, and an average of 6.08 years of experience in software system analysis and design (SSAD) (See Figure 6.4). They also defined their modelling skills as fair (4 people), good (6 people), or very good (2 people). The unit of analysis in this case study was therefore the collection of experts in the empirical evaluation of TranspLan modelling language quality.

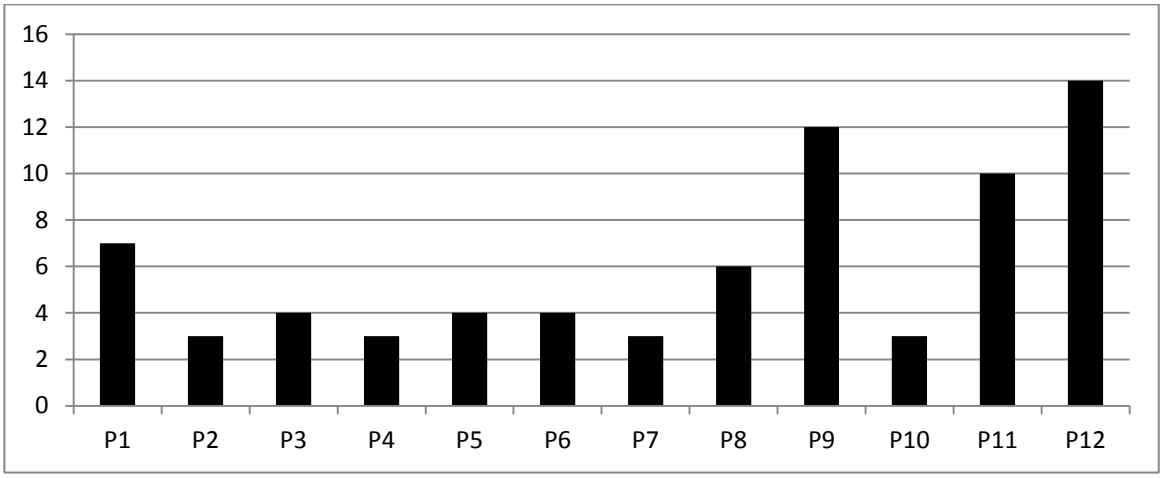


Figure 6.4: Experience years of the participants

Participants were initially chosen based on their SSAD experience from doctorate students. The average of more than six years of experience in SSAD meant that participants were familiar with SSAD concepts, including modelling. The participants mostly classified themselves as having good modelling skills (e.g., having worked with Unified Modelling Language (UML), Business Process

Modelling Notation (BPMN), and Goal Modelling), and while the screening process in the study meant to rule out participants with very poor or poor modelling skills, none of the participants put themselves in either of these categories. On the other hand, since participants did not apply modelling in large scale industrial projects, they did not identify themselves as having excellent modelling skills. Consequently, all the initially chosen participants for this study could be recruited.

The details of a plan were laid early in the study in order to estimate the time, prepare the props, and cater for the modelling session needs (See Appendix Two, Parts 1, 2, and 3). The participants were given the modelling language and its theoretical foundations one week before the start of the study, and they were briefed in a half-hour session about the modelling language. Furthermore, and to ensure everyone is familiar with the modelling language in practice, the study session also started with an introduction to the language, where the modelling was discussed and a small modelling task was given for them to complete. Then one possible solution was shown and discussed in the group (See Appendix Two, Section 2.1).

The case study contained four parts. In the first part of the study, 6 participants were asked to draw a model based on the given scenario, while 6 people were asked to detail a scenario based on a given model. Then, the two groups shifted their tasks, i.e., the first group started to build a scenario while the second group started to draw a model. This method was selected in order to reduce the learning effect (Lazar et al. 2010). The learning effect does not happen if the participant is only exposed to one condition and does not learn from a previous task (See Appendix Two, Section 2.2). In the second part, every participant was given another participant's model and scenario to evaluate. This method was selected in order to remove the bias of the investigator from the evaluation part and also to measure the social quality and social pragmatic quality criteria (See Appendix Two, Section 2.4). In the third part, a questionnaire was given to the participants to answer. The questions covered questions on their evaluation as well as general questions on TranspLan (See Appendix Two, Section 2.5 and Section 4). In the fourth and last part, a discussion was held in order to hear participants' opinions and suggestions, as well as discuss their modelling experience in TranspLan (See Appendix Two, Section 2.6). The whole session took 2 hours and 30 minutes to complete and it was audio recorded.

6.2.3 The Scenario and the Task of Model Building

Participants were given the following scenario and were asked to model transparency provision and requests from the customer relationship management (CRM) viewpoint (i.e., with the CRM as the information provider). They were given a TranspLan Quick Reference Card (See Appendix Two, Section 5) for the ease and speed of modelling:

A financial institution plans to introduce several improvements to their current Customer Relationship Management (CRM) plans. As part of the improvement, they are introducing customer categories based on existing customer information on their databases. The categorisation is meant to amend their existing transparency policies of the institution, providing information to customers in a way that minimises information overload and maximises their decision making power.

The **CRM management** has identified three types of customers:

- **Class A customers**: they have at least three financial products (e.g., current account, saving account, ISA account, mortgage, Loans, and credit card) with the institution. They are usually the most loyal customers, are very important and beneficial to the institution, and are very important for the financial institution to keep. Their informational needs must be always met, and they must be updated instantly with new products and services.

- **Class B customers**: they are customers with a current account and at most one more product. The institution policy is to encourage them to take up more new products with them, and increase their interaction, and therefore increase their loyalty to the institution.

- **Class C customers**: they are ex-customers who have no financial services and products with the financial institution at the moment.

  There are three information types usually communicated to these stakeholders:

- Information on new products and services: This information is mainly communicated to class B customers to encourage them to engage more with the institution and to increase their loyalty. This information is available to class A customers only on demand. The provision of this information is legal or coercive.

- Information on updates to existing products and services: This information is mainly communicated to Class A customers, but also to class B customers. The provision of this information is optional.

- Information on Xclusive Club benefits: The new scheme of the institution (Called Xclusive Club) is a legal necessity to provide an exclusive club with exclusive benefits (such as high cash back rates and holiday flights) only to Class A customers, and this must not be communicated to class B or class C customers.

  Furthermore, the CRM management has decided to provide the following information to customers, based on legal demands:

- Savings and investment newsletter: including process and policies, and available on demand (i.e., subscription via institution website) to all customers except Class C.

  Institution annual financial report: To everyone (customer or otherwise) with an access to the website.

6.2.4 The Model and the Task of Scenario Building

Participants were also given the following model (Figure 6.5) and were asked to write a scenario based on it. They were asked to write their scenarios for each information exchange between two stakeholders and to include as much information as they could observe in the model.

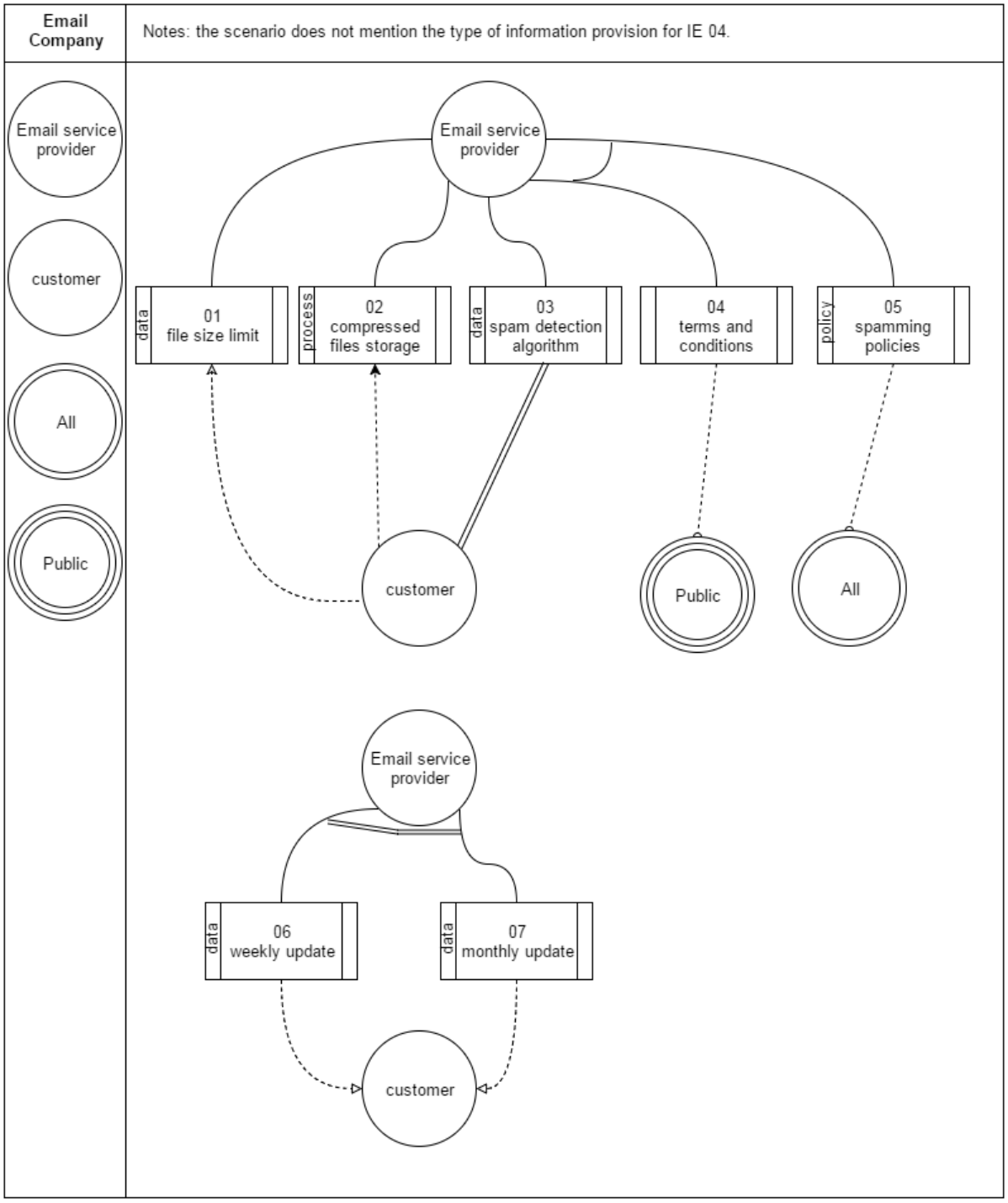


Figure 6.5: Case study model for participants to write a scenario from

6.2.5 Questionnaire: Evaluation of the Given Model

The questionnaire consisted of four parts. The first two parts assessed the participants' evaluation of another participant's drawn transparency model and written scenario, while the last two parts assessed the participants' evaluation of the transparency model itself. In this section, the results obtained from these four parts are discussed, and conclusions are drawn upon these results at the end of each subsection.

6.2.5.1 Evaluating the Given Model

The evaluation of another participant's model was conducted in order to find similarity amongst participants in their modelling practice, which can be translated into social quality. It was also conducted to investigate whether the participants could understand different models, which can be translated into social pragmatic quality, and also to find out whether participants could highlight issues with models drawn by other participants, which can be translated into empirical quality.

In order to find similarities amongst models, three measurement methods are proposed (Dijkman et al. 2011):

1) Syntactic similarity, where only the syntax of the models are considered,
2) Semantic similarity, where the syntax is abstracted from the models, and the semantics of the words within the models are investigated, and
3) Contextual similarity, where the context in which the models occur is explored.

The questions in this part targeted the correctness of the model under evaluation in addition to the similarity between the models. The logic is that if a participant thinks the model is incorrect, they will not vote for similarity between their own model and the model they are evaluating, because it would mean their model is also incorrect.

Regarding the *syntax of the models*, participants thought everybody else followed the correct syntax of the modelling language, with all 12 participants agreeing with the syntactic correctness of the model under evaluation. They also agreed (11 participants agreeing and one remaining neutral) that there was a syntactic similarity between their model and the one they were evaluating. These results indicate social quality in terms of modelling syntax.

Regarding the *semantics of the models*, participants thought everybody else was following the correct semantics during their modelling, with 11 participants agreeing with the semantics correctness and one remaining neutral. Out of these 11, ten participants agreed with the semantics similarity between their model and the one they were evaluating. These results indicate social quality in terms of the modelling semantics.

Finally, regarding the *contextual similarity*, most participants agreed that the model they were evaluating represented the scenario they were given, with seven participants agreeing with the contextual correctness and two participants remaining neutral. The same nine mentioned participants also agreed that there was a contextual similarity between their model and the one they were evaluating. These results indicate social quality in terms of modelling context.

The results of the evaluation in this part of the study are summarised in Figure 6.6 and Table 6.1.

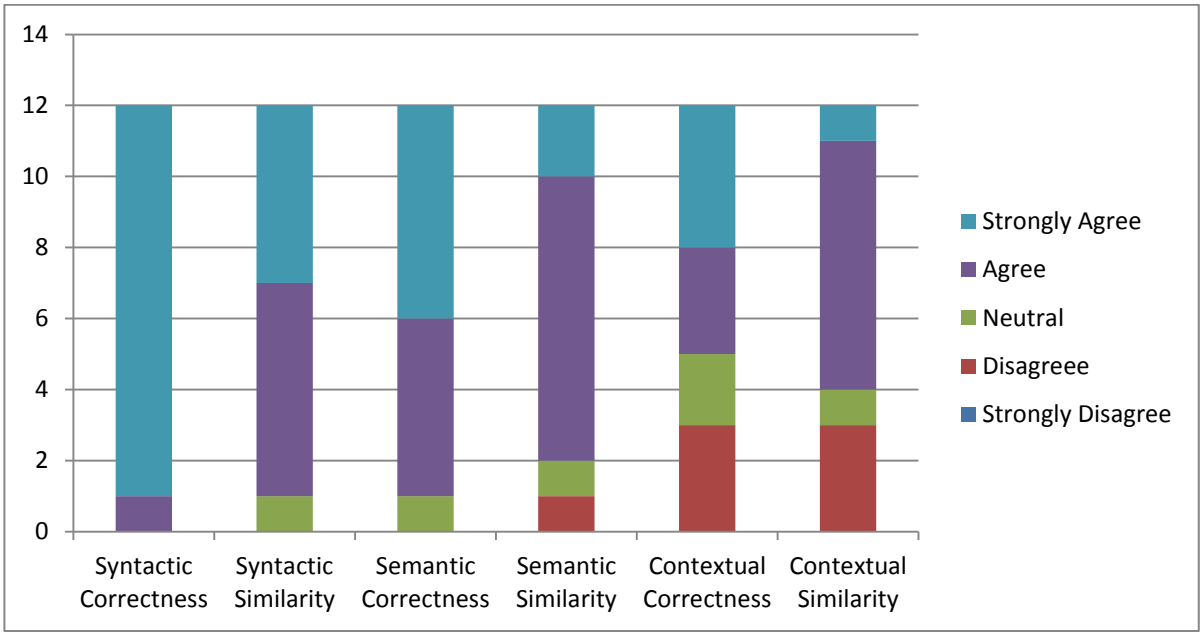


Figure 6.6: Summary of answers to questions in part one

Table 6.1: Summary of the results on model correctness and similarity

	Syntactic Correctness	Syntactic Similarity	Semantic Correctness	Sematic Similarity	Contextual Correctness	Contextual Similarity
(Strongly) Agree	12	11	11	10	7	8
Neutral	0	1	1	1	2	1
(Strongly) Disagree	0	0	0	1	3	3

The results obtained from this part of the evaluation highlighted three types of quality found in the TranspLan modelling language:

1) TranspLan has social pragmatic quality, i.e., the extent to which people understand the model, since they can judge whether a model is correct or not.
2) TranspLan has social quality, i.e., the amount of agreement amongst audience members' interpretations, since they judged an overall similarity between their model and another participant's model. The disagreements are in line with correctness of the evaluated model.

3) TranspLan has empirical quality, i.e., predictable error frequencies identified when a model is read or written by different users through coding and visualisation, since the participants could point out problems with the models under evaluation.

6.2.5.2 Evaluating the Given Scenario

The evaluation of another participant's scenario was conducted in order to find out whether participants could highlight issues and problems with scenarios written by other participants, which can be translated into empirical quality. It was also conducted to investigate whether back translation or round-trip translation (i.e., drawing the same or similar model based on the written scenario) is possible (Somers 2005) and whether the scenario under evaluation is useful. Scenario usefulness means that the scenario under evaluation reveals transparency actors (i.e., the information provider and the information receiver), the disclosed information and its type (i.e., data, process and policy), and the type of information disclosure (e.g., optional/personal and coercive/legal disclosure).

Regarding the *correctness and similarity of the scenarios*, most participants agreed that the scenario they were evaluating represented the model they were given, with eight participants agreeing with the scenario correctness and two participants remaining neutral. The same ten mentioned participants also agreed that there was a similarity between their scenario and the one they were evaluating.

On the topic of *back translation*, participants showed divided opinions, with half of them agreeing that back translation is possible, but four remaining neutral and two disagreeing. The reasons could be linked to studies which suggest any translation from one language (here, the transparency model) into another (here, the written language) loses certain characteristics and meanings (Van Nes et al. 2010), which then makes it difficult to translate back with the same amount of meaningfulness into the original one.

Regarding the *usefulness of the scenario*, participants generally found the scenario they were evaluating useful in terms of the identification of the constituents of transparency, with eight participants agreeing and four participants remaining neutral. This illustrates that the scenarios under evaluation could be used by requirements engineers for transparency elicitation reasons.

The results of the evaluation in this part of the study are summarised in Figure 6.7 and Table 6.2.

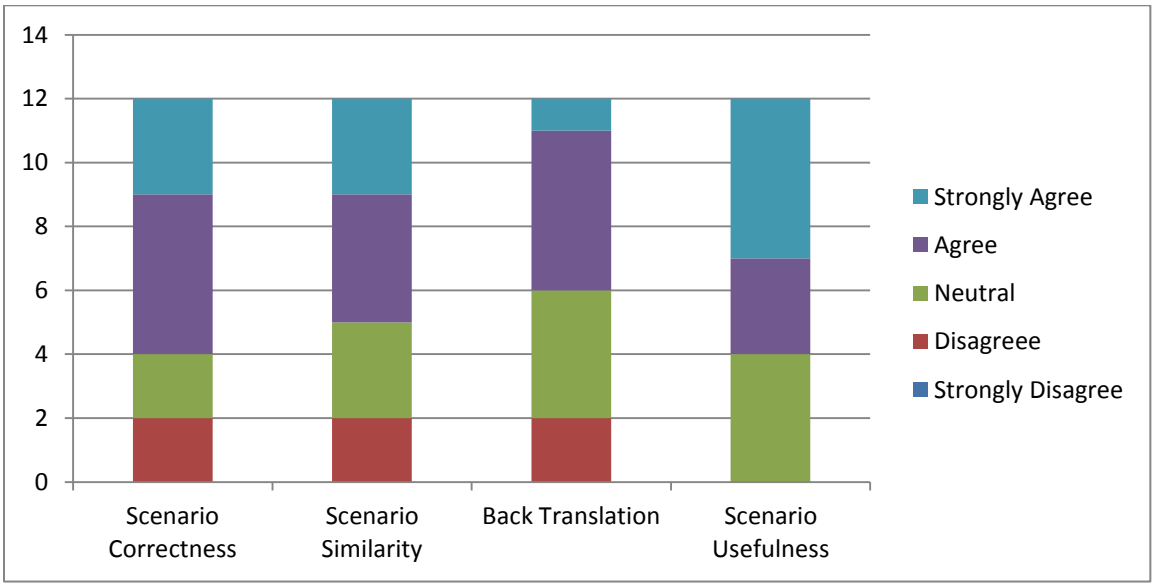


Figure 6.7: Summary of answers to questions in part two

Table 6.2: Summary of the results on scenario evaluation

	Scenario Correctness	Scenario Similarity	Back Translation	Scenario Usefulness
(Strongly) Agree	8	7	6	8
Neutral	2	3	4	4
(Strongly) Disagree	2	2	2	0

The results obtained from this part of the evaluation highlighted one type of quality found in the TranspLan modelling language, plus the level of usefulness of the scenarios and their back-translation capabilities:

1) TranspLan has empirical quality, i.e., predictable error frequencies identified when a model is read or written by different users through coding and visualisation, since the participants could point out problems with the scenarios under evaluation.
2) Scenarios which were evaluated were useful, helping the participants identify transparency constituents.
3) There was uncertainty amongst some participants whether back translation would be accurately possible with the given scenario.

6.2.5.3 Evaluating TranspLan Modelling Language

In this part of the evaluation, the TranspLan modelling language was evaluated independently from the drawn models or written scenarios and on its own merit. For this evaluation part, two sets of questions were asked. The first set of questions, including four questions, investigated *ontological completeness* and *ontological clarity* (Wand and Weber 1993). A modelling language is ontologically complete if all real-world concepts that should be captured by that modelling language can be represented by it. Otherwise, the modelling language is ontologically incomplete, or said to have *construct deficit*. A modelling language is ontologically clear if it has no *construct overload*, no *construct redundancy*, and no *construct excess*.

According to Wand and Weber (1993), construct overload happens in a modelling language when one design construct maps into two or more real-world concepts. For example, if in a modelling language a rectangle is used to represent a process and also to represent an actor, then the modelling language has construct overload. Construct redundancy occurs in a modelling language when two or more design constructs can be used to represent a single real-world concept. For example, if in a modelling language a rectangle and a circle are used to represent a process, then the modelling language has construct redundancy. Construct excess arises in a modelling language when there is a design construct that does not map into any real-world concept. For example, if in a modelling language an arrow type is never used to represent a concept, then the modelling language has construct excess. The existence of any of these three issues (i.e., construct overload, construct redundancy, and construct excess) leads to ontological ambiguity in a modelling language.

The second set of questions in this part of the evaluation investigated six evaluation criteria proposed by Ruiz et al. (1994). These six criteria are *expressiveness*, *frequency of errors*, *redundancy*, *locality of change*, *reusability*, and *guidelines*. In a modelling language, expressiveness refers to both the possibility and the ease of expressing real-world concepts and to effectively conveying the meaning of that concept. The existence of frequency of error means that the constructions in a modelling language are error prone and these errors can happen often during the modelling activity. Redundancy refers to construct redundancy which was explained above. Locality of change means that changes in one part of the model do not propagate to the other parts of the same (or another) model. Reusability denotes that fragments or the entire model can be used with no or little modifications in another model. Finally, the existence of useful and comprehensive guidelines helps the modellers to draw models with comfort and confidence, and get help from these guidelines when needed.

In this evaluation parts, all participants agreed that TranspLan has no *construct overload*, so every modelling construct can be used for only one concept. They mostly agreed that TranspLan has no *construct redundancy*, meaning that one concept can be modelled with only one modelling construct. The only person who pointed to construct redundancy in TranspLan pointed out that "All Actors Except" construct can be equal to a set of actors. While this is the case, the reason for devising this construct is to make the model less cluttered during the design process. Furthermore, participants found no *construct excess* in TranspLan, meaning that all modelling constructs in TranspLan have a real-world corresponding concept. They mostly agreed that TranspLan has no *construct deficit*, meaning that all real-world concepts related to transparency can be modelled using TranspLan. The only person who pointed to construct deficit stated that the language does not capture whether the requested information is actually provided to the information receiver or not. While this is not the initial concern in TranspLan, one way to address this issue is to use solid lines for 'requited information provision' and dotted lines for 'unrequited information provision'. The answers are summarised in Table 6.3 and Figure 6.8.

Table 6.3: A summary of answers given to the absence of ontological clarity and completeness in TranspLan

	Absence of Ontological Clarity			**Absence of Ontological Completeness**
	Construct Overload	Construct Redundancy	Construct Excess	Construct Deficit
Yes	0	1	0	1
No	12	8	11	7
IDK	0	3	1	4

With regards to *expressiveness*, participants generally agreed that TranspLan is expressive, meaning that the modelled concepts effectively convey the meaning of that concept. The only person who found an example of lack of expressiveness in TranspLan pointed to the "undecided" relationship type, which they considered to be ambiguous in conveying the meaning of the provision type. However, this type of relationship was intentionally put in TranspLan to capture instances of transparency where the information provision type is unknown at the time of design. Therefore, it is another example of expressiveness and ontological completeness of TranspLan.

With regards to the *frequency of error*, half of the participants agreed that certain modelling mistakes do no happen several times, while three participants disagreed and mentioned that certain modelling mistakes might happen several times during modelling with TranspLan. These three people all pointed out that the arrow direction and head type can become confusing, while one also mentioned that "All Actors Except" construct could be equal to "restricted" construct for those stakeholders who are exempt from information provision, and therefore could be confusing. In

response to the first concern, the arrowheads type and direction can be mastered by practice, as is the case in other modelling languages with several similar constructs, such as the gates types in BPMN. Furthermore, "All Actors Except" construct does not mean that stakeholders who are exempt from information provision are banned from getting such information, only that they are not simply the relevant stakeholders for that information, which is different in meaning from "restricted" stakeholders, who are actually banned from getting such information.

With regards to *locality of change*, all participants agreed that changes in TranspLan are local, i.e., changing part of the model does not propagate and does not require changes in other parts of the model to maintain its consistency and correctness.

With regards to *reusability*, most participants agreed that TranspLan has the reusability feature, meaning that parts or the entire model in one scenario may be used with little customisation in another scenario. For example, one participant pointed out similar scenarios related to customer support in ticketing systems in buses, trains, and flights where TranspLan could be reused, while another participant pointed to similarities of information exchange in many environments regarding Terms and Conditions documents, where TranspLan could benefit from reusability.

With regards to *guidelines* provided for TranspLan, half of the participants agreed that the information that was provided in the conference paper (Hosseini et al. 2016a) and the guidelines and reference guides given to them during the study session were complete enough for drawing and understanding the model drawn in TranspLan. The two people who answered otherwise referred again to another issue not necessarily related to guidelines. For example, one participant asked whether information becomes available when it is requested by a stakeholder, which they could not find in the guidelines, and the answer to which, as explained earlier, is implied to be positive in the modelling language at the moment. However, this could be further clarified in the next version of the language as well. The other participant also mentioned that when information is surely received by the information receiver, there is no way to model it using the modelling language. The same response in the previous example also applies to this comment.

The results of the evaluation in this part of the study are summarised in Figure 6.8.

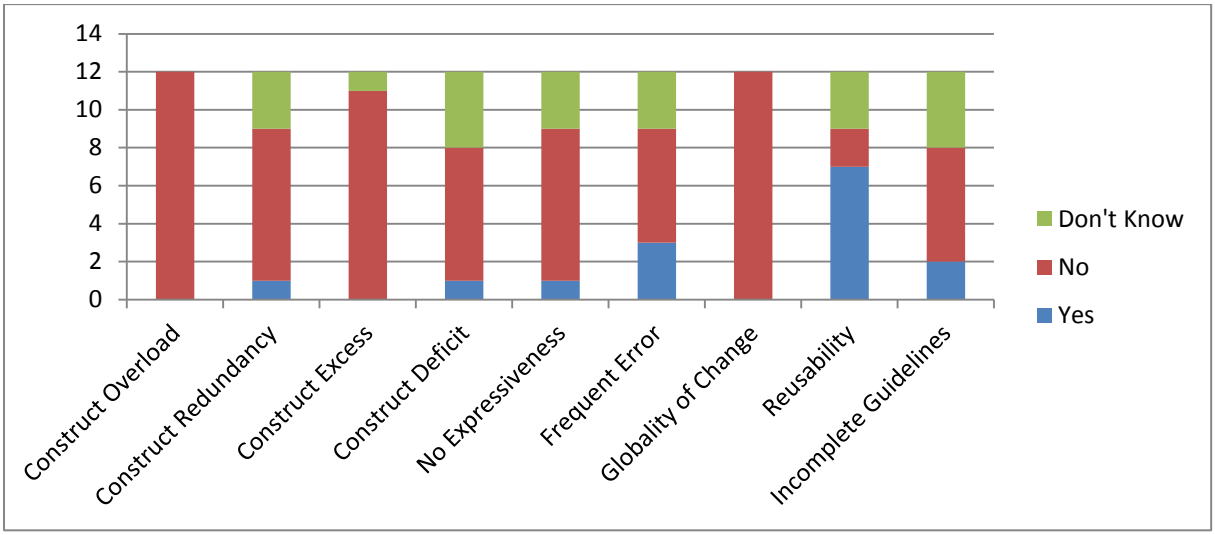


Figure 6.8: Summary of answers to questions in part three

The results obtained from this part of the evaluation highlighted the following outcomes:

1) TranspLan has perceived semantic quality, because it is perceived to be ontologically clear and complete, with no issues found during the empirical evaluation of the TranspLan modelling language. In part, this could reflect the syntactic and semantic quality of TranspLan as well.
2) TranspLan is expressive, with little or no frequency in making errors, and has the reusability characteristics. Furthermore, changes in TranspLan are local and the guidelines provided for it are complete.

6.2.5.4 Evaluating Scenario Building in TranspLan

In this last part of the evaluation, the TranspLan modelling language was evaluated in terms of scenario building based on drawn models. The logic in this part was that a model should be easy enough to extract from a drawn model of transparency, the extracted scenario should be expressive in identifying the constituents of transparency, it should not be prone to frequent errors, and the guidelines should be complete enough in the act of scenario building. These were the four questions which participants answered in their evaluation of scenario building in TranspLan.

With regards to *scenario extraction*, participants generally agreed that building a scenario is easy based on a given model, with ten participants agreeing and one participant remaining neutral. This means that the model is easy to read and is therefore another sign of social pragmatic quality of the TranspLan modelling language.

With regards to scenario *expressiveness*, all participants agreed that the scenario built based on a model is expressive and conveys the meaning of concepts in that model, e.g., effectively reveals transparency actors. This is yet another sign of social pragmatic quality of TranspLan.

With regards to the *frequency of errors*, half of the participants pointed out that making a mistake several times does not usually occur while building a scenario based on a model drawn using TranspLan. On the other hand, four participants thought it is possible to make a certain mistake several times during scenario building. This again was mostly the result of interpreting arrowheads type and direction, which can be mastered over time.

With regard to the provided *guidelines* for scenario extraction, all participants agreed that the guidelines provided in the conference paper (Hosseini et al. 2016a) and the guidelines and reference guides given to them during the study session were complete enough for building a scenario based on a given model drawn using TranspLan.

The results of the evaluation in this part of the study are summarised in Figure 6.9.

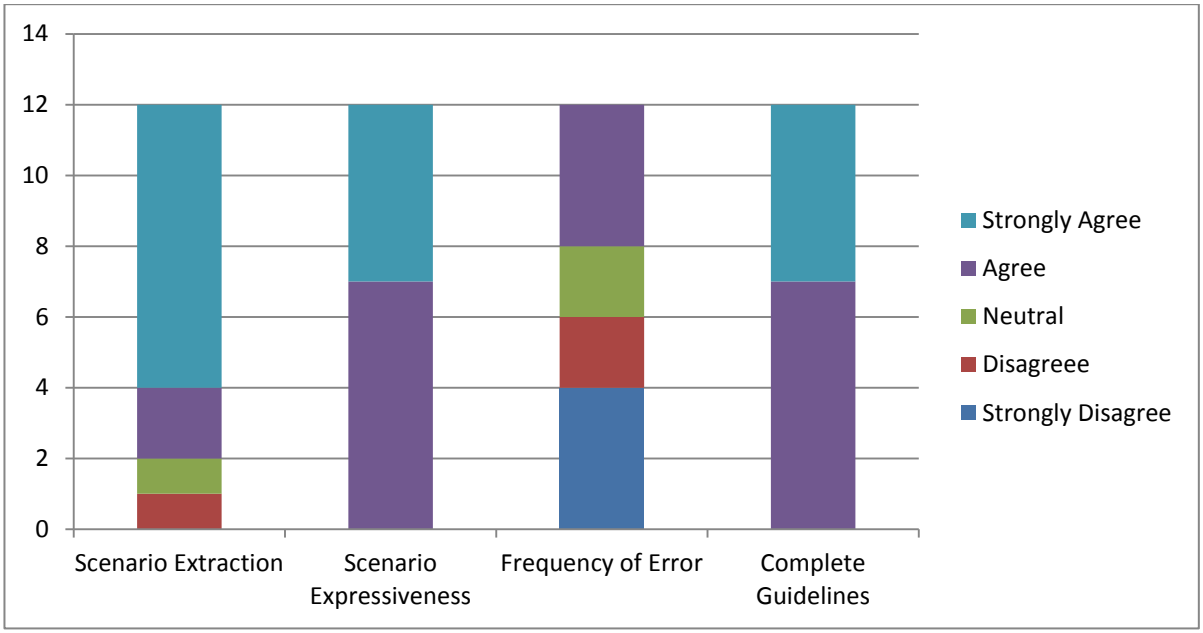


Figure 6.9: Summary of answers to questions in part four

The results obtained from this part of the evaluation highlighted the following outcomes:

1) TranspLan has social pragmatic quality, since participants could understand the model and could build and extract expressive scenarios based on it.
2) TranspLan is expressive in scenario building, with little or no frequency in making errors. Furthermore, the guidelines provided for TranspLan are complete and help in scenario extraction.

6.2.6 TranspLan and Quality Criteria

The empirical study which was conducted (explained in Section 6.2.5) helped identify four types of quality criteria which were categorised as observational quality types. In other words, the empirical study suggested that TranspLan has empirical quality, social pragmatic quality, social quality, and perceived semantic quality.

In this Section, the non-observational quality types will be investigated using the same method followed by Krogstie (2003) for assessing the quality of UML.

6.2.6.1 Physical Quality of TranspLan

Physical quality relates to the basic quality goals on the physical level that are externalised, that the knowledge *K* of the domain *D* of some social actor has been externalised by the use of a modelling language and internalised, and that the externalised model *M* is persistent and available, and so the audience can make sense of it.

Physical quality has two main aspects. The first one is the externalisation of the knowledge using the modelling language. It can be argued that TranspLan externalises the knowledge on transparency because it is based on the reference models which capture several (if not all) aspects of transparency requirements. That is to say, TranspLan has the capability to externalise the knowledge on transparency so that people can make sense of it and discuss it. In terms of documentation, the specifications of TranspLan are primarily externalised as a documentation which includes examples.

The second aspect is the internalisation of the knowledge. How people perceive the model is a matter of internalisation. A persistent and available modelling language helps the internalisation process. TranspLan is available for everyone and has only one version and one interpretation at the moment; therefore it is persistent as well. This helps the internalisation process of TranspLan. Consequently, it can be concluded that TranspLan has physical quality.

6.2.6.2 Syntactic Quality of TranspLan

Syntactic quality is the correspondence between the model *M* and the language extension *L* of the language in which the model is written.

TranspLan uses mathematical definitions for its constituents which gives it a vigorous structure. The syntax used in TranspLan is detailed to the understanding level of its users and the examples given are according to the syntax of TranspLan. The three-layered structure of each information exchange facilitates easier error detection and error correction. Consequently, it can be concluded that TranspLan has syntactic quality.

6.2.6.3 Semantic Quality of TranspLan

Semantic quality is the correspondence between the model *M* and the domain *D*. The framework contains two semantic goals: validity, meaning that all statements made in the model are correct relative to the domain, and completeness, meaning that the model contains all statements which are found in the domain.

In TranspLan, it was already explored empirically that the language benefits from ontological clarity and completeness. Furthermore, it can be argued that TranspLan makes all statements made in the model correct and related to transparency and also all statements found in the domain are contained in the model as it is founded on the reference models. This means that the two semantics goals of validity and completeness are achieved. Finally, the descriptions of the notation and semantics are fairly complete and there are no inconsistencies in the language. Consequently, it can be concluded that TranspLan has semantic quality.

6.2.6.4 Organisational Quality of TranspLan

Organisational quality of the model corresponds to the premise that all statements in the model either directly or indirectly contribute to fulfilling the goals of modelling (i.e., organisational goal validity) and that all goals of modelling are addressed through the model (i.e., organisational goal completeness).

In the TranspLan modelling language, all the statements in the model assist the goals of the modelling, meaning that every statement serves its purpose in identifying one aspect of transparency. This fulfils the organisational goal validity. Furthermore, all the goals of modelling (i.e., finding transparency meaningfulness, transparency usefulness, transparency stakeholders, and information quality in transparency) are addressed by the use of the model. This fulfils organisational goal completeness. Consequently, it can be concluded that TranspLan has organisational quality.

6.2.6.5 Technical Quality of TranspLan

Technical pragmatic quality refers to the extent to which tools can be constructed to understand the models.

As it was shown in the previous chapters, TranspLan facilitates the development of analytical algorithms and the automated analysis of transparency requirements. The language also has the potential to be represented by Computer-Aided Software Engineering (CASE) tools for the modelling of transparency requirements. Consequently, it can be concluded that TranspLan has technical quality.

6.2.7 Discussion

In the light of the obtained results, the study question can now be answered as follows:

1) **How much empirical quality, social pragmatic quality, social quality, and perceived semantic quality does TranspLan modelling language have?** The results of the evaluation case study, obtained from experts in software modelling, illustrates that TranspLan has a reasonably high quality in the aforementioned areas of observational quality types. The investigation into non-observational quality types (i.e., physical quality, syntactic quality, semantic quality, organisational quality, and technical quality) complements the evaluation case study and denotes that TranspLan modelling language benefits from all quality types mentioned in SEQUAL framework. The obtained results imply that requirements engineers will be able to use TranspLan for transparency requirements with minimal difficulty when it comes to the quality of the language.

Similar to the previous case study, it should be noted that the results obtained from this case study are not definitive, and in order to truly observe the quality of TranspLan, it should be first used in a larger scale by the requirements engineering community so that it is verified across several real-world transparency modelling and analysis activities. This, of course, is not limited to TranspLan and all modelling languages have to undergo this process. It is also understandable that TranspLan is a newly devised modelling language and consequently, the results of this evaluation case study remain valid until future usages.

6.2.8 Threats to Validity

In the empirical part of this study, twelve participants, each with expertise in modelling, participated in the evaluation. The study session included four sections which together served to evaluate TranspLan in terms of expressiveness, locality of change, etc., while they also served to investigate four different types of quality criteria mentioned in the SEQUAL framework. In the empirical part of this study, some threats to validity were identified. These threats are listed below:

- It is well understood that the quality of a given modelling language can be assessed more realistically with real applications and implementations, in which an organisation's transparency requirements are elicited, modelled, and analysed in a real-world setting. Only through the constant use of the modelling language in authentic requirements engineering scenarios can that modelling language be really tested and its qualities recognised. However, a case study approach would still be desirable for a newly-devised modelling language, and could provide a useful means to evaluate and assess its fundamental quality attributes.

- During the study, each participant could only evaluate one model and scenario of another participant. This could lead to conditions where bias against a participant could affect the evaluation of their models and scenarios. However, models and scenarios were randomly assigned to participants to minimise the effects of such bias.

6.2.9 Lessons Learnt

This study highlighted the quality criteria associated with TranspLan and its potential for being used as a modelling language for the engineering of transparency requirements in business information systems. However, during the discussion on the modelling and scenario building with TranspLan, some interesting comments were also observed.

Participants appreciated the three-layered structure of the information exchanges in TranspLan, as it made it easy for them to draw them once they learned the basics of the language. According to one participant, it also made it easier for them to avoid possible errors during modelling and to detect and correct them in their (or other people's) models.

With regards to the graphical representation, one participant mentioned that the drawing of two parallel lines (which indicates limited access to an information element) could be a bit ungainly and a possible source of confusion when the model is or has been drawn by hand. They suggested an alternative, like a line with a cross over it instead. On the other hand, participants appreciated the use of a few shapes which could increase the learning curve. For example, they appreciated the use of rectangles for all information types (i.e., data, process, and policy) instead of devising a shape for each one of them.

It was also observed during the evaluation session that drawing a model from a given scenario is more difficult than writing a scenario based on a given model. It can be argued that this is shared by all modelling languages, as writing in your own language takes less mental power than drawing in a modelling language, especially a new one, where you have to remember the meanings of shapes, lines, etc.

6.3 Evaluating the Structured Feedback Elements Used in Stream Method

In the previous chapter (i.e., Chapter 5), a method for the elicitation and adaptation of transparency requirements in a business information system, called Stream, was proposed. The method is based on a conceptual framework for crowdsourcing transparency requirements through structured feedback and social adaptation. It is acknowledged that evaluating a method in its entirety is a very time-consuming task in which every aspect and step in the method should be evaluated, before one can claim that the method, in its entirety, works as expected. However, given the scale of this thesis,

a full evaluation of Stream was impractical in terms of time and resources, and it was decided that one aspect of the conceptual framework, upon which the method is based, be evaluated. Of the three aspects of crowdsourcing, structured feedback acquisition, and social adaptation, feedback was selected. One reason to choose this aspect is that the method itself relies heavily on feedback and is bound to fail if feedback is not provided by stakeholders during the elicitation, clarification, and evolution phases. Therefore, providing feedback in a timely and structured manner plays a vital role in the success of the proposed method. Another reason is that in requirements engineering, the role of user feedback is accentuated, especially for the purpose of system adaptation and evolution (Madhavji et al. 2006).

In the previous chapter, a guideline was presented for feedback elements and their structure for the engineering of transparency requirements (see Figure 5.5). This guideline maps out the elements of transparency, based on the reference models, which stakeholders can provide feedback on. However, it was also briefly pointed out that the language of the crowd might be different from the terminology which is used in the guideline. Therefore, the first question that comes to mind is, how do crowd members express their feedback on transparency requirements and what words and expressions do they use to channel these needs to requirements engineers?

Furthermore, with regards to the evaluation of the feedback, it is important to identify whether all the listed items in the feedback guideline are also perceived by crowd members in their ordinary language. In other words, it is important to identify that real-world equivalents exist for every item listed in the feedback guide. Therefore, the second question regarding the feedback on transparency requirements is, do all the transparency constituents listed in the feedback guideline actually exist in the perception of crowd members on their transparency requirements?

Finally, asking every crowd member about all those constituents of transparency is unlikely going to work, as people generally do not tend to allocate too much time on their feedback (Pagano and Maalej 2013). This means that when crowd members encounter a long list of tick boxes and radio buttons to tick off and choose from, they will either provide no feedback at all and close the feedback form or they will click through options carelessly without much thought. In both cases, requirements engineers will be left either with no feedback or with unreliable feedback. The third question, therefore, in the case of transparency requirements feedback acquisition is, how can feedback on transparency be acquired from the crowd, feedback which is both reliable and covers all aspects of transparency, as listed in the feedback guideline?

6.3.1 Case Study Aim and Questions

The aim of conducting this evaluation case study was to assess how the acquired feedback from the crowd is expressed and determine whether this feedback is also reflected in the feedback guide for the engineering of transparency requirements. In particular, the case study aims at finding the answers to these questions:

1) How do crowd members express their feedback on transparency requirements and what words and expressions do they use to channel these needs to requirements engineers? The answer to this question provides a list of vocabulary items and terminology understood by the crowd and can be utilised in the design of structured feedback acquisition forms.
2) Do all the transparency constituents listed in the feedback guideline actually exist in the perception of crowd members on their transparency requirements? A positive answer to this question paves the way for requirements engineers to translate every item in the list to a crowd-friendly language and present it as a form of structured feedback to the crowd, which brings up the next questions.
3) How can feedback on transparency be acquired from the crowd, feedback which is both reliable and covers all aspects of transparency, as listed in the feedback guideline?

6.3.2 Study Design and Conduct

This case study was conducted in a way that all of the three questions mentioned above are duly answered. In order to answer question one, the study utilised an open text feedback acquisition method. The open text design helped in understanding whether every transparency constituent listed in the feedback guide has actual real-world representations in the language of the crowd. In order to answer the second question, the study allowed crowd members to provide as much feedback on their transparency requirements as they felt necessary during the conduct of the study, while simultaneously asking them to answer some questions on a voluntary basis. In order to answer the third question, a detailed text analysis on the acquired feedback was performed, first by the main investigators and then by another investigator for modification and confirmation purposes. However, for developing a *comprehensive* terminology of the crowd on transparency requirements analysis, a bigger crowd should be recruited.

In order to attract participants in this study, the university mailing list was chosen while the study was also advertised on social media, including Facebook and Linkedin. Several files, including the Evaluation Sheet (See Appendix Three, Section 2), Information Sheet (See Appendix Three, Section 3), and Consent Form (See Appendix Three, Section 4) were sent via email (See Appendix Three, Section 1) to participants who responded to the participation call and expressed their interest to take part in the study.

The participants were given four scenarios and were requested to answer some statements made on each scenario. Furthermore, they were asked to write a paragraph on the quality on the information in each scenario. The statements and the mentioned paragraphs were meant to capture transparency requirements of the participants through open text and in the way they preferred to answer. Responding to any part of the statements in the scenarios was voluntary to minimise the chances of quick thoughtless feedback. In total, 32 people participated in the study, from which 28 information sheets were used for this evaluation study, and four were removed as a result of total lack of quality in providing any meaningful feedback. The unit of analysis in this case study was therefore the collection of participants in this case study.

This should be noted that because the nature of the study included getting feedback in a real-world setting, a few participants did not answer some of the questions. Having an ambitious evaluation project in mind, it was initially aimed at finding how different ages use different linguistics, words and phrases, as confirmed in several studies (e.g., Pennebaker and Stone 2003, Schler et al. 2006). However, because of the number of participants and because most of them were at the age range of 26-35, this part of the study was later abrogated.

6.3.3 The Four Scenarios and Related Statements

Four scenarios were presented to the participants and they were requested to answer voluntarily to some statements based on each scenario. The scenarios were prepared in a way that covered all constituents of the feedback guideline in terms of information quality and transparency meaningfulness, and also covered different stages of transparency usefulness. The information provided in each scenario lacked certain quality attributes, could lead to information starvation or information overload in certain cases, and could potentially fail in achieving useful transparency in different steps. They were also asked to voluntarily write a paragraph on the quality on the information they were provided in every scenario. Finally, they were asked for further voluntary comments and thoughts. These scenarios and their corresponding statements are given below.

6.3.3.1 Scenario 1

Information Source: A mortgage pamphlet with 50 pages that you find after a very long search

Excerpts from the pamphlet: … The capital gains tax may defer certain buy-to-let mortgage seekers to apply for the mortgage … Customers should look at droplock and drawdown rules and regulations … In certain cases, a redemption administration fee or a valuation administration fee may apply … It is subject to either a homebuyer's survey or a full structural survey … You may also have to consider the deed of postponement in this case … Gazumping and gazundering will be prohibited after an agreed time and date.

Statements:

1. You want to get some information on how to get a mortgage to buy a house.
2. You want to know why there is a difference between first-time buyers and regular buyers.
3. You want to know if you can buy a house based on your deposit.
4. You want personal advice on how to apply for a mortgage.

6.3.3.2 Scenario 2

Information Source: An anonymous blogger's opinion not representing the bank, before you install the banking app.

Information: I used to work with the banking app, and I should tell you it is totally harmful for your privacy. First, they store all the passwords on their servers without any protection such as encryption (this is what I have heard even though they do not admit it). Second, I have heard that their banking app is full of bugs and errors. Third, you cannot uninstall the app any time you want and you have to go to a branch for full uninstallation.

Statements:

1. You want to download and install a banking app and you want to know their privacy policy on where they store your username and password.
2. You want to know whether you can uninstall the app any time you want.
3. You want to get your answers before you install the app.
4. You want a reliable source of information.

6.3.3.3 Scenario 3

Information Source: The website of the football club one month before the match the information is available on the website.

Information: You can purchase tickets safely from official Club websites or ticket offices, in person or over the phone. Clubs will also provide details of any authorised ticket partners on their official site. To get a discount, you can become a member, buy group tickets (at least 20) or buy an early bird ticket (at least two months in advance):

- You may want to become a member because you want to enjoy the benefits of priority access to tickets.
- You can buy group tickets (20 tickets or more) for you and your companions.
- You may buy a ticket to a match at least two months advance.

Statements:

1. You want to buy a ticket to a football match and you want to know what the different ways to get a discount are. There are actually three ways to get a discount, becoming a member, buying at least 10 tickets at the same time, or buy a ticket at least two months in advance.
2. You want to know how you can become a member.
3. You want to buy one ticket to a match two months in advance to get a discount.
4. You want a reliable source of information.

6.3.3.4 Scenario 4

Information Source: The website of the member-exclusive hotel booking

Information: The booking process starts when you click on Book Now on the bottom of the page. You need to follow three very easy steps: 1) choose you hotel and date, 2) enter your exclusive membership number you find on your card, and 3) enter your credit card info. Our amazing members of staff will do the rest and ensure you will have the most wonderful stay in your exclusively prepared hotel during your visit. (Hotel names and corresponding information are all fictional.)

Hotel	Available From	Available To	Country	Stars Rating
Blue Atlanta	January 12, 2017	January 18, 2017	Spain	4
Heavenly Sky	2017-09-18	2017-09-22	Germany	4
Precious Gem	09/10/2017	14/10/2017	Wales	4
Spring Hotel	June 2017	August 2017	France	4

Statements:

1. You are reading an online member-exclusive travel brochure and you only want to find a suitable date when you can travel to a European destination with a reasonable price for 2017. You already know the booking process.
2. You want to know if the hotel price is inclusive of local taxes.
3. You want a reliable source of information.

6.3.4 Results

The results of this evaluation study are presented per scenario. These results are divided into two sections of “meeting requirements”, which discusses whether the statements in each scenario were addressed properly, and “information quality”, which describes information quality dimensions

which were missing in that scenario. A “discussion” section for each scenario is also presented in the same section and discusses the obtained results.

6.3.4.1 Scenario 1

Meeting Requirements: Most of the participants in this scenario explicitly mentioned that none of their questions were answered by looking at the information provided in the scenario. More specifically, some participants mentioned that the amount of information was more than they really needed to answer their questions, and this could lead to confusion, while some other participants stated that they could not find the information they wanted. This leads to an interesting case where both information starvation and information overload happens.

As it was discussed earlier on Transparency Depth Pyramid, information overload and information starvation can happen both vertically and horizontally. In this case, information starvation happens vertically, because people are only given data and not provided with policies (in this case, why there is a difference between first-time buyers and regular buyers). On the other hand, information overload happens horizontally, because people are given more data than they need, and it makes it difficult for them to find the answers to their questions inside the provided information.

Some participants noticed that the pamphlet was a general-purpose information sheet, and therefore it was impractical to find the answers to any personal questions in it (i.e., the third and fourth questions), and they felt obliged to find the information by other means (e.g., calling a bank branch). That is to say, these participants noticed that the information has no (personal) relevance to their information needs.

Information Quality: Since participants could not find the information they needed, they mostly mentioned that the information was not complete and it was “missing”, “not found”, “not available”, and “not answering the questions”, while the lengthy pamphlet (containing 50 pages) also made some participants complain about the lack of an appropriate amount of information and the lack of concise representation of information. Here, they used expressions such as “very long” and “too much unnecessary detail”.

Understandability and interpretability of the information were among other information quality dimensions that were repeatedly mentioned by the participants, using words and expressions such as “complex”, “complicated”, “vague”, “unclear”, “ambiguous”, “not simple”, “confusing”, “unexplained”, “undefined”, and “unfamiliar”. They mostly criticised the use of mortgage jargons and technical terms, and some even stated that they needed to refer to a dictionary or Google the terms (hence, the lack of *interpretability*), while some expressed their confusion in understanding

what the text meant and stated that the language used in the pamphlet was “different from common users’ terminology” and therefore was not appropriate for the general audience and ordinary people.

The lack of information regarding personal questions made several participants doubt the relevance of the information to their personal needs, using expressions such as “unrelated” “not personalised”, and “hardly informative”. On the other hand, a few participants picked up on the long search for information and questioned the accessibility of information. Since the information did not help participants make an informed decision, it can be deduced that the value-added quality of the information was also lacking. For the failure of transparency in reaching actionability, most participants blamed the lack of *understandability* and *interpretability*, while some also blamed the difficulty in accessing the information (i.e., the lack of *accessibility*).

Some participants listed reliability as a positive information quality. They did not mention any other positive information quality for the information provided in this scenario.

Discussion: The lack of some quality attributes was easier for the participants to notice. For example, understandability, interpretability, and completeness were noted by almost all participants. On the other hand, the lack of concise representation and the lack of accessibility were mentioned by fewer participants. This might be an indicator of what information quality dimensions people take most and least notice of, and an indicator of what to be emphasised in a structured feedback form.

With regards to transparency meaningfulness, all participants noticed a lack of policy and an abundance of data. With regards to transparency usefulness, everyone indicated a failure in providing useful transparency. The results in this scenario illustrated that while participants may not be able to identify the exact loci where information quality dimensions are lacking, they could still identify whether the information provided to them was meaningful and useful.

Table 6.4 summarises the findings for the spotted transparency problems in scenario one, with regards to transparency meaningfulness and transparency usefulness. Table 6.5 summarises the crowd language for the missing information quality dimensions in scenario one.

Table 6.4: Spotted problems in transparency meaningfulness and transparency usefulness in scenario one

	Spotted Problem(s)
Transparency meaningfulness	Information starvation Information overload
Transparency Usefulness	Lack of interpretability Lack of accessibility Lack of understandability

Table 6.5: Crowd language for the missing information quality dimensions in scenario one

Information Quality Dimension	Words and Expressions Used
Completeness	Missing ● Not found ● Not available ● Not answering the questions
Appropriate Amount	Lengthy
Concise Representation	Too much unnecessary detail
Understandability and Interpretability	Complex ● Complicated ● Vague ● Unclear ● Ambiguous ● Not simple ● Confusing ● Unexplained ● Undefined ● Unfamiliar ● Different from common users' terminology
Relevance	Unrelated ● Not personalised ● Hardly informative
Accessibility	Long search
Value Added	Not useful ● Not being able to make decisions

6.3.4.2 Scenario 2

Meeting Requirements: Participants almost unanimously stated that their first three questions in this scenario were answered, while for the last question regarding a reliable source of information, they stated that the source was not reliable. Interestingly though, a few participants said that their first question regarding the understanding of the privacy policy of the banking app was not answered, as they linked it to the reputation of the source. In other words, since they did not believe in the source of the information, they could not confirm that their question was really answered. This, in turn, emphasises the importance of the information source reputation. On the other hand, one participant mentioned that an anonymous blogger might still be a reliable source of information, since many people nowadays get their information from blogs scattered on the Internet. They also mentioned that it provided a user's perspective, which could be more useful than

that of a bank representative. In terms of information starvation or information overload, everyone agreed that the amount of information, regardless of its source reputation, was satisfactory.

Information Quality: Participants generally noticed that the information lacks reputation and as a result, believability. Some of the words and phrases they used included “suspicious”, “unreliable”, “not trusted”, “untrustworthy”, “not accredited”, “not credible”, “not certified”, “not independently reviewed”, “invalid [source]”, “fishy”, and “risky”. Some participants furthermore questioned the objectivity of the information, saying that it was “subjective”, “personal”, “unprofessional”, “unofficial”, “biased”, “judgy”, “unverifiable”, “word of mouth”, “based on what he heard”, “[based on] a predetermined opinion”, “not based on facts”, and “purely anecdotal review based on his own experience”. A participant went as far as to say that the information was not complete, because, as they argued, it only represented one person’s perspective of the problem at hand.

Almost all participants did not find the provided information actionable and refused to make a decision based on it. All these participants pointed to the lack of *acceptance* as the main factor of failed transparency. Only one participant (discussed previously) still found the information actionable and expressed that they could make a decision based on it, even though they still articulated their concern on the unreliability of the information source. Once again, since the information did not help participants make an informed decision (except in one case), it could be reasoned that the value-added quality of the information was also missing.

As for positive information quality dimensions, some participants stated that the information was timely, as they could have the information before installing the app. They also mentioned it was concise and presented in short simple sentences. They mentioned it was detailed enough and understandable.

Discussion: In this scenario, the lack of some information quality dimensions was more prominent than others. Almost every participant identified the lack of a reputable source, and many participants also identified that the information was no longer believable because of such disrepute. Fewer participants mentioned the lack of objectivity of the information though, which could be explained as tacit or presupposed knowledge. This, in turn, could emphasise again the importance of a proper structured feedback acquisition form where such tacit knowledge could be elicited by the requirements engineers on transparency requirements of stakeholders.

Table 6.6 summarises the findings for the spotted transparency problems in scenario two, with regards to transparency meaningfulness and transparency usefulness. Table 6.7 summarises the crowd language for the missing information quality dimensions in scenario two.

Table 6.6: Spotted problems in transparency meaningfulness and transparency usefulness in scenario two

	Spotted Problem(s)
Transparency meaningfulness	No issues spotted
Transparency Usefulness	Lack of acceptance

Table 6.7: Crowd language for the missing information quality dimensions in scenario two

Information Quality Dimension	Words and Expressions Used
Reputation and Believability	Suspicious ● Unreliable ● Not trusted ● Untrustworthy ● Not accredited ● Not credible ● Not certified ● Not independently reviewed ● invalid [source] ● Fishy ● Risky
Objectivity	Subjective ● Personal ● Unprofessional ● Unofficial ● Biased ● Judgy ● Unverifiable ● Word of mouth ● Based on what he heard ● [Based on] a predetermined opinion ● Not based on facts ● Purely anecdotal review based on his own experience
Value Added	Not useful ● Not being able to make decisions

6.3.4.3 Scenario 3

Meeting Requirements: Participants generally agreed that the information answered their first question regarding the different ways to buy a discount ticket, and failed in answering their second and third questions, regarding how to become a member and buying a ticket two months in advance. The failure in answering the second question led to information starvation in participants, while failure in providing the information when it could be useful resulted in failure in information actionability. However, regarding the fourth question which was about a reliable source of information, while many agreed that the information source is reliable, a few participants argued that because of the unavailability of the information when they needed it to purchase a discount ticket, the information source was not reliable anymore. In other words, they associated the lack of timeliness in providing actionable information to unreliability of the information source.

Information Quality: Since the provided information did not mention anything about how one can become a member, many participants could identify a lack of completeness and a lack of appropriate amount in the provided information, complaining about information that is "missing", "incomprehensive", "containing extra information", "not enough", and "insufficient". Furthermore, as the information only became available one month prior to the match, while to get a discount they needed to buy a ticket at least two months before the match, many participants easily spotted a lack

of timeliness in the information, saying it was “no longer useful”, “published too late”, and “outdated”. The same problem, i.e., the lack of *accessibility* in the information when it was needed, led to a failure in transparency provision, as participants argued that the information “was not useful anymore” when it became accessible on the website. Several participants also pointed to an inconsistency between what they knew (i.e., buying ten tickets gives them a discount), and what the website stated (i.e., buying twenty tickets gives them a discount), and therefore, they expressed that the information was “wrong”, “incorrect”, “different [than what they knew]”, “conflicting”, “dissimilar [to what they knew]”, and that it “had a mistake” and with “questionable integrity”, i.e., it was not free of error. The failure of information in providing useful transparency could also lead to a lack of value-added quality in the provided information.

Some participants also noticed the positive information quality dimensions. For example, some participants found the provided information reliable and credible, as it was from the website of the football club. Some other participants stated their satisfaction with the precision, correctness, and understandability of the information.

Discussion: Once again, participants mentioned that information starvation on how to become a member is a notable issue with the provided information. That suggests, once more, that a lack of meaningfulness in information is quickly spotted by transparency seekers and information receivers. The same applies to a lack of useful transparency which is a result of not having access to actionable information. Participants could easily spot problems in the provided information quality such as a lack of completeness or timeliness, while a smaller number of participants could spot that the information actually contained an error.

Another interesting feedback was the association a few participants made between the untimeliness of the information and the reliability of the information source. They argued that an information source which fails to provide information in a timely manner cannot be a reliable one. In a bigger picture, this could be true when an information source repeatedly provides outdated information, as pointed out by do Prado Leite and Cappelli (2010). That demonstrates the importance of information sources to keep their stakeholders informed with recent updated information.

Table 6.8 summarises the findings for the spotted transparency problems in scenario three, with regards to transparency meaningfulness and transparency usefulness. Table 6.9 summarises the crowd language for the missing information quality dimensions in scenario three.

Table 6.8: Spotted problems in transparency meaningfulness and transparency usefulness in scenario three

	Spotted Problem(s)
Transparency meaningfulness	Information starvation
Transparency Usefulness	Lack of accessibility

Table 6.9: Crowd language for the missing information quality dimensions in scenario three

Information Quality Dimension	Words and Expressions Used
Completeness	Missing ● Incomprehensive ● Not enough ● Insufficient
Appropriate Amount	Containing extra information
Timeliness	No longer useful ● Published too late ● Outdated
Free-of-error	Wrong ● Incorrect ● Different [than what they knew] ● Conflicting ● Dissimilar [to what they knew] ● [With] mistakes ● [With] questionable integrity
Value Added	Not useful ● Not being able to make decisions

6.3.4.4 Scenario 4

Meeting Requirements: Participants mostly stated that their first question, regarding finding dates for a journey based on the provided information, was answered. For their second requirement regarding the local taxes, all participants unanimously agreed that the information was missing, and considered it as a deterrent in making an informed decision. For the third question, many participants considered the member-exclusive hotel booking website a reliable source of information, while a few considered it as unreliable because of its failure to provide transparent information to them for making a booking decision.

Some participants identified the existence of information overload in the scenario. They pointed out to the fact that they already knew the booking process, but the website still offered this information. Since they did not need to be reminded of this information again, they considered it as information overload. In other words, while the participants only needed to be provided with the data they required, they were given information on processes which they were already aware of. The lack of information on local taxes also resulted in information starvation, which was noticed by a few.

Information Quality: Participants mainly discovered that the information lacked completeness, since it could not answer their questions on local taxes, using expressions such as “missing” and “lacking”. Some also noticed that the information did not have an appropriate amount, not giving any

information on local taxes while giving some information on the booking process which they did not need. In other words, they identified “too much information” on what they already knew (which consequently led to information overload) and no information on local taxes (which consequently resulted in information starvation). Some of the words and expressions they used were “not detailed enough” and “redundant”.

Several participants also expressed their concern over the lack of a consistent representation of information regarding the dates in the table, using words and phrases such as “inconsistent”, “non-uniform”, “confusing”, and “in different formats”. Participants stated that because of the lack of the *availability* of price information on the website, the provided information was not actionable and they could not proceed with the booking. Once again, this also implied that the information lacks the value-added quality.

As for the positive information quality dimensions, some participants mentioned that the information was reliable and trustworthy because it was from the website of the member-exclusive hotel booking. A few participants also stated that the information had to be correct because it was coming from a reliable source.

Discussion: Interestingly, and contrary to the initial assumptions of the investigator, some participants did not notice the inconsistency in the provided information. One reason could be that the information was still understood by those participants, and as a result this quality measure was overlooked. Another interesting observation was that similar to the previous scenario, some participants associated the missing information to the reliability of the information source. In other words, failing in providing transparency could be linked to unreliability, a characteristic that must be appropriately noted by information providers.

Finally, the lack of meaningfulness and usefulness in transparency was easily identified by participants. On the other hand, participants also recognised the presence of information which they already knew and no longer needed. This also calls for information providers to be aware of the possible negative effects of presenting already known information to stakeholders, which could simultaneously increase the volume of information and unintentionally hide the sought-after information from them.

Table 6.10 summarises the findings for the spotted transparency problems in scenario four, with regards to transparency meaningfulness and transparency usefulness. Table 6.11 summarises the crowd language for the missing information quality dimensions in scenario four.

Table 6.10: Spotted problems in transparency meaningfulness and transparency usefulness in scenario four

	Spotted Problem(s)
Transparency meaningfulness	Information overload Information starvation
Transparency Usefulness	Lack of availability

Table 6.11: Crowd language for the missing information quality dimensions in scenario four

Information Quality Dimension	Words and Expressions Used
Completeness	Missing ● Lacking
Appropriate Amount	Too much information ● Not detailed enough ● Redundant
Consistent Representation	Inconsistent ● Non-uniform ● Confusing ● In different formats
Value Added	Not useful ● Not being able to make decisions

6.3.4.5 Discussion

In light of the results presented above, the questions related to this case study are presented again, and their answers are also provided based on the obtained results.

1) **How do crowd members express their feedback on transparency requirements and what words and expressions do they use to channel these needs to requirements engineers?** As the study suggests, crowd members use words and phrases which may not be necessarily identical to the words and phrases in the feedback guide. As a result, it is important for requirements engineers to design their structured feedback in a way that covers this diversity in the language by the utilisation of a crowd-friendly language. Furthermore, the acquisition of open text feedback on transparency should also facilitate methods (e.g., natural language processing techniques) considering such multiplicity. The aggregation and compilation of a comprehensive list of words and phrases for transparency requirements and the meticulous design of all-encompassing structured feedback remains a challenge and a future work.
2) **Do all the transparency constituents listed in the feedback guideline actually exist in the perception of crowd members on their transparency requirements?** The study illustrated that the constituents of feedback guideline are in reality also noticed and expressed by stakeholders. Even though a particular stakeholder may not be aware of all these

constituents and mention a subset of them in their feedback, the collective feedback acquired from a reasonably large crowd is enough to pinpoint the lack or the existence of transparency measures and information quality dimensions for the use of requirements engineers. This, in turn, explains why crowdsourcing transparency requirements elicitation can be a solution to the elicitation of these requirements.

3) **How can feedback on transparency be acquired from the crowd, feedback which is both reliable and covers all aspects of transparency, as listed in the feedback guideline?** The results of the study suggest that it is impractical to request a thorough feedback on all the constituents of transparency from each stakeholder. At least two reasons can be enumerated for such impracticality. First, as the study illustrated, some aspects of transparency might be obscured to some stakeholders. Therefore, it would be impossible to provide feedback on those transparency aspects unbeknownst to them. Second, since there are many constituents of transparency (as listed in feedback guide), stakeholders may not be willing or may not have the resources (e.g., time) to provide a comprehensive feedback. Consequently, requirements engineers should provide parts of the transparency constituents to a large, diverse pool of stakeholders in a systematic way. However, the development of such a systematic method for the elicitation of transparency requirements remains a challenge and a future work.

Furthermore, the following results were obtained based on the study. First, all transparency requirements of stakeholders were already present in the feedback guide. That is, the feedback guide was effective in capturing their transparency requirements. This indicates that the feedback guide is a comprehensive list of transparency requirements constituents which can be used by requirements engineers. Second, it was observed during the study that once information is provided to the stakeholders, they may no longer need to have access to that information. This is because transparency requirements are sometimes transient, and it illustrates that constant adaptation is needed in the engineering of transparency requirements in business information systems.

Finally, although participants were asked to talk about information quality, they mostly picked up on those missing information qualities. In other words, the amount of feedback on positive quality dimensions was far less than the negative ones. Furthermore, participants were more aware of leaving a positive feedback when they were explicitly asked for it, e.g., in the second scenario for the timeliness of information and in the third and fourth scenario for the reliability of information. This observation leads to an interesting result. If requirements engineers want positive feedback in the engineering of transparency requirements, they had better be explicit about it. Although negative

feedback is more needed for removing bugs and fixing software problems (Barlow and Møller 1996), having positive feedback can also assure requirements engineers that a part of the software system is working according to the expectations of its stakeholders.

6.3.5 Threats to Validity

This study evaluated one part of the Stream method which was related to the feedback acquired from the stakeholders (i.e., the crowd) as an attempt to be informed while designing structured feedback for transparency requirements of stakeholders in a business information system. The study included some threats to validity, which are discussed below:

- The number of participants did not allow for the construction of a comprehensive list of terminology for the crowd-friendly language related to transparency. On the other hand, the number was big enough to encompass all the constituents of transparency listed in the feedback guide. Therefore, the goal of the study was nonetheless achieved.
- Since answering each statement and providing feedback on the quality of the information was voluntary, there were participants who did not provide answers to some of the statements. This made any type of statistical analysis difficult. However, this also made the provided feedback more reliable, as participants answered willingly and carefully those parts which they did.

6.3.6 Lessons Learnt

This study proved that the feedback guideline provided for transparency requirements has the potential to be used to capture all transparency requirements of the stakeholders. What remains to be done by requirements engineers is 1) to format it in a language easily understood by crowd members, 2) to present part of it to the crowd members on a random basis but systematically so that all transparency aspects are covered in general, and 3) to watch out for possible new words and expressions in order to add them to their already list of vocabulary used for the elicitation of transparency requirements.

As stated earlier in this section, a complete evaluation of the method would be ideal, but is out of the scale of this thesis both in terms of time and resources. Therefore, it remains as part of the future work to fully evaluate the method and also to make use of a bigger crowd during a full evaluation study.

6.4 Summary

This chapter was dedicated to three case studies evaluating the TranspLan modelling language and the partial evaluation of the Stream method. The evaluation of TranspLan focussed on its usefulness and quality aspects while the evaluation of Stream mainly concentrated on the feedback acquired

from crowd members and stakeholders on their transparency requirements. Both the modelling language and the method illustrated great potentials for helping requirements engineers in the modelling and analysis of transparency requirements in particular and in the engineering of transparency requirements in business information systems in general. In the next chapter, this thesis will be concluded and future work, where relevant, will be presented.

Chapter 7

Conclusion

"It always seems impossible until it's done."

Nelson Mandela

7 Conclusion

Transparency requirements, similar to any other requirement in the domain of requirements engineering, need to be properly met so that stakeholders of a business information system feel content and satisfied. However, the turn of the millennium has probably rendered transparency requirements more important and more difficult to manage than ever before and this required dealing with it with more scrutiny and handling its nuances and peculiarities as a special kind of requirement.

The growing importance of transparency requirements stems from several facts. The millennials, for example, and their successive generations, are transparent in a way that is different from their predecessors as a result of growing up with Internet, social media, and Web 2.0, and they illustrate such transparency by sharing their photos, feelings, thoughts, everyday life events, places they check into, and so on. They also need more transparency, especially in a digital form, from other people, organisations, and government agencies, which usually directly affects their trust relations with them. Their desire to know, as the result of easier access to information in the information age, drives their need for more transparency. Furthermore, the driving force of the increasing call for transparency lies in the belief that it can be useful in leading to more accountability, democracy, and effective decision-making and action at different levels and across private and public domains. This growing importance is especially reflected in the growing amount of research in transparency requirements, and this thesis was a contribution to that effort.

The increasing difficulty of managing transparency requirements is rooted in technical, managerial, and also psychological factors. This includes information explosion, or the rapid growth of the amount of accessible information, which makes it difficult to be able to retrieve the required meaningful information from the abundance of information available from various information sources. It is also included in the dissimilarity in stakeholders' perception of obtained information, which requires tailored transparency to meet the requirements of every individual and render it useful to them. Last but not least, its difficulty lies in the provision of information which meets the quality threshold of the stakeholders and is "good enough" to help them in their decision-making processes without creating subconscious bias.

In the light of the aforementioned issues, this thesis has attempted to address the management of transparency requirements of stakeholders in a business information system. In order to do so, a domain-specific modelling language, called TranspLan, was proposed for the modelling and analysis of transparency requirements. Then, an engineering method, called Stream, was proposed for the

whole life cycle of transparency requirements, which facilitated the elicitation, evaluation, and adaptation of transparency requirements in a business information system.

To conclude this thesis, this chapter presents a summary of the thesis contributions to knowledge in Section 7.1. The limitations and research challenges are discussed in Section 7.2, and future work is presented in Section 7.3.

7.1 Thesis Contributions

This thesis has contributed to the knowledge on the engineering of transparency requirements. In the following, three main contributions of this thesis will be presented.

7.1.1 Reference Models for Transparency

The first main contribution of this thesis is the construction and development of reference models for transparency (See Chapter 3). These reference models were based on an extensive literature review in multiple disciplines, including finance, management, politics, law, and customer relations. They are technology-agnostic and represent different constituents of transparency with regards to the stakeholders involved in transparency provision, the meaningfulness and usefulness of transparency, and the quality of information in transparency. These constituents are clearly interlinked and provide a holistic view of transparency requirements.

The reference models for transparency allow requirements engineers to concentrate on high level concepts related to transparency. They provide an ontology specific to transparency and subsequently groundwork for requirements engineers to be able to communicate. The meticulous decomposition of transparency to its building blocks allows requirements engineers to spot the exact loci where transparency provision has failed. It also provides a reference point for the research in the topic as a tool for comparison and benchmarking.

In this thesis, the reference models for transparency also served as the foundation for the development of a domain-specific modelling language for transparency requirements in business information systems.

7.1.2 A Domain-Specific Modelling Language for Transparency Requirements

The second main contribution of this thesis is the development of a domain-specific modelling language for transparency requirements, called TranspLan (See Chapter 4). As discussed earlier, before the development of this language was ever conceived, it was first attempted to augment existing modelling languages; particularly attempts were made to augment the *i** goal modelling language, as early research illustrated its potential in capturing transparency requirements of stakeholders (Cappelli et al. 2007). This study also confirmed that the current structure of *i** needs

to undergo some changes and augmentations before it can be fully adopted in the modelling of transparency requirements, and the research conducted by this thesis further confirmed this notion. Further investigations illustrated that *i** will have to go through fundamental augmentation before it can be adopted for transparency requirements, and therefore the idea of the creation of a new modelling language was formed in order to better manage transparency requirements.

TranspLan is mathematically defined in order to maintain rigor and solidarity, and it benefits from both textual and graphical modelling. The textual representation of TranspLan includes sets of data representing stakeholders, information elements, relations, relationships, and information exchanges. It also includes two types of specification: Infolet specification and Sitreq specification. The graphical representation of TranspLan includes Shield diagram. Together, they facilitate the modelling of transparency requirements, while they also serve the many purposes of other modelling languages, e.g., providing abstraction, aiding in communication amongst stakeholders, helping in requirements documentation, and assisting in requirements elicitation.

Another benefit of TranspLan is that it enables the automated analysis of transparency requirements (See also Chapter 4). The modular nature of TranspLan allows algorithms to be developed in order to find possible shortcomings in providing transparency to its stakeholders in a business information system. These algorithms are specifically useful in dealing with the large amount of information stored in Infolet and Sitreq specifications, and when human eyes fail to capture nuisances and imperfections in the provided transparency.

7.1.3 A Method for Elicitation and Adaptation of Transparency Requirements

The third main contribution of this thesis is the invention of a method for the elicitation and adaptation of transparency requirements in a business information system, called Stream (See Chapter 5). It covers the whole life cycle of transparency requirements and engages stakeholders in the engineering of transparency requirements. Stream relies heavily on feedback acquired form stakeholders and adapts the business information system to the changing transparency requirements of stakeholders.

At the core level, Stream utilises three concepts crowdsourcing, structured feedback acquisition, and social adaptation in the engineering of transparency requirements. Crowdsourcing brings about a large, diverse crowd of stakeholders who can participate in the elicitation and adaptation phases. Structured feedback acquisition allows for a less time-consuming and more efficient collection of feedback from the stakeholders, and social adaptation facilitates the run-time adaptation of the business information system according to the requirements obtained from the crowd in the form of structured feedback.

As a complementary contribution, the development of this method required a thorough literature review in order to provide a taxonomy for crowdsourcing. The taxonomy in crowdsourcing introduced several other challenges, e.g., the inter-relations between crowdsourcing features had to be explored and configurations for crowdsourcing problem types had to be investigated. The taxonomy was then utilised in the field of requirements engineering. Such a taxonomy has proven to be influential, looking at recent studies conducted by other researchers in the field and referencing it in their works.

7.2 Research Challenges and Areas of Use

This thesis was a first attempt towards achieving a systematic and model-driven approach to engineering transparency requirements in a business information system. The course of the work revealed a number of potentials and also a number of challenges. While the challenges were addressed in several cases, there have been still limitations which require further work.

7.2.1 Challenges

The treatment of transparency as a collective property requires a different analysis of the business information system in which approaches like information propagation in complex systems may help. Not only would this affect the way transparency requirements are elicited and validated but also the judgements made in the need for their evolution.

Following from the previous point, the evolution of transparency is inevitable and many information pieces may have a short relevance lifespan, i.e., they might be needed only once or a few times before they start to cause information overload.

Again following from the previous point, transparency requirements are contextual by nature, i.e., the same information could be relevant and highly appreciated only in a specific context. This would require the capturing of those contextual factors and embedding them in the modelling language in order to facilitate a more intelligent and powerful decision making and reasoning on transparency.

Following again from the previous point, the assumption of a decision making analysis based on a one-size-fits-all perspective is unlikely going to work, as the validation chapter also indicated. This requires transparency personalisation and customisation to individuals, e.g., their interests and cognitive styles and even personality traits, e.g., introverts not willing to be transparent to avoid social contact.

7.2.2 Areas of Use

Despite the fact that this thesis was conducted using the mind set of requirements and software engineering, it is speculated that it would benefit other areas in computer science and information systems and possibly beyond. Some of the areas of use are as follows.

- The algorithms proposed for transparency can inform or at least trigger a research on embedding computational behavioural models in requirements engineering processes.
- The feedback-based Stream method is an example where socio-technical intelligence can also be embedded within a software engineering process and can provide an example for other requirements, especially those heavily related to human perception and cognition.

7.3 Future Work

The engineering of transparency requirements using the modelling language and the method provided in this thesis facilitates a methodological, structured way of managing them in a business information system. Given the novelty of this approach, several future contributions are possible, which will be discussed below.

One of the possible future contributions to the engineering of transparency requirements is to implement TranspLan modelling language as a computer-aided software engineering (CASE) tool. Such a tool can help in the computerised modelling and analysis of transparency requirements as well as their documentation and maintenance.

As another future work, more algorithms can be devised to capture possible transparency provision failures. Furthermore, the relationship between transparency and other concepts such as accountability could be investigated from an algorithmic perspective. The development of such algorithms can enrich the language and assist requirements engineers in the analysis of stakeholders' transparency requirements.

Another possible future contribution is to conduct a full evaluation of the Stream method. This thesis only focused on one aspect of the method, i.e., the acquired feedback, and consequently, a full evaluation will be needed before one can firmly declare that the method is fully functional, practical, and useful.

The Stream method can further be customised for adjacent concepts and similar non-functional requirements with some adjustments and modifications. The reason could be that the method benefits from a conceptual architecture which could, with little or no alterations, be used to capture other requirements as well. In fact, any requirement which could be elicited through crowdsourcing

techniques and benefit from structured feedback, and socially adapted at runtime, could profit from the Stream method and its rigorous conceptual architecture.

Another future work would be to delve into the theoretical foundations of transparency and investigate the delta between the information providers' perception of transparency and information receivers' perception of transparency. As transparency is often said to be in the eye of the beholder (Park and Blenkinsopp 2016), it is essential, particularly for information providers, to know how people perceive the transparency level of the information, and how individuals' characteristics, such as information providers' reputation and information receivers' bias, play a role in achieved or failed transparency.

Similarly, it would be interesting to examine what effects and side effects the multiplicity of information sources can have on the information receivers' perception of transparency. Since information explosion and the cyber world allow for people to obtain the same information from multiple resources, one might be interested in knowing how differences in the information obtained from different sources can be shaped into a unified form in the information receiver's perception, what issues may arise as a result of exposure to different versions of the same information, and how decision-making processes are conducted.

Since transparency has neighbouring concepts such as security, privacy, and trust, one possible future work could be to use the TranspLan modelling language to capture these concepts within a transparency framework. For example, the modelling language could be augmented to add security concerns in an information exchange, or it could be augmented with the increase or decrease in trust as an outcome of a given information exchange, similar to the effect of performing tasks and reaching goals on softgoals in an *i** model. Furthermore, these non-functional requirements could be incorporated in the TranspLan language constructs, such as Infolet and Sitreq.

Last but not least, the effect and importance of every information quality dimension on the concept of transparency remains to be explored in the future. For instance, it could be explored whether information receivers prefer error-prone information from a reputable source, or error-free information from an ill-reputed one. Similarly, it could be examined whether information receivers prefer to receive complete information with inconsistent representation, or incomplete information with consistent representation. A hierarchy of importance and effectiveness of information quality dimensions on the perception of transparency, and their impact on decision-making processes could be a future work.

References

Abelson, J., Gauvin, F., MacKinnon, M.P. and Watling, J., 2004. Transparency, trust and citizen engagement. *Ottawa: Canadian Policy Research Networks Inc*.

Aboody, D. and Lev, B., 2000. Information asymmetry, R&D, and insider gains. *The journal of Finance*, *55*(6), pp.2747-2766.

Abu-Shanab, E.A., 2013. The Relationship between Transparency and E-Government: An Empirical Support. *EGOV/ePart Ongoing Research*, *221*, pp.84-91.

Ali, R., Solis, C., Salehie, M., Omoronyia, I., Nuseibeh, B. and Maalej, W., 2011, September. Social sensing: when users become monitors. In *Proceedings of the 19th ACM SIGSOFT symposium and the 13th European conference on Foundations of software engineering* (pp. 476-479). ACM.

Ali, R., Solis, C., Omoronyia, I., Salehie, M. and Nuseibeh, B., 2012. Social adaptation: when software gives users a voice. 7th International Conference Evaluation of Novel Approaches to Software Engineering (ENASE 2012)

Allen, D.S., 2008. The trouble with transparency: The challenge of doing journalism ethics in a surveillance society. *Journalism Studies*, *9*(3), pp.323-340.

Allenspach, N., 2009. Banking and transparency: Is more information always better?.

Almaliki, M., Ncube, C. and Ali, R., 2015, May. Adaptive software-based Feedback Acquisition: A Persona-based design. In *2015 IEEE 9th International Conference on Research Challenges in Information Science (RCIS)* (pp. 100-111). IEEE.

Alt, J.E. and Lassen, D.D., 2006. Fiscal transparency, political parties, and debt in OECD countries. *European Economic Review*, *50*(6), pp.1403-1439.

Anctil, R.M., Dickhaut, J., Johnson, C. and Kanodia, C., 2010. Does information transparency decrease coordination failure?. *Games and Economic Behavior*, *70*(2), pp.228-241.

Andersson, C. and Runeson, P., 2007. A spiral process model for case studies on software quality monitoring—method and metrics. *Software Process: Improvement and Practice*, *12*(2), pp.125-140.

Anton, A.I., 1997. Goal identification and refinement in the specification of software-based information systems.

Araujo, R.M., Taher, Y., Heuvel, W.V.D. and Cappelli, C., 2013. Evolving Government-Citizen Ties in Public Service Design and Delivery. In *IFIP EGOV Conference* (pp. 19-26).

Arrowsmith, S., 1998. Towards a multilateral agreement on transparency in government procurement. *International and Comparative Law Quarterly*,*47*(04), pp.793-816.

Auld, G. and Gulbrandsen, L.H., 2010. Transparency in nonstate certification: consequences for accountability and legitimacy. *Global Environmental Politics*, *10*(3), pp.97-119.

Bac, M., 2001. Corruption, connections and transparency: Does a better screen imply a better scene?. *Public Choice*, *107*(1-2), pp.87-96.

Backes, M., Lorenz, S., Maffei, M. and Pecina, K., 2010, July. Anonymous webs of trust. In *International Symposium on Privacy Enhancing Technologies Symposium* (pp. 130-148). Springer Berlin Heidelberg.

Bagdai, N., Van der Molen, P. and Tuladhar, A., 2012. Does uncertainty exist where transparency is missing? Land privatisation in Mongolia. *Land use policy*, *29*(4), pp.798-804.

Bagella, M., Becchetti, L. and Hasan, I. eds., 2006. *Transparency, governance and markets*. Emerald Group Publishing.

Baker, S., 2009. The ethics of advocacy: Moral reasoning in the practice of public relations. *The Handbook of Mass Media Ethics*, pp.115-130.

Ball, C., 2009. What is transparency?. *Public Integrity*, *11*(4), pp.293-308.

Bannister, F. and Connolly, R., 2011. The Trouble with Transparency: A Critical Review of Openness in e-Government. *Policy & Internet*, *3*(1), pp.1-30.

Barlow, J. and Møller, C., 1996. *A complaint is a gift: using customer feedback as a strategic tool*. Berrett-Koehler Publishers.

Bauhr, M. and Grimes, M., 2014. Indignation or resignation: the implications of transparency for societal accountability. *Governance*, *27*(2), pp.291-320.

Bawden, D. and Robinson, L., 2009. The dark side of information: overload, anxiety and other paradoxes and pathologies. *Journal of information science*,*35*(2), pp.180-191.

Beckers, K., 2012, August. Comparing privacy requirements engineering approaches. In *Availability, Reliability and Security (ARES), 2012 Seventh International Conference on* (pp. 574-581). IEEE.

Beckers, K. and Heisel, M., 2012, August. A foundation for requirements analysis of privacy preserving software. In *International Conference on Availability, Reliability, and Security* (pp. 93-107). Springer Berlin Heidelberg.

Bentele, G. and Seiffert, J., 2009. Organisatorische Transparenz und Vertrauen. *Corporate transparency*, pp.42-61.

Berggren, E. and Bernshteyn, R., 2007. Organizational transparency drives company performance. *Journal of Management Development*, *26*(5), pp.411-417.

Bertot, J.C., Jaeger, P.T. and Grimes, J.M., 2010a, May. Crowd-sourcing transparency: ICTs, social media, and government transparency initiatives. In *Proceedings of the 11th Annual International Digital Government Research Conference on Public Administration Online: Challenges and Opportunities*(pp. 51-58). Digital Government Society of North America.

Bertot, J.C., Jaeger, P.T., Munson, S. and Glaisyer, T., 2010b. Social media technology and government transparency. *Computer*, (11), pp.53-59.

Bessire, D., 2005. Transparency: a two-way mirror?. *International Journal of Social Economics*, *32*(5), pp.424-438.

Bhatnagar, S., 2003. Transparency and corruption: Does e-government help?. *DRAFT Paper prepared for the compilation of CHRI*.

Birchall, C., 2011. Introduction to 'Secrecy and Transparency' The Politics of Opacity and Openness. *Theory, Culture & Society*, *28*(7-8), pp.7-25.

Birkinshaw, P., 2006, January. Transparency as a human right. In *Proceedings-British Academy* (Vol. 1, No. 135, pp. 47-58). Oxford University Press.

Blinder, A.S., 1999. *Central bank credibility: why do we care? How do we build it?* (No. w7161). National bureau of economic research.

Blomqvist, Å., 1991. The doctor as double agent: Information asymmetry, health insurance, and medical care. *Journal of Health Economics*, *10*(4), pp.411-432.

Bok, S., 1989. *Secrets: On the ethics of concealment and revelation*. Vintage.

Bowen, S., 2010, April. Critical theory and participatory design. In *Proceedings of CHI*.

Brito, J., 2008. Hack, mash, & peer: Crowdsourcing government transparency. *The Columbia Science and Technology Law Review*, *9*, pp.119-157.

Brito, J. and Perraut, D., 2010. Transparency and performance in government. *NCJL & Tech. On.*, *11*, pp.161-259.

Brun, Y., Serugendo, G.D.M., Gacek, C., Giese, H., Kienle, H., Litoiu, M., Müller, H., Pezzè, M. and Shaw, M., 2009. Engineering self-adaptive systems through feedback loops. In *Software engineering for self-adaptive systems* (pp. 48-70). Springer Berlin Heidelberg.

Brunnermeier, M.K., 2005. Information leakage and market efficiency. *Review of Financial Studies*, *18*(2), pp.417-457.

Canning, M. and O'Dwyer, B., 2001. Professional accounting bodies' disciplinary procedures: accountable, transparent and in the public interest?. *European Accounting Review*, *10*(4), pp.725-749.

Cappelli, C., Cunha, H., Gonzalez-Baixauli, B. and do Prado Leite, J.C.S., 2010, March. Transparency versus security: early analysis of antagonistic requirements. In *Proceedings of the 2010 ACM Symposium on Applied Computing* (pp. 298-305). ACM.

Cappelli, C., do Prado Leite, J.C.S. and Oliveira, A.D.P.A., 2007, October. Exploring business process transparency concepts. In *15th IEEE International Requirements Engineering Conference (RE 2007)* (pp. 389-390). IEEE.

Capurro, R., 2005. Privacy. An intercultural perspective. *Ethics and Information Technology*, *7*(1), pp.37-47.

Carlile, P.R., 2002. A pragmatic view of knowledge and boundaries: Boundary objects in new product development. *Organization science*, *13*(4), pp.442-455.

Carlo Bertot, J., Jaeger, P.T. and Grimes, J.M., 2012. Promoting transparency and accountability through ICTs, social media, and collaborative e-government. *Transforming Government: People, Process and Policy*, *6*(1), pp.78-91.

Carlson, M., 2011. Whither anonymity? Journalism and unnamed sources in a changing media environment. *Journalists, sources and credibility: New perspectives*, pp.37-48.

Casalino, N., Buonocore, F., Rossignoli, C. and Ricciardi, F., 2013, February. Transparency, openness and knowledge sharing for rebuilding and strengthening government institutions. In *WBE 2013 conference, IASTED-ACTA Press Zurich, Innsbruck, Austria, DOI* (Vol. 10).

Casey, S., 2015. How Millennial Are You?. *PM World Journal*, vol. IV(X).

Castells, M., 2010. *End of Millennium: The Information Age: Economy, Society, and Culture*| (Vol. 3). John Wiley & Sons.

Cazzola, W., Ghoneim, A. and Saake, G., 2004. Software evolution through dynamic adaptation of its oo design. In *Objects, Agents, and Features* (pp. 67-80). Springer Berlin Heidelberg.

Chung, L. and do Prado Leite, J.C.S., 2009. On non-functional requirements in software engineering. In *Conceptual modeling: Foundations and applications* (pp. 363-379). Springer Berlin Heidelberg.

Chung, L., Nixon, B.A., Yu, E. and Mylopoulos, J., 2012. *Non-functional requirements in software engineering* (Vol. 5). Springer Science & Business Media.

Cole, M., and others 1971. The Cultural Context of Learning and Thinking: An Exploration in Experimental Anthropology. Basic Books, Inc.

Collins, A., Greeno, J., Resnick, L.B., Berliner, B. and Calfee, R., 1992. Cognition and learning. *B. Berliner & R. Calfee, Handbook of Educational Psychology, New York: Simon & Shuster MacMillan*.

Crabtree, A., 2006. *Designing collaborative systems: A practical guide to ethnography*. Springer Science & Business Media.

Craft, S. and Heim, K., 2009. Transparency in journalism: Meanings, merits, and risks. *The handbook of mass media ethics*, pp.217-228.

Cucciniello, M., Nasi, G. and Valotti, G., 2012, January. Assessing transparency in government: rhetoric, reality and desire. In *System Science (HICSS), 2012 45th Hawaii International Conference on* (pp. 2451-2461). IEEE.

Cukierman, A., 2009. The limits of transparency. *Economic Notes*, *38*(1-2), pp.1-37.

Cunha, H., do Prado Leite, J.C.S., Duboc, L. and Werneck, V., 2013, July. The challenges of representing transparency as patterns. In *Requirements Patterns (RePa), 2013 IEEE Third International Workshop on* (pp. 25-30). IEEE.

Curtin, D. and Meijer, A.J., 2006. Does transparency strengthen legitimacy?. *Information polity*, *11*(2), pp.109-122.

Cysneiros, L.M., 2013. Using i* to Elicit and Model Transparency in the Presence of Other Non-Functional Requirements: A Position Paper. In *iStar* (pp. 19-24).

Cysneiros, L.M. and Werneck, V.M.B., 2009, July. An Initial Analysis on How Software Transparency and Trust Influence each other. In *WER*.

Dabbish, L., Stuart, C., Tsay, J. and Herbsleb, J., 2012, February. Social coding in GitHub: transparency and collaboration in an open software repository. In *Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work* (pp. 1277-1286). ACM.

Dabbish, L., Stuart, C., Tsay, J. and Herbsleb, J., 2013. Leveraging transparency. *IEEE software*, *30*(1), pp.37-43.

Dabbish, L., Stuart, C., Tsay, J. and Herbsleb, J., 2014. Transparency and Coordination in Peer Production. *arXiv preprint arXiv:1407.0377*.

Dalsgaard, C., 2008. Social networking sites: Transparency in online education. *European University Information Systems Organisation. from Retrieved June*.

Dalsgaard, C. and Paulsen, M.F., 2009. Transparency in cooperative online education. *The International Review of Research in Open and Distributed Learning*, *10*(3).

Damian, D.E. and Zowghi, D., 2002, September. The impact of stakeholders' geographical distribution on managing requirements in a multi-site organization. In *Requirements Engineering, 2002. Proceedings. IEEE Joint International Conference on* (pp. 319-328). IEEE.

Da Silveira, G., Borenstein, D. and Fogliatto, F.S., 2001. Mass customization: Literature review and research directions. *International journal of production economics*, *72*(1), pp.1-13.

Davis, J., 1998. Access to and Transmission of Information: Position of the Media. *Openness and Transparency in the European Union*, pp.121-126.

Dawes, S.S., 2010. Stewardship and usefulness: Policy principles for information-based transparency. *Government Information Quarterly*, *27*(4), pp.377-383.

Demertzis, M. and Hoeberichts, M., 2007. The costs of increasing transparency. *Open Economies Review*, *18*(3), pp.263-280.

de Oliveira, S.T., 1996. *Ferramentas para o aprimoramento da qualidade*. Pioneira.

Deverka, P.A., Lavallee, D.C., Desai, P.J., Esmail, L.C., Ramsey, S.D., Veenstra, D.L. and Tunis, S.R., 2012. Stakeholder participation in comparative effectiveness research: defining a framework for effective engagement. *Journal of Comparative Effectiveness Research 1*(2): 181–194.

Dijkman, R., Dumas, M., Van Dongen, B., Käärik, R. and Mendling, J., 2011. Similarity of business process models: Metrics and evaluation. *Information Systems*, *36*(2), pp.498-516.

DiStaso, M.W. and Bortree, D.S., 2012. Multi-method analysis of transparency in social media practices: Survey, interviews and content analysis. *Public Relations Review*, *38*(3), pp.511-514.

Doan, A., Ramakrishnan, R. and Halevy, A.Y., 2011. Crowdsourcing systems on the world-wide web. *Communications of the ACM*, *54*(4), pp.86-96.

do Prado Leite, J.C.S. and Cappelli, C., 2008. Exploring i* Characteristics that Support Software Transparency. In *iStar* (pp. 51-54).

do Prado Leite, J.C.S. and Cappelli, C., 2010. Software transparency. *Business & Information Systems Engineering*, *2*(3), pp.127-139.

Dourish, P. and Bellotti, V., 1992, December. Awareness and coordination in shared workspaces. In *Proceedings of the 1992 ACM conference on Computer-supported cooperative work* (pp. 107-114). ACM.

Duffy, D., MacNish, C., McDermid, J. and Morris, P., 1995, June. A framework for requirements analysis using automated reasoning. In *International Conference on Advanced Information Systems Engineering* (pp. 68-81). Springer Berlin Heidelberg.

Easterbrook, S., Singer, J., Storey, M.A. and Damian, D., 2008. Selecting empirical methods for software engineering research. In *Guide to advanced empirical software engineering* (pp. 285-311). Springer London.

El Emam, K., Quintin, S. and Madhavji, N.H., 1996. User participation in the requirements engineering process: An empirical study. *Requirements engineering*, *1*(1), pp.4-26.

Elia, J., 2009. Transparency rights, technology, and trust. *Ethics and Information Technology*, *11*(2), pp.145-153.

Erickson, T. and Kellogg, W.A., 2000. Social translucence: an approach to designing systems that support social processes. *ACM transactions on computer-human interaction (TOCHI)*, *7*(1), pp.59-83.

Etzioni, A., 2010. Is transparency the best disinfectant?. *Journal of Political Philosophy*, *18*(4), pp.389-404.

Fairbanks, J., Plowman, K.D. and Rawlins, B.L., 2007. Transparency in government communication. *Journal of Public Affairs*, *7*(1), pp.23-37.

Felgenhauer, M., 2010. Transparency and special interests. *Economics Letters*, *106*(1), pp.4-7.

Fenster, M., 2006. The opacity of transparency. *Iowa Law Review*, *91*.

Finel, B.I. and Lord, K.M., 1999. The surprising logic of transparency. *International Studies Quarterly*, *43*(2), pp.315-339.

Florini, A., 2000. The end of secrecy. In *Power and Conflict in the Age of Transparency* (pp. 13-28). Palgrave Macmillan US.

Florini, A., Birdsall, N., Flynn, S., Haufler, V., Lipton, D., Morrow, D. and Sharma, S., 2000, December. Does the invisible hand need a transparent glove? The politics of transparency. In *World Banks Annual Conference on Development Economics* (pp. 163-184).

FOIA 2000. “Freedom of information act 2000,” Online [Last Accessed 25 July 2016], 2000. [Online]. Available: http://www.legislation.gov.uk/ukpga/2000/36/contents.

Fox, J., 2007. The uncertain relationship between transparency and accountability. *Development in Practice*, *17*(4-5), pp.663-671.

Frentrup, M. and Theuvsen, L., 2006. Transparency in supply chains: Is trust a limiting factor. *Trust and Risk in Business Networks, ILB-Press, Bonn*, pp.65-74.

Friðriksson, I., 2000. *Code of good practices on transparency in monetary and financial policies*. International Monetary Fund Standards and Codes Section

Fuller, M.A., Serva, M.A. and Benamati, J., 2007. Seeing is believing: The transitory influence of reputation information on e-commerce trust and decision making. *Decision Sciences*, *38*(4), pp.675-699.

Fung, A., 2013. Infotopia unleashing the democratic power of transparency. *Politics & Society*, *41*(2), pp.183-212.

Furman, J., Stiglitz, J.E., Bosworth, B.P. and Radelet, S., 1998. Economic crises: evidence and insights from East Asia. *Brookings papers on economic activity*, *1998*(2), pp.1-135.

Garrido, J.L., Gea, M. and Rodríguez, M.L., 2005. Engineering in Cooperative Systems. *Requirements Engineering for Sociotechnical Systems*, p.226.

Gaventa, J. and McGee, R., 2013. The impact of transparency and accountability initiatives. *Development Policy Review*, *31*(s1), pp.s3-s28.

Geraats, P.M., 2002. Central bank transparency. *The economic journal*,*112*(483), pp.F532-F565.

Gerring, J. and Thacker, S.C., 2004. Political institutions and corruption: The role of unitarism and parliamentarism. *British Journal of Political Science*,*34*(02), pp.295-330.

Ghanavati, S., Amyot, D. and Peyton, L., 2007, June. Towards a framework for tracking legal compliance in healthcare. In *International Conference on Advanced Information Systems Engineering* (pp. 218-232). Springer Berlin Heidelberg.

Giorgini, P., Mouratidis, H. and Zannone, N., 2006. Modelling security and trust with secure tropos. *Integrating Security and Software Engineering: Advances and Future Vision*, pp.160-189.

Glinz, M., 2007, October. On non-functional requirements. In *15th IEEE International Requirements Engineering Conference (RE 2007)* (pp. 21-26). IEEE.

Gower, K.K., 2006. Truth and transparency. *Ethics in public relations*, pp.89-105.

Granados, N. and Gupta, A., 2013. Transparency Strategy: Competing With Information In A Digital World. *MIS quarterly*,*37*(2).

Griffith, J.C., 2006. *Beyond transparency: New standards for legislative information systems*. Geneva,, Switzerland: European Centre for Parliamentary Research and Documentation.

Grimmelikhuijsen, S., 2012. Linking transparency, knowledge and citizen trust in government: An experiment. *International Review of Administrative Sciences*, *78*(1), pp.50-73.

Grimmelikhuijsen, S.G. and Meijer, A.J., 2012. The effects of transparency on the perceived trustworthiness of a government organization: Evidence from an online experiment. *Journal of Public Administration Research and Theory*, p.mus048.

Grimmelikhuijsen, S.G.and others, 2012. Transparency and trust. An experimental study of online disclosure and trust in government.

Grimmelikhuijsen, S., Porumbescu, G., Hong, B. and Im, T., 2013. The effect of transparency on trust in government: A cross-national comparative experiment. *Public Administration Review*, *73*(4), pp.575-586.

Gulliksen, J., Göransson, B., Boivie, I., Blomkvist, S., Persson, J. and Cajander, Å., 2003. Key principles for user-centred systems design. *Behaviour and Information Technology*, *22*(6), pp.397-409.

Gupta, A., 2008. Transparency under scrutiny: Information disclosure in global environmental governance. *Global Environmental Politics*, *8*(2), pp.1-7.

Hale, T.N., 2008. Transparency, accountability, and global governance. *Global Governance: A Review of Multilateralism and International Organizations*, *14*(1), pp.73-94.

Hang, B.C., 2012. *Transparenzgesellschaft*. Berlin: Matthes & Seitz.

Harrison, T.M., Guerrero, S., Burke, G.B., Cook, M., Cresswell, A., Helbig, N., Hrdinová, J. and Pardo, T., 2012. Open government and e-government: Democratic challenges from a public value perspective. *Information Polity*,*17*(2), pp.83-97.

Heise, J.A., 1985. Toward closing the confidence gap: An alternative approach to communication between public and government. *Public Administration Quarterly*, pp.196-217.

Herbsleb, J.D., 2007, May. Global software engineering: The future of socio-technical coordination. In *2007 Future of Software Engineering* (pp. 188-198). IEEE Computer Society.

Herlocker, J.L., Konstan, J.A. and Riedl, J., 2000, December. Explaining collaborative filtering recommendations. In *Proceedings of the 2000 ACM conference on Computer supported cooperative work* (pp. 241-250). ACM.

Herschel, R.T., Nemati, H. and Steiger, D., 2001. Tacit to explicit knowledge conversion: knowledge exchange protocols. *Journal of knowledge management*, *5*(1), pp.107-116.

Hirsch, W.Z. and Osborne, E., 2000. Privatization of government services: Pressure-group resistance and service transparency. *Journal of Labor Research*, *21*(2), pp.315-326.

Holzner, B. and Holzner, L., 2006. *Transparency in global change: the vanguard of the open society*. University of Pittsburgh Pre.

Hood, C., 2006. *Transparency in historical perspective* (No. 135, pp. 3-23). Oxford University Press.

Hood, C., 2011. From FOI World to WikiLeaks World: A new chapter in the transparency story?. *Governance*, *24*(4), pp.635-638.

Hope, O.K., Thomas, W.B. and Vyas, D., 2009. Transparency, ownership, and financing constraints in private firms. *Journal of Accounting Research*,*46*(3), pp.591-626.

Hosseini, M., Phalp, K.T., Taylor, J. and Ali, R., 2014a. Towards crowdsourcing for requirements engineering. In *20th International working conference on Requirements engineering: foundation for software quality-Empirical Track*.

Hosseini, M., Phalp, K., Taylor, J. and Ali, R., 2014b, May. The four pillars of crowdsourcing: A reference model. In *2014 IEEE Eighth International Conference on Research Challenges in Information Science (RCIS)* (pp. 1-12). IEEE.

Hosseini, M., Shahri, A., Phalp, K.T. and Ali, R., 2015a. Transparency as a requirement. In: *Joint Proceedings of REFSQ-2015 Workshops, Research Method Track, and Poster Track co-located with the 21st International Conference on Requirements Engineering: Foundation for Software Quality (REFSQ).*

Hosseini, M., Shahri, A., Phalp, K. and Ali, R., 2015b, August. Towards engineering transparency as a requirement in socio-technical systems. In *2015 IEEE 23rd International Requirements Engineering Conference (RE)*(pp. 268-273). IEEE.

Hosseini, M., Shahri, A., Phalp, K., Taylor, J., Ali, R. and Dalpiaz, F., 2015c, May. Configuring crowdsourcing for requirements elicitation. In *2015 IEEE 9th International Conference on Research Challenges in Information Science (RCIS)* (pp. 133-138). IEEE.

Hosseini, M., Shahri, A., Phalp, K., Taylor, J. and Ali, R., 2015d. Crowdsourcing: A taxonomy and systematic mapping study. *Computer Science Review*, *17*, pp.43-69.

Hosseini, M., Shahri, A., Phalp, K. and Ali, R., 2015e, May. Recommendations on adapting crowdsourcing to problem types. In *2015 IEEE 9th International Conference on Research Challenges in Information Science (RCIS)* (pp. 423-433). IEEE.

Hosseini, M., Phalp, K., Taylor, J. and Ali, R., 2015f. On the configuration of crowdsourcing projects. *International Journal of Information System Modeling and Design (IJISMD)*, *6*(3), pp.27-45.

Hosseini, M., Moore, J., Almaliki, M., Shahri, A., Phalp, K. and Ali, R., 2015g. Wisdom of the Crowd within enterprises: Practices and challenges. *Computer Networks*, *90*, pp.121-132.

Hosseini, M., Shahri, A., Phalp, K. and Ali, R., 2016a, June. A Modelling Language for Transparency Requirements in Business Information Systems. In *International Conference on Advanced Information Systems Engineering*(pp. 239-254). Springer International Publishing.

Hosseini, M., Shahri, A., Phalp, K.T. and Ali, R., 2016b. Crowdsourcing Transparency Requirements through Structured Feedback and Social Adaptation. In *Proceedings of the IEEE Tenth International Conference on Research Challenges in Information Science (RCIS)*.

Howe, J., 2006. The rise of crowdsourcing. *Wired magazine*, *14*(6), pp.1-4.

Hultman, J. and Axelsson, B., 2007. Towards a typology of transparency for marketing management research. *Industrial Marketing Management*, *36*(5), pp.627-635.

IEEE Standards Association, 1990. Standard glossary of software engineering terminology. *IEEE Std*, pp.610-12.

Ignacio Aguaded, J., 2014. From Infoxication to the Right to Communicate.

Indjejikian, R.J., 1991. The impact of costly information interpretation on firm disclosure decisions. *Journal of Accounting Research*, pp.277-301.

Ingolfo, S., Siena, A., Mylopoulos, J., Susi, A. and Perini, A., 2013. Arguing regulatory compliance of software requirements. *Data & Knowledge Engineering*, *87*, pp.279-296.

Islam, R., 2003. Do more transparent governments govern better?. *World Bank Policy Research Working Paper*, (3077).

Jacob, B., Lanyon-Hogg, R., Nadgir, D.K. and Yassin, A.F., 2004. A practical guide to the IBM autonomic computing toolkit. *IBM Redbooks*, *4*, p.10.

Jacobson, I., Booch, G., and Rumbaugh, J., 1999.*The unified software development process* (Vol. 1). Reading: Addison-wesley.

Jahansoozi, J., 2006. Organization-stakeholder relationships: exploring trust and transparency. *Journal of Management Development*, *25*(10), pp.942-955.

Jayal, N.G., 2007. New directions in theorising social accountability?. *IDS bulletin*, *38*(6), pp.105-112.

Jayasree, H. and Damodaram, A., 2012. Anonymity And Accountability in Web Based Transactions. *Advanced Computing*, *3*(2), p.193.

Johnson, D.G., 1997. Ethics online. *Communications of the ACM*, *40*(1), pp.60-65.

Joshi, A., 2013. Do they work? Assessing the impact of transparency and accountability initiatives in service delivery. *Development Policy Review*,*31*(s1), pp.s29-s48.

Kachalia, A., 2013. Improving patient safety through transparency. *New England Journal of Medicine*, *369*(18), pp.1677-1679.

Kahn, B.K., Strong, D.M. and Wang, R.Y., 2002. Information quality benchmarks: product and service performance. *Communications of the ACM*, *45*(4), pp.184-192.

Kaner, S., 2014. *Facilitator's guide to participatory decision-making*. John Wiley & Sons.

Karat, J., 1996. User centered design: quality or quackery?. *interactions*,*3*(4), pp.18-20.

Kataoka, H., Ogawa, Y., Echizen, I., Kuboyama, T. and Yoshiura, H., 2014, September. Effects of external information on anonymity and role of transparency with example of social network de-anonymisation. In*Availability, Reliability and Security (ARES), 2014 Ninth International Conference on* (pp. 461-467). IEEE.

Kaufmann, D. and Bellver, A., 2005. Transparenting transparency: Initial empirics and policy applications. *Available at SSRN 808664*.

Kayem, A.V., Deshai, A. and Hammer, S., 2012, August. On anonymizing social network graphs. In *2012 Information Security for South Africa* (pp. 1-8). IEEE.

Kearney, A.R., 1994. Understanding global change: a cognitive perspective on communicating through stories. *Climatic Change*, *27*(4), pp.419-441.

Kharaji, M.Y. and Rizi, F.S., 2015. A Fast Survey on Methods for Classification Anonymity Requirements. *arXiv preprint arXiv:1510.00805*.

Kiesler, S. and Sproull, L., 1992. Group decision making and communication technology. *Organizational behavior and human decision processes*, *52*(1), pp.96-123.

Kinnaird, P., Dabbish, L. and Kiesler, S., 2012, October. Workflow transparency in a microtask marketplace. In *Proceedings of the 17th ACM international conference on Supporting group work* (pp. 281-284). ACM.

Kinnaird, P., Dabbish, L., Kiesler, S. and Faste, H., 2013, February. Co-worker transparency in a microtask marketplace. In *Proceedings of the 2013 conference on Computer supported cooperative work* (pp. 1285-1290). ACM.

Kitchenham, B., Pickard, L. and Pfleeger, S.L., 1995. Case studies for method and tool evaluation. *IEEE software*, *12*(4), p.52.

Kitchenham, B.A., 1996. Evaluating software engineering methods and tool—part 3: selecting an appropriate evaluation method—practical issues. *ACM SIGSOFT Software Engineering Notes*, *21*(4), pp.9-12.

Kitchenham, B.A., Pfleeger, S.L., Pickard, L.M., Jones, P.W., Hoaglin, D.C., El Emam, K. and Rosenberg, J., 2002. Preliminary guidelines for empirical research in software engineering. *IEEE Transactions on software engineering*, *28*(8), pp.721-734.

Klaidman, S., 1987. The virtuous journalist. Oxford University Press.

Klievink, B., Bharosa, N. and Tan, Y.H., 2013. Exploring Barriers and Stepping Stones for System Based Monitoring: Insights from Global Supply Chains. In *EGOV/ePart Ongoing Research* (pp. 35-42).

Ko, R.K., Russello, G., Nelson, R., Pang, S., Cheang, A., Dobbie, G., Sarrafzadeh, A., Chaisiri, S., Asghar, M.R. and Holmes, G., 2015, November. STRATUS: Towards Returning Data Control to Cloud Users. In *International Conference on Algorithms and Architectures for Parallel Processing* (pp. 57-70). Springer International Publishing.

Kolstad, I. and Wiig, A., 2009. Is transparency the key to reducing corruption in resource-rich countries?. *World Development*, *37*(3), pp.521-532.

Konstan, J.A. and Riedl, J., 2012. Recommender systems: from algorithms to user experience. *User Modeling and User-Adapted Interaction*, *22*(1-2), pp.101-123.

Koster, R., Black, A.P., Huang, J., Walpole, J. and Pu, C., 2001, November. Thread transparency in information flow middleware. In *IFIP/ACM International Conference on Distributed Systems Platforms and Open Distributed Processing* (pp. 121-140). Springer Berlin Heidelberg.

Kotz, D., Avancha, S. and Baxi, A., 2009, November. A privacy framework for mobile health and home-care systems. In *Proceedings of the first ACM workshop on Security and privacy in medical and home-care systems* (pp. 1-12). ACM.

Kreuter, M.W. and Wray, R.J., 2003. Tailored and targeted health communication: strategies for enhancing information relevance. *American Journal of Health Behavior*, *27*(1), pp.S227-S232.

Krogstie, J., Lindland, O.I. and Sindre, G., 1995. Defining quality aspects for conceptual models. In *Information System Concepts* (pp. 216-231). Springer US.

Krogstie, J. and Solvberg, A., 2000. Quality of conceptual models. *Information systems engineering: Conceptual modeling in a quality perspective. Kompendiumforlaget, Trondheim, Norway*, pp.91-120.

Krogstie, J., 2003. Evaluating UML using a generic quality framework. *UML and the Unified Process*, *1*.

Krogstie, J., Sindre, G. and Jørgensen, H., 2006. Process models representing knowledge for action: a revised quality framework. *European Journal of Information Systems*, *15*(1), pp.91-102.

Lawrence, D.A., 1993. Stability and transparency in bilateral teleoperation. *IEEE transactions on robotics and automation*, *9*(5), pp.624-637.

Lazar, J., Feng, J.H. and Hochheiser, H., 2010. *Research methods in human-computer interaction*. John Wiley & Sons.

Li, N., Li, T. and Venkatasubramanian, S., 2007, April. t-closeness: Privacy beyond k-anonymity and l-diversity. In *2007 IEEE 23rd International Conference on Data Engineering* (pp. 106-115). IEEE.

Lidberg, J., 2009. The International Freedom of Information Index. *Nordicom Review*, *30*(1), pp.167-182.

Lindstedt, C. and Naurin, D., 2006, July. Transparency Against Corruption–A Cross-Country Analysis. In *IPSA 20th World Congress, Fukuoka, Japan* (pp. 9-13).

Lim, S.L. and Finkelstein, A., 2012. StakeRare: using social networks and collaborative filtering for large-scale requirements elicitation. *IEEE Transactions on Software Engineering*, *38*(3), pp.707-735.

Lim, S.L., Quercia, D. and Finkelstein, A., 2010, May. StakeSource: harnessing the power of crowdsourcing and social networks in stakeholder analysis. In *Proceedings of the 32nd ACM/IEEE International Conference on Software Engineering-Volume 2* (pp. 239-242). ACM.

Lindstedt, C. and Naurin, D., 2010. Transparency is not enough: Making transparency effective in reducing corruption. *International political science review*, *31*(3), pp.301-322.

Lodge, M., 2004. *Accountability and transparency in regulation: critiques, doctrines and instruments* (pp. 124-144). Edward Elgar Publishing.

Lopp, M., 2007. Information Starvation. *Managing Humans: Biting and Humorous Tales of a Software Engineering Manager*, pp.33-36.

Lord, K.M., 2006. The perils and promise of global transparency. *State University of New York Press, New York*.

Lucas, G.R., 2013, June. Privacy, Anonymity, and Cyber Security. In *Amsterdam Law Forum* (Vol. 5, No. 2, pp. 107-114).

Lyytinen, K.J. and Ngwenyama, O.K., 1992. What does computer support for cooperative work mean? A structurational analysis of computer supported cooperative work. *Accounting, Management and Information Technologies*,*2*(1), pp.19-37.

Machanavajjhala, A., Kifer, D., Gehrke, J. and Venkitasubramaniam, M., 2007. l-diversity: Privacy beyond k-anonymity. *ACM Transactions on Knowledge Discovery from Data (TKDD)*, *1*(1), p.3.

Macho Stadler, I., Pérez Castrillo, D. and Inés Macho Stadler, D.P.C., 1994.*Introducción a la economía de la información* (No. 338.501/M15i).

Madhani, P.M., 2008. Role of voluntary disclosure and transparency in financial reporting.

Madhavji, N.H., Fernandez-Ramil, J. and Perry, D. eds., 2006. *Software evolution and feedback: Theory and practice*. John Wiley & Sons.

Margetts, H., 2011. The internet and transparency. *The Political Quarterly*,*82*(4), pp.518-521.

Marques, D., Duarte, L. and Carriço, L., 2012, September. Privacy and secrecy in ubiquitous text messaging. In *Proceedings of the 14th international conference on Human-computer interaction with mobile devices and services companion* (pp. 95-100). ACM.

Marschall, M., 2002, October. Legitimacy and effectiveness: civil society organizations' role in good governance. In *Poverty Reduction Strategies Forum, Baden, Austria*.

Mavropoulos, O., Mouratidis, H., Fish, A., Panaousis, E. and Kalloniatis, C., 2016, June. Apparatus: Reasoning About Security Requirements in the Internet of Things. In *International Conference on Advanced Information Systems Engineering* (pp. 219-230). Springer International Publishing.

McCarthy, J., 2007. The ingredients of financial transparency. *Nonprofit and Voluntary Sector Quarterly*, *36*(1), pp.156-164.

McGee, R.W., 2009. The timeliness of financial reporting in developing countries: An overview. In *Corporate Governance in Developing Economies*(pp. 87-95). Springer US.

McKenna, K.Y. and Bargh, J.A., 1998. Coming out in the age of the Internet: Identity "demarginalization" through virtual group participation. *Journal of personality and social psychology*, *75*(3), p.681.

Meijer, A., 2009. Understanding modern transparency. *International Review of Administrative Sciences*, *75*(2), pp.255-269.

Menéndez-Viso, A., 2009. Black and white transparency: Contradictions of a moral metaphor. *Ethics and information technology*, *11*(2), pp.155-162.

Mercuri, R.T., 2005. Trusting in transparency. *Communications of the ACM*,*48*(5), pp.15-19.

Meunier, P., 2008. Software transparency and purity. *Communications of the ACM*, *51*(2), pp.104-104.

Michener, G. and Bersch, K., 2011, May. Conceptualizing the quality of transparency. In *paper apresentado na 1ª Conferência Global sobre Transparência, ocorrida na Rutgers University, Newark, em maio de*.

Middleton, S.E., De Roure, D.C. and Shadbolt, N.R., 2001, October. Capturing knowledge of user preferences: ontologies in recommender systems. In *Proceedings of the 1st international conference on Knowledge capture* (pp. 100-107). ACM.

Middleton, S.E., Shadbolt, N.R. and De Roure, D.C., 2004. Ontological user profiling in recommender systems. *ACM Transactions on Information Systems (TOIS)*, *22*(1), pp.54-88.

Mitchell, R.B., 1998. Sources of transparency: Information systems in international regimes. *International Studies Quarterly*, *42*(1), pp.109-130.

Mol, A.P., 2010. The future of transparency: Power, pitfalls and promises.*Global Environmental Politics*, *10*(3), pp.132-143.

Moghaddam, S., Jamali, M., Ester, M. and Habibi, J., 2009, October. FeedbackTrust: using feedback effects in trust-based recommendation systems. In *Proceedings of the third ACM conference on Recommender systems* (pp. 269-272). ACM.

Moore, M., 2011. The limits of transparency. *The political quarterly*, *82*(4), pp.506-508.

Morris, J.H., 2003. Tales of technology: Consider a cure for pernicious infobesity. *The Pittsburgh Post-Gazette*.

Morris, S. and Shin, H.S., 2002. Social value of public information. *The American Economic Review*, *92*(5), pp.1521-1534.

Mouratidis, H., Giorgini, P. and Manson, G., 2003, September. An ontology for modelling security: The tropos approach. In *International Conference on Knowledge-Based and Intelligent Information and Engineering Systems* (pp. 1387-1394). Springer Berlin Heidelberg.

Naurin, D., 2006. Transparency, publicity, accountability-the missing links. *Swiss Political Science Review*, *12*(3), p.90.

Neureiter, C., Eibl, G., Veichtlbauer, A. and Engel, D., 2013, November. Towards a framework for engineering smart-grid-specific privacy requirements. In *Industrial Electronics Society, IECON 2013-39th Annual Conference of the IEEE* (pp. 4803-4808). IEEE.

Neyland, D., 2007. Achieving transparency: The visible, invisible and divisible in academic accountability networks. *Organization*, *14*(4), pp.499-516.

Norman, D.A., 1986. Cognitive engineering. *User centered system design: New perspectives on human-computer interaction*, *3161*.

O'Hara, K., 2011. Transparent government, not transparent citizens: a report on privacy and transparency for the Cabinet Office. Commissioned by the Cabinet Office.

O'Hara, K., 2012, June. Transparency, open data and trust in government: shaping the infosphere. In *Proceedings of the 4th Annual ACM Web Science Conference* (pp. 223-232). ACM.

Ojameruaye, B. and Bahsoon, R., 2014, April. Systematic elaboration of compliance requirements using compliance debt and portfolio theory. In *International Working Conference on Requirements Engineering: Foundation for Software Quality* (pp. 152-167). Springer International Publishing.

Oliver, R., 2004. *What is transparency?*. McGraw Hill Professional.

O'Neill, O., 2002. *A question of trust: The BBC Reith Lectures 2002*. Cambridge University Press.

O'Neill, O., 2009. Ethics for communication?. *European Journal of Philosophy*, *17*(2), pp.167-180.

Omoronyia, I., Cavallaro, L., Salehie, M., Pasquale, L. and Nuseibeh, B., 2013, May. Engineering adaptive privacy: on the role of privacy awareness requirements. In *Proceedings of the 2013 International Conference on Software Engineering* (pp. 632-641). IEEE Press.

O'Reilly, C.A., 1980. Individuals and information overload in organizations: is more necessarily better?. *Academy of management journal*, *23*(4), pp.684-696.

Osborne, D., 2004. Transparency and accountability reconsidered. *Journal of Financial Crime*, *11*(3), pp.292-300.

Pagano, D. and Maalej, W., 2013, July. User feedback in the appstore: An empirical study. In *2013 21st IEEE international requirements engineering conference (RE)* (pp. 125-134). IEEE.

Park, H. and Blenkinsopp, J., 2016. Transparency is in the eye of the beholder: the effects of identity and negative perceptions on ratings of transparency via surveys. *International Review of Administrative Sciences*, p.0020852315615197.

Pasquier, M. and Villeneuve, J.P., 2006. Access to information in Switzerland. From secrecy to transparency. *Open Government: a journal on Freedom of Information*, pp.20-32.

Patel, S.A. and Dallas, G.S., 2002. Transparency and disclosure: Overview of methodology and study results-United States. *Available at SSRN 422800*.

Peisakhin, L. and Pinto, P., 2010. Is transparency an effective anti-corruption strategy? Evidence from a field experiment in India. *Regulation & Governance*, *4*(3), pp.261-280.

Pennebaker, J.W. and Stone, L.D., 2003. Words of wisdom: language use over the life span. *Journal of personality and social psychology*, *85*(2), p.291.

Pernul, G., Tjoa, A.M. and Winiwarter, W., 1998. Modelling data secrecy and integrity. *Data & Knowledge Engineering*, *26*(3), pp.291-308.

Piotrowski, S.J. (2009). Is Transparency Sustainable? *Public Administration Review, 69*(2), 359-361. Retrieved from http://www.jstor.org/stable/27697873

Piotrowski, S.J. and Van Ryzin, G.G., 2007. Citizen attitudes toward transparency in local government. *The American Review of Public Administration*, *37*(3), pp.306-323.

Pronin, E., Gilovich, T. and Ross, L., 2004. Objectivity in the eye of the beholder: divergent perceptions of bias in self versus others. *Psychological review*, *111*(3), p.781.

Rawlins, B., 2008a. Give the emperor a mirror: Toward developing a stakeholder measurement of organizational transparency. *Journal of Public Relations Research*, *21*(1), pp.71-99.

Rawlins, B.R., 2008b. Measuring the relationship between organizational transparency and employee trust. Public Relations Journal. Vol. 2, (Issue 2), pp. 1-21.

Ripken, S.K., 2006. The dangers and drawbacks of the disclosure antidote: Toward a more substantive approach to securities regulation. *Baylor Law Review*, *58*(1), pp.2007-08.

Robertson, S. and Robertson, J., 2012. *Mastering the requirements process: Getting requirements right*. Addison-wesley.

Robinson, W.N., 2005, January. Implementing rule-based monitors within a framework for continuous requirements monitoring. In *Proceedings of the 38th Annual Hawaii International Conference on System Sciences* (pp. 188a-188a). IEEE.

Robinson, W.N., 2006. A requirements monitoring framework for enterprise systems. *Requirements engineering*, *11*(1), pp.17-41.

Roth, D., 2009. Road map for financial recovery: Radical transparency now!.

Ruiz, F., van Harmelen, F., Aben, M. and van de Plassche, J., 1994, September. Evaluating a formal modelling language. In *International Conference on Knowledge Engineering and Knowledge Management* (pp. 26-45). Springer Berlin Heidelberg.

Runeson, P. and Höst, M., 2009. Guidelines for conducting and reporting case study research in software engineering. *Empirical software engineering*,*14*(2), pp.131-164.

Ruppert, T., Bernard, J. and Kohlhammer, J., 2013. Bridging Knowledge Gaps in Policy Analysis with Information Visualization. *EGOV/ePart Ongoing Research*, *221*, pp.92-103.

Ryan, P. and Sennett, C. eds., 2012. *Formal methods in systems engineering*. Springer Science & Business Media.

Salehie, M. and Tahvildari, L., 2009. Self-adaptive software: Landscape and research challenges. *ACM Transactions on Autonomous and Adaptive Systems (TAAS)*, *4*(2), p.14.

Santana, A. and Wood, D.J., 2009. Transparency and social responsibility issues for Wikipedia. *Ethics and information technology*, *11*(2), pp.133-144.

Savolainen, R., 2007. Filtering and withdrawing: strategies for coping with information overload in everyday contexts. *Journal of Information Science*,*33*(5), pp.611-621.

Scauer, F., 2011. Transparency in three dimensions. *U. Ill. L. Rev.*, p.1339.

Schler, J., Koppel, M., Argamon, S. and Pennebaker, J.W., 2006, March. Effects of Age and Gender on Blogging. In *AAAI Spring Symposium: Computational Approaches to Analyzing Weblogs* (Vol. 6, pp. 199-205).

Schnackenberg, A.K. and Tomlinson, E.C., 2014. Organizational transparency a new perspective on managing trust in organization-stakeholder relationships. *Journal of Management*, p.0149206314525202.

Schuler, D. and Namioka, A. eds., 1993. *Participatory design: Principles and practices*. CRC Press.

Schultz, K.A., 1998. Domestic opposition and signaling in international crises. *American Political Science Review*, *92*(04), pp.829-844.

Scott, T.W., 1994. Incentives and disincentives for financial disclosure: Voluntary disclosure of defined benefit pension plan information by Canadian firms. *Accounting Review*, pp.26-43.

SCREEN Glossary (1999). *Glossary of EU SCREEN Project*. Available at: http://cordis.europa.eu/infowin/acts/rus/projects/screen/glossary/glossary.htm

Serrano, M. and do Prado Leite, J.C.S., 2011, August. Capturing transparency-related requirements patterns through argumentation. In *Requirements Patterns (RePa), 2011 First International Workshop on* (pp. 32-41). IEEE.

Serrano, M., do Prado Leite, J.C.S., and Mylopoulos, J., 2011, February. "Relative Validation for Transparency Requirements," Monograph, Department of Informatics, Pontifical Catholic University of Rio de Janeiro, 14 pages.

Sherief, N., Abdelmoez, W., Phalp, K. and Ali, R., 2015, November. Modelling Users Feedback in Crowd-Based Requirements Engineering: An Empirical Study. In *IFIP Working Conference on The Practice of Enterprise Modeling* (pp. 174-190). Springer International Publishing.

Shkabatur, J., 2012. Transparency with (out) accountability: Open government in the United States. *Yale Law & Policy Review*, *31*(1), pp.79-140.

Simon, C., 2006. Corporate information transparency: The synthesis of internal and external information streams. *Journal of Management Development*, *25*(10), pp.1029-1031.

Sinha, R. and Swearingen, K., 2002, April. The role of transparency in recommender systems. In *CHI'02 extended abstracts on Human factors in computing systems* (pp. 830-831). ACM.

Small, M., 1996. *Democracy and Diplomacy: The Impact of Domestic Politics in US Foreign Policy, 1789-1994*. JHU Press.

Snijders, R., Dalpiaz, F., Hosseini, M., Shahri, A. and Ali, R., 2014, December. Crowd-centric requirements engineering. In *Utility and Cloud Computing (UCC), 2014 IEEE/ACM 7th International Conference on* (pp. 614-615). IEEE.

Somers, H., 2005, December. Round-trip translation: What is it good for. In *Proceedings of the Australasian Language Technology Workshop* (pp. 127-133).

Sommerville, I., 2004. Software Engineering. International computer science series. *ed: Addison Wesley*.

Sprague, R., 2007. Rethinking information privacy in an age of online transparency. *Hofstra Labor & Employment Law Journal*, *25*, p.395.

Star, S.L., Bowker, G.C. and Neumann, L.J., 1998. Transparency at different level of scale: convergence between information artefcts and social worlds. *Library and Information Science, Urbana-Champaign*.

Stasavage, D., 2003. Transparency, democratic accountability, and the economic consequences of monetary institutions. *American Journal of Political Science*, *47*(3), pp.389-402.

Stasavage, D., 2006, January. Does transparency make a difference? The example of the European Council of Ministers. In *Proceedings-British Academy* (Vol. 135, p. 165). Oxford University Press Inc..

Stauss, B., 2000. Using new media for customer interaction: A challenge for relationship marketing. In *Relationship marketing* (pp. 233-253). Springer Berlin Heidelberg.

Stiglitz, J.E., 2000. The contributions of the economics of information to twentieth century economics. *Quarterly Journal of economics*, pp.1441-1478.

Stirton, L. and Lodge, M., 2001. Transparency mechanisms: Building publicness into public services. *Journal of Law and Society*, *28*(4), pp.471-489.

Strathern, M., 2000. The tyranny of transparency. *British educational research journal*, *26*(3), pp.309-321.

Streufert, S.C., 1973. Effects of information relevance on decision making in complex environments. *Memory & Cognition*, *1*(3), pp.224-228.

Strong, D.M., Lee, Y.W. and Wang, R.Y., 1997. 10 potholes in the road to information quality. *IEEE Computer*, *30*(8), pp.38-46.

Stuart, H.C., Dabbish, L., Kiesler, S., Kinnaird, P. and Kang, R., 2012, February. Social transparency in networked information exchange: a theoretical framework. In *Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work* (pp. 451-460). ACM.

Sturges, P., 2005. Corruption, Transparency and a Role for ICT?. *International Journal of Information Ethics, 2*(11): pp.1-9.

Sullivan, A.J., 1965. Values of public relations. *Information, Influence and Communication: A Reader, Basic Books, New York*, pp.412-439.

Surowiecki, J., 2005. *The wisdom of crowds*. Anchor.

Svenson, O., 1979. Process descriptions of decision making. *Organizational behavior and human performance*, *23*(1), pp.86-112.

Swank, O.H. and Visser, B., 2013. Is transparency to no avail?. *The Scandinavian Journal of Economics*, *115*(4), pp.967-994.

Swann, W.B. and Hill, C.A., 1982. When our identities are mistaken: Reaffirming self-conceptions through social interaction. *Journal of Personality and Social Psychology*, *43*(1), p.59.

Tagiuri, R., Kogan, N. and Bruner, J.S., 1955. The transparency of interpersonal choice. *Sociometry*, *18*(4), pp.368-379.

Tanimoto, S., 2005, July. Dimensions of transparency in open learner models. In *Proc Int. Workshop on Learner Modelling for Reflection, to Supporter Learner Control, Metacognition and Improved Communication between Teachers and Learners, AIED, IOS Press, Amsterdam*.

Tesch, D., Miller, R., Jiang, J.J. and Klein, G., 2005. Perception and expectation gaps of information systems provider skills: the impact on user satisfaction. *Information Systems Journal*, *15*(4), pp.343-355.

Tidline, T.J., 1999. The mythology of information overload. *Library trends*,*47*(3), pp.485-506.

Tintarev, N. and Masthoff, J., 2012. Evaluating the effectiveness of explanations for recommender systems. *User Modeling and User-Adapted Interaction*, *22*(4-5), pp.399-439.

Truman, E.M., 2007. *Sovereign wealth funds: the need for greater transparency and accountability* (No. PB07-6). Washington, DC: Peterson Institute for International Economics.

Turilli, M. and Floridi, L., 2009. The ethics of information transparency. *Ethics and Information Technology*, *11*(2), pp.105-112.

Vaccaro, A., 2006. Privacy, security, and transparency: ICT-related ethical perspectives and contrasts in contemporary firms. In *Social inclusion: Societal and organizational implications for information systems* (pp. 245-258). Springer US.

Vaccaro, A. and Madsen, P., 2006, September. Firm information transparency: Ethical questions in the information age. In *IFIP International Conference on Human Choice and Computers* (pp. 145-156). Springer US.

Vaccaro, A. and Madsen, P., 2009a. Corporate dynamic transparency: the new ICT-driven ethics?. *Ethics and Information Technology*, *11*(2), pp.113-122.

Vaccaro, A. and Madsen, P., 2009b. ICT and an NGO: Difficulties in attempting to be extremely transparent. *Ethics and Information Technology*,*11*(3), pp.221-231.

Vaccaro, A. and Madsen, P., 2009c. Transparency in business and society: introduction to the special issue. *Ethics and information technology*, *11*(2), pp.101-103.

Van Belle, D.A. and Oneal, J.R., 1998. Press Freedom as a Source of the Democratic Peace. In *94th Annual Meeting of the American Political Science Association, Boston*.

Van der Cruijsen, C.A. and Eijffinger, S.C., 2010. From actual to perceived transparency: The case of the European Central Bank. *Journal of Economic Psychology*, *31*(3), pp.388-399.

Van Lamsweerde, A., 2009. *Requirements engineering: from system goals to UML models to software specifications*. Wiley Publishing.

Van Nes, F., Abma, T., Jonsson, H. and Deeg, D., 2010. Language differences in qualitative research: is meaning lost in translation?. *European journal of ageing*, *7*(4), pp.313-316.

Vattimo, G., and Webb, D. 1992. *The transparent society* (pp. 62-75). Cambridge: Polity Press.

Vaughan, M., 2013. *The Thinking Effect: Rethinking Thinking to Create Great Leaders and the New Value Worker*. Nicholas Brealey Publishing.

Venkatesh, V., Morris, M.G., Davis, G.B. and Davis, F.D., 2003. User acceptance of information technology: Toward a unified view. *MIS quarterly*, pp.425-478.

Vishwanath, T. and Kaufmann, D., 1999. Towards transparency in finance and governance. *Available at SSRN 258978*.

Von Furstenberg, G.M., 2001. Hopes and delusions of transparency. *The North American Journal of Economics and Finance*, *12*(1), pp.105-120.

Wall, S.P., 1996. Public justification and the transparency argument. *The Philosophical Quarterly (1950-)*, *46*(185), pp.501-507.

Wand, Y. and Weber, R., 1993. On the ontological expressiveness of information systems analysis and design grammars. *Information Systems Journal*, *3*(4), pp.217-237.

Watts, S., 2015. Corporate social responsibility reporting platforms: enabling transparency for accountability. *Information Technology and Management*,*16*(1), pp.19-35.

Weber, R.H., 2008. Transparency and the governance of the Internet. *Computer Law & Security Review*, *24*(4), pp.342-348.

Wehmeier, S. and Raaz, O., 2012. Transparency matters: The concept of organizational transparency in the academic discourse. *Public Relations Inquiry*, *1*(3), pp.337-366.

Weitzner, D.J., Abelson, H., Berners-Lee, T., Feigenbaum, J., Hendler, J. and Sussman, G.J., 2008. Information accountability. *Communications of the ACM*, *51*(6), pp.82-87.

Welch, E.W., Hinnant, C.C. and Moon, M.J., 2005. Linking citizen satisfaction with e-government and trust in government. *Journal of public administration research and theory*, *15*(3), pp.371-391.

Williams, C., 2000. Text of Remarks on Panel: Codes of Conduct and Transparency. *Hastings Int'l & Comp. L. Rev.*, *24*, p.415.

Winkler, B., 2000. Which kind of transparency? On the need for clarity in monetary policy-making.

Wohlin, C., Runeson, P., Höst, M., Ohlsson, M.C., Regnell, B. and Wesslén, A., 2012. *Experimentation in software engineering*. Springer Science & Business Media.

Wolfe, R., 2003. Regulatory transparency, developing countries and the WTO. *World Trade Review*, *2*(2), pp.157-182.

Wong, J., 2008. Information acquisition, dissemination, and transparency of monetary policy. *Canadian Journal of Economics/Revue canadienne d'économique*, *41*(1), pp.46-79.

Wong, R.C.W., Li, J., Fu, A.W.C. and Wang, K., 2006, August. (α, k)-anonymity: an enhanced k-anonymity model for privacy preserving data publishing. In *Proceedings of the 12th ACM SIGKDD international conference on Knowledge discovery and data mining* (pp. 754-759). ACM.

Woo, J., 2006. The right not to be identified: privacy and anonymity in the interactive media environment. *New media & society*, *8*(6), pp.949-967.

Woodford, M., 2005. *Central bank communication and policy effectiveness*(No. w11898). National Bureau of Economic Research.

Wyden, R., 1995. Transparency: a prescription against malpractice. *Public Health Reports*, *110*(4), p.380.

Xu, A., Huang, S.W. and Bailey, B., 2014, February. Voyant: generating structured feedback on visual designs using a crowd of non-experts. In *Proceedings of the 17th ACM conference on Computer supported cooperative work & social computing* (pp. 1433-1444). ACM.

Yin, R.K., 2013. *Case study research: Design and methods*. Sage publications.

Yosha, O., 2003. *Financing Innovation: Is Transparency a Two-Edged Sword?*. Eitan Berglas School of Economics.

Yu, E., 2011. Modelling strategic relationships for process reengineering. *Social Modeling for Requirements Engineering*, *11*, p.2011.

Zhu, K., 2004. Information transparency of business-to-business electronic markets: A game-theoretic analysis. *Management Science*, *50*(5), pp.670-685.

Appendix One: Transparency Modelling and Analysis: Case Study

For modelling and analysis of transparency requirements using *TranspLan*, the following assignment marking process specification was used, which concerns university students' examinations and assignments assessment and marking process. The specification was elicited from university officials involving module leaders and teaching programme leaders.

1 University Assignment Marking Process Specification

During and at the end of each semester, students' understanding of a unit is evaluated by a combination of coursework and exams, hereby called assignment. The marking is generally performed by two markers. The first marker is the unit leader by default, and the second marker performs marking for quality assurance purposes. The marking is performed using a marking process provided by the university as a general guideline. Feedback on assignments is also provided by the first marker to students. Besides, students may ask the first marker to give them statistics about markings. Sometimes, an external examiner is also involved in the marking process by marking the assignments in order to evaluate the quality of the marking performed by the first and second marker. The external examiner also provides feedback on marking of the first and second marker. Furthermore, a teaching committee is in charge of reviewing all the markings and accepting or refusing them.

If any inconsistencies arise between the two markers, or between the two markers and the external examiner, then an exam board will review the markings and decide the final marking. The exam board also investigates students' complaints about their marks, which must not be disclosed to the unit leader, and investigates the marking refusal if the teaching committee refuses the marking. The exam board decision on students' marking will be final.

2 Identifying Stakeholders

Based on the abovementioned specification, the following stakeholders are identified:

1) the student,

2) the first marker,

3) the second marker,

4) the university,

5) the external examiner (or external marker),

6) the teaching committee, and

7) the exam board.

3 Identifying Information Elements

Furthermore, based on the abovementioned specification, the following information elements are also identified:

1) the assignment,

2) the first marker's assignment mark,

3) the second marker's assignment mark,

4) the marking scheme,

5) the feedback on assignment,

6) marking statistics,

7) the external examiner's assignment mark,

8) the feedback on marking,

9) the marking acceptance,

10) the marking refusal,

11) marking problems,

12) students' complaints,

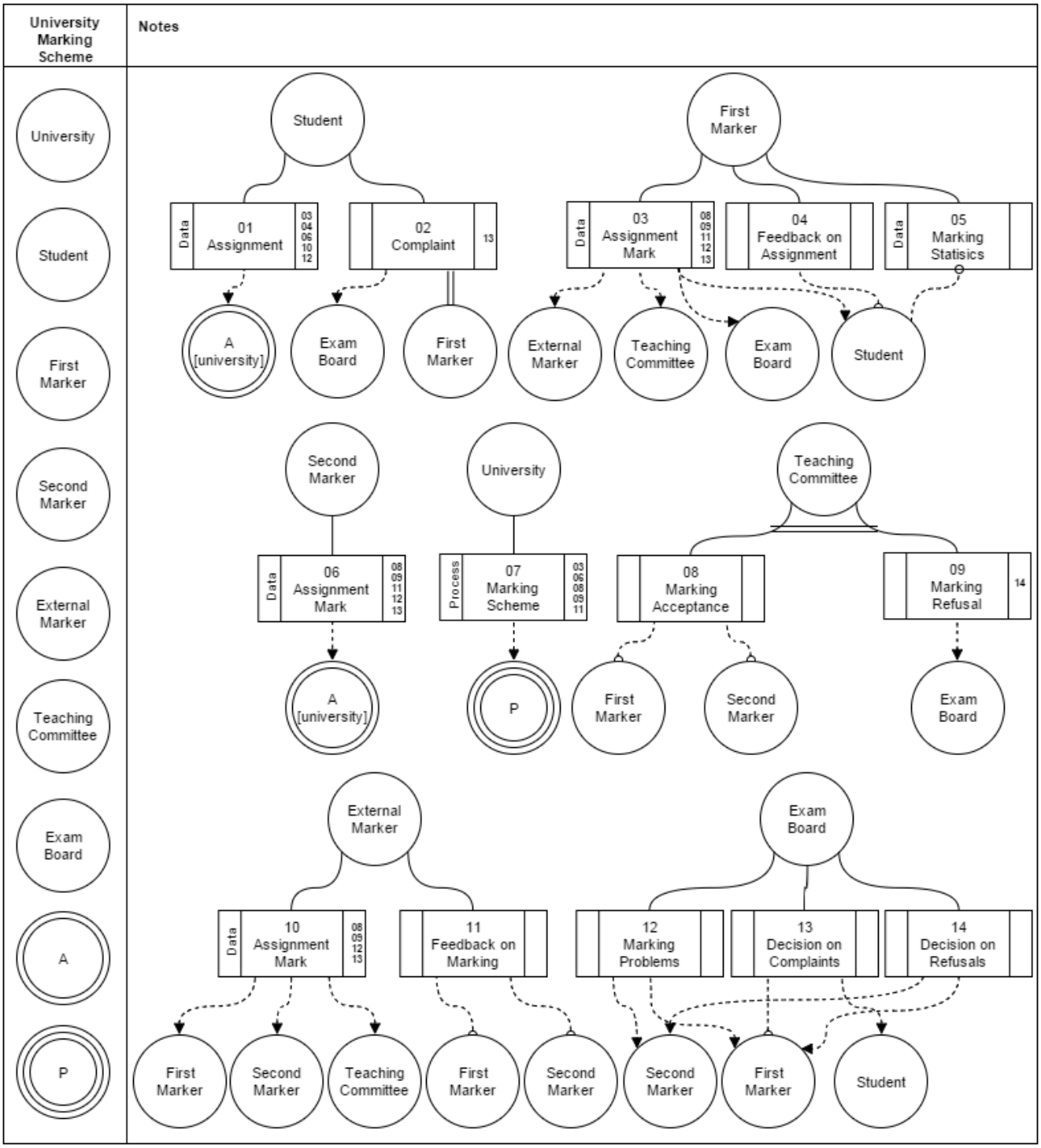
13) the decision on complaints, and

14) the decision on refusals.

4 Initial Transparency Model

Based on the university assignment marking process specification, the initial transparency model is created. This initial transparency model consists of the Shield diagram and the Sitreq and Infolet Specifications. A quick study of this model pinpoints several deficiencies and inadequacies in transparency provision, including several missing data regarding transparency meaningfulness, transparency usefulness, information quality, and transparency requirements of stakeholders.

4.1 The Initial Shield Diagram



4.2 Initial Sitreq Specifications

4.2.1 Student

Stakeholder's Information Transparency REQuirements Specification (Sitreq)						
Stakeholder's Name: Student						
IE Label	**IE Name**	**Relationship**	**Requirement Description**	**Transparency Requirement Type**	**Transparency Meaningfulness Type**	**Stakeholders Involved**
01	Assignment	Producer	Assignment should be handled by different stakeholders	Coercive	Data	All except university
02	Complaint	Producer	Complaint is hidden from the first marker	Restricted	N/A	First marker
02	Complaint	Producer	Complaint should be handled by the exam board	Coercive	???	Exam board
03	Assignment mark	Receiver	First marker provides the mark to the student	Coercive	Data	First marker
04	Feedback on assignment	Receiver	First marker sends feedback on marking	???	Policy	First marker
05	Marking statistics	Requester	Student wants the statistical figures	???	Data	First marker
06	Assignment mark	Receiver	Second marker provides the mark to the student	???	Data	Second marker
07	Marking scheme	Receiver	Student has public access to marking scheme	Coercive	Process	University
13	Decision on Complaint	Receiver	Student gets exam board's decision on their complaint	Coercive	???	Exam board

4.2.2 University

Stakeholder's Information Transparency REQuirements Specification (Sitreq)						
Stakeholder's Name: University						
IE Label	**IE Name**	**Relationship**	**Requirement Description**	**Transparency Requirement Type**	**Transparency Meaningfulness Type**	**Stakeholders Involved**
07	Marking scheme	Producer	University makes the marking scheme publicly available	Coercive	Process	Public

4.2.3 First Marker

Stakeholder's Information Transparency REQuirements Specification (Sitreq)						
Stakeholder's Name: First Marker						
IE Label	**IE Name**	**Relationship**	**Requirement Description**	**Transparency Requirement Type**	**Transparency Meaningfulness Type**	**Stakeholders Involved**
01	Assignment	Receiver	First marker receives the assignment for marking	Coercive	Data	Student
03	Assignment mark	Producer	First marker marks students' assignments	Coercive	Data	Student
03	Assignment mark	Producer	First marker gives the external marker the markings to be assessed	Coercive	Data	External marker
03	Assignment mark	Producer	First marker gives the marking to teaching committee in case of disagreement with second marker	Coercive	Data	Teaching committee
03	Assignment mark	Producer	First marker gives the marking to the exam board in case of students' complaints or disagreements	Coercive	Data	Exam board
04	Feedback on assignment	Producer	First marker provides students with feedback on their assignments	???	Data	Student
05	Marking statistics	Producer	Marking statistics are given to students when requested	???	Data	Student
06	Assignment mark	Receiver	Second marker provides first marker with their assignment mark	Coercive	Data	Second marker
07	Marking scheme	Receiver	First marker has public access to marking scheme	Coercive	Process	University
08	Marking acceptance	Receiver	First marker is informed of teaching committee's marking acceptance	???	???	Teaching Committee
10	Assignment mark	Receiver	External marker provides first marker with their assignment mark	Coercive	Data	External marker
11	Feedback on marking	Receiver	External marker provides first marker with their feedback on their marking	???	???	External marker
12	Marking problems	Receiver	Exam board informs first marker on their marking problems	Coercive	???	Exam board
13	Decision on complaints	Receiver	Exam board informs first marker on student's complaints and their decisions	???	???	Exam board
14	Decision on refusals	Receiver	Exam board informs first marker on their decision on teaching committee's marking refusal	Coercive	???	Exam board

4.2.4 Second Marker

Stakeholder's Information Transparency REQuirements Specification (Sitreq)						
Stakeholder's Name: Second Marker						
IE Label	**IE Name**	**Relationship**	**Requirement Description**	**Transparency Requirement Type**	**Transparency Meaningfulness Type**	**Stakeholders Involved**
01	Assignment	Receiver	Second marker receives the assignment for marking	Coercive	Data	Student
06	Assignment mark	Producer	Second marker marks students' assignments	Coercive	Data	All except university
07	Marking scheme	Receiver	Second marker has public access to marking scheme	Coercive	Process	University
08	Marking acceptance	Receiver	Second marker is informed of teaching committee's marking acceptance	???	???	Teaching Committee
10	Assignment mark	Receiver	External marker provides second marker with their assignment mark	Coercive	Data	External marker
11	Feedback on marking	Receiver	External marker provides second marker with their feedback on their marking	???	???	External marker
12	Marking problems	Receiver	Exam board informs second marker on their marking problems	Coercive	???	Exam board
14	Decision on refusals	Receiver	Exam board informs second marker on their decision on teaching committee's marking refusal	Coercive	???	Exam board

4.2.5 External Marker

Stakeholder's Information Transparency REQuirements Specification (Sitreq)						
Stakeholder's Name: External Marker						
IE Label	**IE Name**	**Relationship**	**Requirement Description**	**Transparency Requirement Type**	**Transparency Meaningfulness Type**	**Stakeholders Involved**
01	Assignment	Receiver	External marker receives the assignment for marking	Coercive	Data	Student
03	Assignment mark	Receiver	First marker gives the marking to external marker for feedback	Coercive	Data	First marker
06	Assignment mark	Receiver	Second marker gives the marking to external marker for feedback	Coercive	Data	Second marker
07	Marking scheme	Receiver	External marker has public access to marking scheme	Coercive	Process	University
10	Assignment mark	Producer	External marker gives his marking to first marker for comparison	Coercive	Data	First marker
10	Assignment mark	Producer	External marker gives his marking to second marker for comparison	Coercive	Data	Second marker
10	Assignment mark	Producer	External marker gives his marking to teaching committee in case of disagreement with first and second marker	Coercive	Data	Teaching committee
11	Feedback on marking	Producer	External marker gives feedback on first marker's marking	???	???	First marker
11	Feedback on marking	Producer	External marker gives feedback on second marker's marking	???	???	Second marker

4.2.6 Teaching Committee

Stakeholder's Information Transparency REQuirements Specification (Sitreq)						
Stakeholder's Name: Teaching Committee						
IE Label	**IE Name**	**Relationship**	**Requirement Description**	**Transparency Requirement Type**	**Transparency Meaningfulness Type**	**Stakeholders Involved**
01	Assignment	Receiver	Teaching committee receives the assignment for decision on marking	Coercive	Data	Student
03	Assignment mark	Receiver	First marker gives the marking to teaching committee in case of disagreement with second marker	Coercive	Data	First marker
06	Assignment mark	Receiver	Second marker gives the marking to teaching committee in case of disagreement with first marker	Coercive	Data	Second marker
07	Marking scheme	Receiver	Teaching committee has public access to marking scheme	Coercive	Process	University
08	Marking acceptance	Producer	Teaching committee informs first marker on their marking acceptance	???	???	First marker
08	Marking acceptance	Producer	Teaching committee informs second marker on their marking acceptance	???	???	Second marker
09	Marking refusal	Producer	Teaching committee informs exam board on marking refusals	Coercive	???	Exam board
10	Assignment mark	Receiver	External marker gives the marking to teaching committee in case of disagreement with first and second markers	Coercive	Data	External marker

4.2.7 Exam Board

Stakeholder's Information Transparency REQuirements Specification (Sitreq)						
Stakeholder's Name: Exam Board						
IE Label	**IE Name**	**Relationship**	**Requirement Description**	**Transparency Requirement Type**	**Transparency Meaningfulness Type**	**Stakeholders Involved**
01	Assignment	Receiver	Exam board receives the assignment in case of complaints, marking problems or marking refusals	Coercive	Data	Student
02	Complaint	Receiver	Students' complaints are handled by the exam board	Coercive	???	Student
03	Assignment mark	Receiver	First marker gives the marking to exam board in case of disagreement with second marker, marking refusals or students' complaints	Coercive	Data	First marker
06	Assignment mark	Receiver	Second marker gives the marking to exam board in case of disagreement with first marker or marking refusals	Coercive	Data	Second marker
07	Marking scheme	Receiver	Exam board has public access to marking scheme	Coercive	Process	University
09	Marking refusal	Receiver	Exam board deals with marking refusals	Coercive	???	Teaching committee
12	Marking problems	Producer	Exam board deals with disagreements between first and second marker	Coercive	???	First marker
12	Marking problems	Producer	Exam board deals with disagreements between first and second marker	Coercive	???	Second marker
13	Decision on complaints	Producer	Exam board informs first marker on student's complaints and their decisions	???	???	First marker
13	Decision on complaints	Producer	Exam board informs student on their decisions on their complaint	Coercive	???	Student
14	Decision on refusals	Producer	Exam board informs first marker on their decision on marking refusal	Coercive	???	First marker
14	Decision on refusals	Producer	Exam board informs second marker on their decision on marking refusal	Coercive	???	Second marker

4.3 Initial Infolet Specifications

4.3.1 Assignment

INFOrmation eLEment Transparency Specification (Infolet)		
① **Information Element (IE) Label** 01	② **Information Element (IE) Name** Assignment	③ **Information Element (IE) Type** Data
④ **Information Element Description** This information element contains the student's assignment. The assignment is used in order to assess the student's progress throughout the semester.		
⑤ **List of Other Information Elements Using This Information Element** 03: Assignment Mark 04: Feedback on Assignment 06: Assignment Mark 10: Assignment Mark 12: Marking Problems		
⑥ **Information Element Creator/Authority** Student		
⑦ **Information Element Provider** Student		
⑧ **List of Stakeholders Receiving Information Element and Information Element Provision Type** All stakeholders except university: Coercive		
⑨ **List of Stakeholders Requesting Information Element and Information Element Request Type** N/A		
⑩ **List of Stakeholders with Restricted Access to Information Element and Restriction Type** N/A		
⑪ **Information Element Quality Control (Sound, Dependable, Useful, Usable)** ◯ **Free of Error** ◯ **Concise Rep.** ◯ **Completeness** ◯ **Consistent Rep.** ◯ **Timeliness** ◯ **Security** ◯ **App. Amount** ◯ **Relevancy** ◯ **Understandability** ◯ **Objectivity** ◯ **Interpretability** ◯ **Accessibility** ◯ **Believability** ◯ **Ease of Manipulation** ◯ **Reputation** ◯ **Value-added**		
⑫ **Information Element Level of Reach** ◯ **Information Availability (Information is made available to the stakeholders)** ◯ **Information Interpretation (Information is appropriately interpreted for the stakeholders)** ◯ **Information Accessibility (Information is easily accessible by the stakeholders)** ◯ **Information Understandability (Information is comprehended by the stakeholders)** ◯ **Information Perception (Information is perceived credible by the stakeholders)** ◯ **Information Acceptance (Information is believed and accepted by the stakeholders)** ◯ **Information Actionability (Information helps stakeholders in their informed decision-making)**		
⑬ **Information Element Notes** N/A		

4.3.2 Complaint

INFOrmation eLEment Transparency Specification (Infolet)		
① Information Element (IE) Label 02	② Information Element (IE) Name Complaint	③ Information Element (IE) Type Unknown
④ Information Element Description This information element contains data about students' complaints on their grades. The complaint uses an online form provided by the university on their unit's webpage, and can be accessed only by the exam board. The form is also available offline.		
⑤ List of Other Information Elements Using This Information Element 13: Decision on Complaints		
⑥ Information Element Creator/Authority Student		
⑦ Information Element Provider Student		
⑧ List of Stakeholders Receiving Information Element and Information Element Provision Type Exam Board: Coercive		
⑨ List of Stakeholders Requesting Information Element and Information Element Request Type N/A		
⑩ List of Stakeholders with Restricted Access to Information Element and Restriction Type First Marker		
⑪ Information Element Quality Control (Sound, Dependable, Useful, Usable) ◯ Free of Error ◯ Concise Rep. ◯ Completeness ◯ Consistent Rep. ◯ Timeliness ◯ Security ◯ App. Amount ◯ Relevancy ◯ Understandability ◯ Objectivity ◯ Interpretability ◯ Accessibility ◯ Believability ◯ Ease of Manipulation ◯ Reputation ◯ Value-added		
⑫ Information Element Level of Reach ◯ Information Availability (Information is made available to the stakeholders) ◯ Information Interpretation (Information is appropriately interpreted for the stakeholders) ◯ Information Accessibility (Information is easily accessible by the stakeholders) ◯ Information Understandability (Information is comprehended by the stakeholders) ◯ Information Perception (Information is perceived credible by the stakeholders) ◯ Information Acceptance (Information is believed and accepted by the stakeholders) ◯ Information Actionability (Information helps stakeholders in their informed decision-making)		
⑬ Information Element Notes The sample form for filing a complaint can be accessed on the following link.		

4.3.3 Assignment Mark

INFOrmation eLEment Transparency Specification (Infolet)		
① **Information Element (IE) Label** 03	② **Information Element (IE) Name** Assignment Mark	③ **Information Element (IE) Type** Data
④ **Information Element Description** This information element contains the first marker's marking results on students' assignments. The marking is performed based on university marking scheme.		
⑤ **List of Other Information Elements Using This Information Element** 08: Marking Acceptance 09: Marking Refusal 11: Feedback on Marking 12: Marking Problems 13: Decision on Complaints		
⑥ **Information Element Creator/Authority** First Marker		
⑦ **Information Element Provider** First Marker		
⑧ **List of Stakeholders Receiving Information Element and Information Element Provision Type** External Marker: Coercive Teaching Committee: Coercive Exam Board: Coercive Student: Coercive		
⑨ **List of Stakeholders Requesting Information Element and Information Element Request Type** N/A		
⑩ **List of Stakeholders with Restricted Access to Information Element and Restriction Type** N/A		
⑪ **Information Element Quality Control (Sound, Dependable, Useful, Usable)** ◯ **Free of Error** ◯ **Concise Rep.** ◯ **Completeness** ◯ **Consistent Rep.** ◯ **Timeliness** ◯ **Security** ◯ **App. Amount** ◯ **Relevancy** ◯ **Understandability** ◯ **Objectivity** ◯ **Interpretability** ◯ **Accessibility** ◯ **Believability** ◯ **Ease of Manipulation** ◯ **Reputation** ◯ **Value-added**		
⑫ **Information Element Level of Reach** ◯ **Information Availability (Information is made available to the stakeholders)** ◯ **Information Interpretation (Information is appropriately interpreted for the stakeholders)** ◯ **Information Accessibility (Information is easily accessible by the stakeholders)** ◯ **Information Understandability (Information is comprehended by the stakeholders)** ◯ **Information Perception (Information is perceived credible by the stakeholders)** ◯ **Information Acceptance (Information is believed and accepted by the stakeholders)** ◯ **Information Actionability (Information helps stakeholders in their informed decision-making)**		
⑬ **Information Element Notes** N/A		

4.3.4 Feedback on Assignment

INFOrmation eLEment Transparency Specification (Infolet)		
① Information Element (IE) Label 04	② Information Element (IE) Name Feedback on Assignment	③ Information Element (IE) Type Unknown
④ Information Element Description This information element contains the first marker's feedback on students' assignments.		
⑤ List of Other Information Elements Using This Information Element N/A		
⑥ Information Element Creator/Authority First Marker		
⑦ Information Element Provider First Marker		
⑧ List of Stakeholders Receiving Information Element and Information Element Provision Type Student: Undecided		
⑨ List of Stakeholders Requesting Information Element and Information Element Request Type N/A		
⑩ List of Stakeholders with Restricted Access to Information Element and Restriction Type N/A		
⑪ Information Element Quality Control (Sound, Dependable, Useful, Usable) ◯ Free of Error ◯ Concise Rep. ◯ Completeness ◯ Consistent Rep. ◯ Timeliness ◯ Security ◯ App. Amount ◯ Relevancy ◯ Understandability ◯ Objectivity ◯ Interpretability ◯ Accessibility ◯ Believability ◯ Ease of Manipulation ◯ Reputation ◯ Value-added		
⑫ Information Element Level of Reach ◯ Information Availability (Information is made available to the stakeholders) ◯ Information Interpretation (Information is appropriately interpreted for the stakeholders) ◯ Information Accessibility (Information is easily accessible by the stakeholders) ◯ Information Understandability (Information is comprehended by the stakeholders) ◯ Information Perception (Information is perceived credible by the stakeholders) ◯ Information Acceptance (Information is believed and accepted by the stakeholders) ◯ Information Actionability (Information helps stakeholders in their informed decision-making)		
⑬ Information Element Notes N/A		

4.3.5 Marking Statistics

INFOrmation eLEment Transparency Specification (Infolet)		
① **Information Element (IE) Label** 05	② **Information Element (IE) Name** Marking Statistics	③ **Information Element (IE) Type** Data
④ **Information Element Description** This information element contains the first marker's provided statistics on students' marks and normally contains the mean, the median, the mode, the maximum and the minimum marks.		
⑤ **List of Other Information Elements Using This Information Element** N/A		
⑥ **Information Element Creator/Authority** First Marker		
⑦ **Information Element Provider** First Marker		
⑧ **List of Stakeholders Receiving Information Element and Information Element Provision Type** N/A		
⑨ **List of Stakeholders Requesting Information Element and Information Element Request Type** Student: Undecided		
⑩ **List of Stakeholders with Restricted Access to Information Element and Restriction Type** N/A		
⑪ **Information Element Quality Control (Sound, Dependable, Useful, Usable)** ◯ **Free of Error** ◯ **Concise Rep.** ◯ **Completeness** ◯ **Consistent Rep.** ◯ **Timeliness** ◯ **Security** ◯ **App. Amount** ◯ **Relevancy** ◯ **Understandability** ◯ **Objectivity** ◯ **Interpretability** ◯ **Accessibility** ◯ **Believability** ◯ **Ease of Manipulation** ◯ **Reputation** ◯ **Value-added**		
⑫ **Information Element Level of Reach** ◯ **Information Availability (Information is made available to the stakeholders)** ◯ **Information Interpretation (Information is appropriately interpreted for the stakeholders)** ◯ **Information Accessibility (Information is easily accessible by the stakeholders)** ◯ **Information Understandability (Information is comprehended by the stakeholders)** ◯ **Information Perception (Information is perceived credible by the stakeholders)** ◯ **Information Acceptance (Information is believed and accepted by the stakeholders)** ◯ **Information Actionability (Information helps stakeholders in their informed decision-making)**		
⑬ **Information Element Notes** N/A		

4.3.6 Assignment Mark

INFOrmation eLEment Transparency Specification (Infolet)		
① **Information Element (IE) Label** 06	② **Information Element (IE) Name** Assignment Mark	③ **Information Element (IE) Type** Data
④ **Information Element Description** This information element contains the second marker's marking results on students' assignments. The marking is performed based on university marking scheme.		
⑤ **List of Other Information Elements Using This Information Element** 08: Marking Acceptance 09: Marking Refusal 11: Feedback on Marking 12: Marking Problems 13: Decision on Complaints		
⑥ **Information Element Creator/Authority** Second Marker		
⑦ **Information Element Provider** Second Marker		
⑧ **List of Stakeholders Receiving Information Element and Information Element Provision Type** All stakeholders except university: Coercive		
⑨ **List of Stakeholders Requesting Information Element and Information Element Request Type** N/A		
⑩ **List of Stakeholders with Restricted Access to Information Element and Restriction Type** N/A		
⑪ **Information Element Quality Control (Sound, Dependable, Useful, Usable)** ◯ **Free of Error** ◯ **Concise Rep.** ◯ **Completeness** ◯ **Consistent Rep.** ◯ **Timeliness** ◯ **Security** ◯ **App. Amount** ◯ **Relevancy** ◯ **Understandability** ◯ **Objectivity** ◯ **Interpretability** ◯ **Accessibility** ◯ **Believability** ◯ **Ease of Manipulation** ◯ **Reputation** ◯ **Value-added**		
⑫ **Information Element Level of Reach** ◯ **Information Availability (Information is made available to the stakeholders)** ◯ **Information Interpretation (Information is appropriately interpreted for the stakeholders)** ◯ **Information Accessibility (Information is easily accessible by the stakeholders)** ◯ **Information Understandability (Information is comprehended by the stakeholders)** ◯ **Information Perception (Information is perceived credible by the stakeholders)** ◯ **Information Acceptance (Information is believed and accepted by the stakeholders)** ◯ **Information Actionability (Information helps stakeholders in their informed decision-making)**		
⑬ **Information Element Notes** N/A		

4.3.7 Marking Scheme

INFOrmation eLEment Transparency Specification (Infolet)		
① Information Element (IE) Label 07	② Information Element (IE) Name Mark Scheme	③ Information Element (IE) Type Process

④ Information Element Description

This information element contains the university's marking scheme. The marking scheme is publicly available on university's website.

⑤ List of Other Information Elements Using This Information Element

03: Assignment Mark
06: Assignment Mark
08: Marking Acceptance
09: Marking Refusal
11: Feedback on Marking

⑥ Information Element Creator/Authority

Unknown

⑦ Information Element Provider

University

⑧ List of Stakeholders Receiving Information Element and Information Element Provision Type

Public: Coercive

⑨ List of Stakeholders Requesting Information Element and Information Element Request Type

N/A

⑩ List of Stakeholders with Restricted Access to Information Element and Restriction Type

N/A

⑪ Information Element Quality Control (Sound, Dependable, Useful, Usable)

◯ Free of Error ◯ Concise Rep. ◯ Completeness ◯ Consistent Rep.
◯ Timeliness ◯ Security
◯ App. Amount ◯ Relevancy ◯ Understandability ◯ Objectivity ◯ Interpretability
◯ Accessibility ◯ Believability ◯ Ease of Manipulation ◯ Reputation ◯ Value-added

⑫ Information Element Level of Reach

◯ Information Availability (Information is made available to the stakeholders)
◯ Information Interpretation (Information is appropriately interpreted for the stakeholders)
◯ Information Accessibility (Information is easily accessible by the stakeholders)
◯ Information Understandability (Information is comprehended by the stakeholders)
◯ Information Perception (Information is perceived credible by the stakeholders)
◯ Information Acceptance (Information is believed and accepted by the stakeholders)
◯ Information Actionability (Information helps stakeholders in their informed decision-making)

⑬ Information Element Notes

The university marking scheme is available at the following link.

4.3.8 Marking Acceptance

INFOrmation eLEment Transparency Specification (Infolet)		
① Information Element (IE) Label 08	② Information Element (IE) Name Marking Acceptance	③ Information Element (IE) Type Unknown

④ Information Element Description
This information element contains the marking acceptance results which is decided by the teaching committee. The decision is initiated when there is a discrepancy between the first maker and the second marker.

⑤ List of Other Information Elements Using This Information Element
N/A

⑥ Information Element Creator/Authority
Teaching Committee

⑦ Information Element Provider
Teaching Committee

⑧ List of Stakeholders Receiving Information Element and Information Element Provision Type
First Marker: Undecided
Second Marker: Undecided

⑨ List of Stakeholders Requesting Information Element and Information Element Request Type
N/A

⑩ List of Stakeholders with Restricted Access to Information Element and Restriction Type
N/A

⑪ Information Element Quality Control (Sound, Dependable, Useful, Usable)

◯ Free of Error	◯ Concise Rep.	◯ Completeness	◯ Consistent Rep.	
◯ Timeliness	◯ Security			
◯ App. Amount	◯ Relevancy	◯ Understandability	◯ Objectivity	◯ Interpretability
◯ Accessibility	◯ Believability	◯ Ease of Manipulation	◯ Reputation	◯ Value-added

⑫ Information Element Level of Reach
◯ Information Availability (Information is made available to the stakeholders)
◯ Information Interpretation (Information is appropriately interpreted for the stakeholders)
◯ Information Accessibility (Information is easily accessible by the stakeholders)
◯ Information Understandability (Information is comprehended by the stakeholders)
◯ Information Perception (Information is perceived credible by the stakeholders)
◯ Information Acceptance (Information is believed and accepted by the stakeholders)
◯ Information Actionability (Information helps stakeholders in their informed decision-making)

⑬ Information Element Notes
N/A

4.3.9 Marking Refusal

INFOrmation eLEment Transparency Specification (Infolet)		
① Information Element (IE) Label 09	② Information Element (IE) Name Marking Refusal	③ Information Element (IE) Type Unknown
④ Information Element Description This information element contains the marking refusal results which is decided by the teaching committee. The decision is initiated when there is a discrepancy between the first maker and the second marker.		
⑤ List of Other Information Elements Using This Information Element 14: Decision on Refusals		
⑥ Information Element Creator/Authority Teaching Committee		
⑦ Information Element Provider Teaching Committee		
⑧ List of Stakeholders Receiving Information Element and Information Element Provision Type Exam Board: Coercive		
⑨ List of Stakeholders Requesting Information Element and Information Element Request Type N/A		
⑩ List of Stakeholders with Restricted Access to Information Element and Restriction Type N/A		
⑪ Information Element Quality Control (Sound, Dependable, Useful, Usable) ◯ Free of Error ◯ Concise Rep. ◯ Completeness ◯ Consistent Rep. ◯ Timeliness ◯ Security ◯ App. Amount ◯ Relevancy ◯ Understandability ◯ Objectivity ◯ Interpretability ◯ Accessibility ◯ Believability ◯ Ease of Manipulation ◯ Reputation ◯ Value-added		
⑫ Information Element Level of Reach ◯ Information Availability (Information is made available to the stakeholders) ◯ Information Interpretation (Information is appropriately interpreted for the stakeholders) ◯ Information Accessibility (Information is easily accessible by the stakeholders) ◯ Information Understandability (Information is comprehended by the stakeholders) ◯ Information Perception (Information is perceived credible by the stakeholders) ◯ Information Acceptance (Information is believed and accepted by the stakeholders) ◯ Information Actionability (Information helps stakeholders in their informed decision-making)		
⑬ Information Element Notes N/A		

4.3.10 Assignment Mark

INFOrmation eLEment Transparency Specification (Infolet)		
① Information Element (IE) Label 10	② Information Element (IE) Name Assignment Mark	③ Information Element (IE) Type Data

④ Information Element Description

This information element contains the external marker's marking results on students' assignments. The marking is performed based on university marking scheme.

⑤ List of Other Information Elements Using This Information Element

08: Marking Acceptance
09: Marking Refusal
12: Marking Problems
13: Decision on Complaints

⑥ Information Element Creator/Authority

External Marker

⑦ Information Element Provider

External Marker

⑧ List of Stakeholders Receiving Information Element and Information Element Provision Type

First Marker: Coercive
Second Marker: Coercive
Teaching Committee: Coercive

⑨ List of Stakeholders Requesting Information Element and Information Element Request Type

N/A

⑩ List of Stakeholders with Restricted Access to Information Element and Restriction Type

N/A

⑪ Information Element Quality Control (Sound, Dependable, Useful, Usable)

◯ Free of Error ◯ Concise Rep. ◯ Completeness ◯ Consistent Rep.
◯ Timeliness ◯ Security
◯ App. Amount ◯ Relevancy ◯ Understandability ◯ Objectivity ◯ Interpretability
◯ Accessibility ◯ Believability ◯ Ease of Manipulation ◯ Reputation ◯ Value-added

⑫ Information Element Level of Reach

◯ Information Availability (Information is made available to the stakeholders)
◯ Information Interpretation (Information is appropriately interpreted for the stakeholders)
◯ Information Accessibility (Information is easily accessible by the stakeholders)
◯ Information Understandability (Information is comprehended by the stakeholders)
◯ Information Perception (Information is perceived credible by the stakeholders)
◯ Information Acceptance (Information is believed and accepted by the stakeholders)
◯ Information Actionability (Information helps stakeholders in their informed decision-making)

⑬ Information Element Notes

N/A

4.3.11 Feedback on Marking

INFOrmation eLEment Transparency Specification (Infolet)		
① Information Element (IE) Label 11	② Information Element (IE) Name Feedback on Marking	③ Information Element (IE) Type Unknown
④ Information Element Description This information element contains the external marker's feedback on the first marker's marking and the second marker's marking.		
⑤ List of Other Information Elements Using This Information Element N/A		
⑥ Information Element Creator/Authority External Marker		
⑦ Information Element Provider External Marker		
⑧ List of Stakeholders Receiving Information Element and Information Element Provision Type First marker: Undecided Second marker: Undecided		
⑨ List of Stakeholders Requesting Information Element and Information Element Request Type N/A		
⑩ List of Stakeholders with Restricted Access to Information Element and Restriction Type N/A		
⑪ Information Element Quality Control (Sound, Dependable, Useful, Usable) ◯ Free of Error ◯ Concise Rep. ◯ Completeness ◯ Consistent Rep. ◯ Timeliness ◯ Security ◯ App. Amount ◯ Relevancy ◯ Understandability ◯ Objectivity ◯ Interpretability ◯ Accessibility ◯ Believability ◯ Ease of Manipulation ◯ Reputation ◯ Value-added		
⑫ Information Element Level of Reach ◯ Information Availability (Information is made available to the stakeholders) ◯ Information Interpretation (Information is appropriately interpreted for the stakeholders) ◯ Information Accessibility (Information is easily accessible by the stakeholders) ◯ Information Understandability (Information is comprehended by the stakeholders) ◯ Information Perception (Information is perceived credible by the stakeholders) ◯ Information Acceptance (Information is believed and accepted by the stakeholders) ◯ Information Actionability (Information helps stakeholders in their informed decision-making)		
⑬ Information Element Notes N/A		

4.3.12 Marking Problems

INFOrmation eLEment Transparency Specification (Infolet)		
① Information Element (IE) Label 12	② Information Element (IE) Name Marking Problems	③ Information Element (IE) Type Unknown
④ Information Element Description This information element contains exam board's decision on marking problems. The exam board periodically investigates marking problems in order to raise marking standards of the university.		
⑤ List of Other Information Elements Using This Information Element N/A		
⑥ Information Element Creator/Authority Exam Board		
⑦ Information Element Provider Exam Board		
⑧ List of Stakeholders Receiving Information Element and Information Element Provision Type First marker: Coercive Second marker: Coercive		
⑨ List of Stakeholders Requesting Information Element and Information Element Request Type N/A		
⑩ List of Stakeholders with Restricted Access to Information Element and Restriction Type N/A		
⑪ Information Element Quality Control (Sound, Dependable, Useful, Usable) ◯ Free of Error ◯ Concise Rep. ◯ Completeness ◯ Consistent Rep. ◯ Timeliness ◯ Security ◯ App. Amount ◯ Relevancy ◯ Understandability ◯ Objectivity ◯ Interpretability ◯ Accessibility ◯ Believability ◯ Ease of Manipulation ◯ Reputation ◯ Value-added		
⑫ Information Element Level of Reach ◯ Information Availability (Information is made available to the stakeholders) ◯ Information Interpretation (Information is appropriately interpreted for the stakeholders) ◯ Information Accessibility (Information is easily accessible by the stakeholders) ◯ Information Understandability (Information is comprehended by the stakeholders) ◯ Information Perception (Information is perceived credible by the stakeholders) ◯ Information Acceptance (Information is believed and accepted by the stakeholders) ◯ Information Actionability (Information helps stakeholders in their informed decision-making)		
⑬ Information Element Notes N/A		

4.3.13 Decision on Complaints

INFOrmation eLEment Transparency Specification (Infolet)		
① **Information Element (IE) Label** 13	② **Information Element (IE) Name** Decision on Complaints	③ **Information Element (IE) Type** Unknown
④ **Information Element Description** This information element contains exam board's decision on student's complaints. The exam board's decision is final.		
⑤ **List of Other Information Elements Using This Information Element** N/A		
⑥ **Information Element Creator/Authority** Exam Board		
⑦ **Information Element Provider** Exam Board		
⑧ **List of Stakeholders Receiving Information Element and Information Element Provision Type** First marker: Undecided Student: Coercive		
⑨ **List of Stakeholders Requesting Information Element and Information Element Request Type** N/A		
⑩ **List of Stakeholders with Restricted Access to Information Element and Restriction Type** N/A		
⑪ **Information Element Quality Control (Sound, Dependable, Useful, Usable)** ◯ **Free of Error** ◯ **Concise Rep.** ◯ **Completeness** ◯ **Consistent Rep.** ◯ **Timeliness** ◯ **Security** ◯ **App. Amount** ◯ **Relevancy** ◯ **Understandability** ◯ **Objectivity** ◯ **Interpretability** ◯ **Accessibility** ◯ **Believability** ◯ **Ease of Manipulation** ◯ **Reputation** ◯ **Value-added**		
⑫ **Information Element Level of Reach** ◯ **Information Availability (Information is made available to the stakeholders)** ◯ **Information Interpretation (Information is appropriately interpreted for the stakeholders)** ◯ **Information Accessibility (Information is easily accessible by the stakeholders)** ◯ **Information Understandability (Information is comprehended by the stakeholders)** ◯ **Information Perception (Information is perceived credible by the stakeholders)** ◯ **Information Acceptance (Information is believed and accepted by the stakeholders)** ◯ **Information Actionability (Information helps stakeholders in their informed decision-making)**		
⑬ **Information Element Notes** N/A		

4.3.14 Decision on Refusals

INFOrmation eLEment Transparency Specification (Infolet)		
① **Information Element (IE) Label** 14	② **Information Element (IE) Name** Decision on Refusals	③ **Information Element (IE) Type** Unknown
④ **Information Element Description** This information element contains exam board's decision on marking refusals submitted from the teaching committee. The exam board's decision is final.		
⑤ **List of Other Information Elements Using This Information Element** N/A		
⑥ **Information Element Creator/Authority** Exam Board		
⑦ **Information Element Provider** Exam Board		
⑧ **List of Stakeholders Receiving Information Element and Information Element Provision Type** First marker: Coercive Second Marker: Coercive		
⑨ **List of Stakeholders Requesting Information Element and Information Element Request Type** N/A		
⑩ **List of Stakeholders with Restricted Access to Information Element and Restriction Type** N/A		
⑪ **Information Element Quality Control (Sound, Dependable, Useful, Usable)** ◯ **Free of Error** ◯ **Concise Rep.** ◯ **Completeness** ◯ **Consistent Rep.** ◯ **Timeliness** ◯ **Security** ◯ **App. Amount** ◯ **Relevancy** ◯ **Understandability** ◯ **Objectivity** ◯ **Interpretability** ◯ **Accessibility** ◯ **Believability** ◯ **Ease of Manipulation** ◯ **Reputation** ◯ **Value-added**		
⑫ **Information Element Level of Reach** ◯ **Information Availability (Information is made available to the stakeholders)** ◯ **Information Interpretation (Information is appropriately interpreted for the stakeholders)** ◯ **Information Accessibility (Information is easily accessible by the stakeholders)** ◯ **Information Understandability (Information is comprehended by the stakeholders)** ◯ **Information Perception (Information is perceived credible by the stakeholders)** ◯ **Information Acceptance (Information is believed and accepted by the stakeholders)** ◯ **Information Actionability (Information helps stakeholders in their informed decision-making)**		
⑬ **Information Element Notes** N/A		

5 Elicitation and Clarification of Transparency Requirements

The stakeholders were engaged during this phase in elicitation and clarification of their transparency requirements. The interview with each stakeholder revealed the following ideas and concerns.

Students generally preferred that their complaints are not made available to their unit leaders. They thought that it could possibly affect their relationship with them. Marking statistics were also identified as personal demands. Finally, they also wanted the feedback on their assignments to be more about why they have got such marks, why did not score any higher, and how they could improve their assignments to get higher scores. That would imply more meaningful transparency for the students.

The first marker stated that getting marking acceptance results from the teaching community could result in information overload, as they did not consider such information to be useful. They stated that only in the case of marking refusal, they would be interested to know why their marking has been refused in order not to repeat the same mistakes in future markings.

The second marker stated similar concerns about marking acceptance and marking refusal. Moreover, they expressed their concern about getting unnecessary feedback from the external marker regarding the marking. They did not need such feedback as they were not the primary marker or the unit leader. Finally, they demanded that their markings should not be seen by students, as the students should only have access to their first marker's markings and feedback.

The teaching committee stated that they had to receive the exam board final decision on refusal, as they needed to use the data for the evaluation of their own procedures. They also confirmed that sending marking acceptance results to first and second markers is not usually appreciated by them, as it holds no apparent value for the markers.

The external examiner was fine with the system as is.

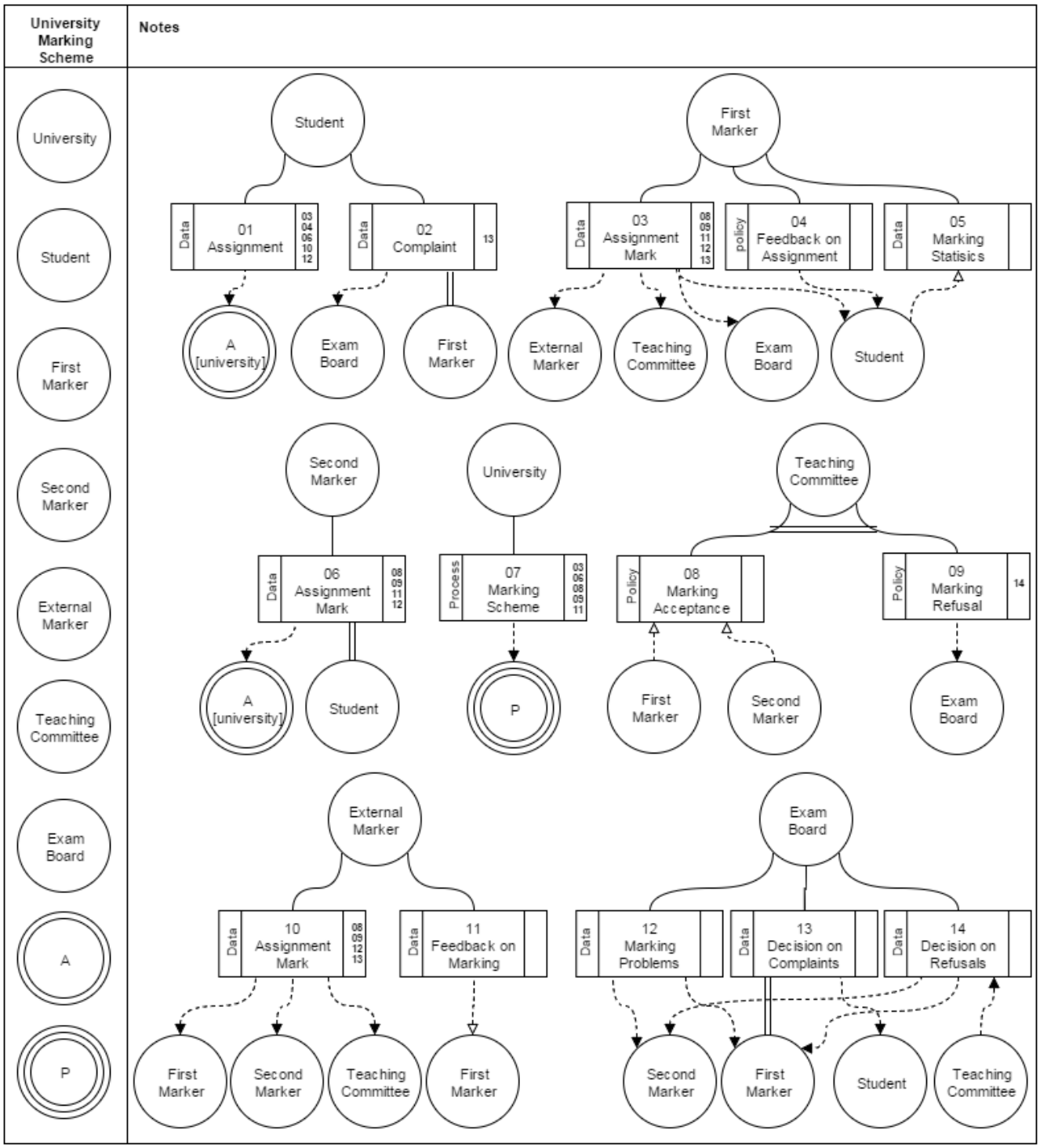
The exam board was convinced that their decision on students' complaints should not reach the first marker, as it could also possibly reveal the identity of the complaining student. However, they stated that the matter needs further consideration. Their primary motive for providing these decisions to the first marker was to prevent future similar problems between the first marker and the students. Therefore, they expressed their interest in contemplating on alternative methods which could reach the same results without compromising students' identities to their lecturers.

Other clarifications: Each participant was also asked for some clarifications on the missing data in Sitreq specifications (e.g., transparency meaningfulness type and transparency requirements type), while they were also asked about the quality and the level of reach of the information elements. In the case of information elements quality and level of reach, the unanimous consensus was considered. It means that even if one stakeholder thought the information element missed a certain quality measure or failed in reaching a certain level of reach, it would not be checked in the Infolet as met or achieved.

6 Updating the Transparency Model

After consulting with the stakeholders and eliminating the gaps in transparency provision, the transparency model was updated and analysed once again to ensure no inconsistencies have remained. This final transparency model consists of the updated versions of the Shield diagram and the Sitreq and Infolet Specifications

6.1 The Final Shield Diagram



6.2 Final Sitreq Specifications

6.2.1 Student

Stakeholder's Information Transparency REQuirements Specification (Sitreq)						
Stakeholder's Name: Student						
IE Label	**IE Name**	**Relationship**	**Requirement Description**	**Transparency Requirement Type**	**Transparency Meaningfulness Type**	**Stakeholders Involved**
01	Assignment	Producer	Assignment should be handled by different stakeholders	Coercive	Data	All except university
02	Complaint	Producer	Complaint is hidden from the first marker	Restricted	N/A	First marker
02	Complaint	Producer	Complaint should be handled by the exam board	Coercive	Data	Exam board
03	Assignment mark	Receiver	First marker provides the mark to the student	Coercive	Data	First marker
04	Feedback on assignment	Receiver	First marker sends feedback on marking	Coercive	Policy	First marker
05	Marking statistics	Requester	Student wants the statistical figures	Personal	Data	First marker
06	Assignment mark	Receiver	Second marker should not provide the mark to student	Restricted	N/A	Second marker
07	Marking scheme	Receiver	Student has public access to marking scheme	Coercive	Process	University
13	Decision on Complaint	Receiver	Student gets exam board's decision on their complaint	Coercive	Data	Exam board

6.2.2 University

Stakeholder's Information Transparency REQuirements Specification (Sitreq)						
Stakeholder's Name: University						
IE Label	**IE Name**	**Relationship**	**Requirement Description**	**Transparency Requirement Type**	**Transparency Meaningfulness Type**	**Stakeholders Involved**
07	Marking scheme	Producer	University makes the marking scheme publicly available	Coercive	Process	Public

6.2.3 First Marker

Stakeholder's Information Transparency REQuirements Specification (Sitreq)						
Stakeholder's Name: First Marker						
IE Label	**IE Name**	**Relationship**	**Requirement Description**	**Transparency Requirement Type**	**Transparency Meaningfulness Type**	**Stakeholders Involved**
01	Assignment	Receiver	First marker receives the assignment for marking	Coercive	Data	Student
03	Assignment mark	Producer	First marker marks students' assignments	Coercive	Data	Student
03	Assignment mark	Producer	First marker gives the external marker the markings to be assessed	Coercive	Data	External marker
03	Assignment mark	Producer	First marker gives the marking to teaching committee in case of disagreement with second marker	Coercive	Data	Teaching committee
03	Assignment mark	Producer	First marker gives the marking to the exam board in case of students' complaints or disagreements	Coercive	Data	Exam board
04	Feedback on assignment	Producer	First marker provides students with feedback on their assignments	Coercive	Policy	Student
05	Marking statistics	Producer	Marking statistics are given to students when requested	Personal	Data	Student
06	Assignment mark	Receiver	Second marker provides first marker with their assignment mark	Coercive	Data	Second marker
07	Marking scheme	Receiver	First marker has public access to marking scheme	Coercive	Process	University
08	Marking acceptance	Requester	First marker is informed of teaching committee's marking acceptance	Personal	Policy	Teaching Committee
10	Assignment mark	Receiver	External marker provides first marker with their assignment mark	Coercive	Data	External marker
11	Feedback on marking	Receiver	External marker provides first marker with their feedback on their marking	Voluntary	Data	External marker
12	Marking problems	Receiver	Exam board informs first marker on their marking problems	Coercive	Data	Exam board
13	Decision on complaints	Receiver	Exam board informs first marker on student's complaints and their decisions	Restricted	N/A	Exam board
14	Decision on refusals	Receiver	Exam board informs first marker on their decision on teaching committee's marking refusal	Coercive	Data	Exam board

6.2.4 Second Marker

Stakeholder's Information Transparency REQuirements Specification (Sitreq)						
Stakeholder's Name: Second Marker						
IE Label	**IE Name**	**Relationship**	**Requirement Description**	**Transparency Requirement Type**	**Transparency Meaningfulness Type**	**Stakeholders Involved**
01	Assignment	Receiver	Second marker receives the assignment for marking	Coercive	Data	Student
06	Assignment mark	Producer	Second marker marks students' assignments	Coercive	Data	All except university and student
06	Assignment mark	Producer	Second marker's mark should not be visible by the student	Restricted	N/A	Student
07	Marking scheme	Receiver	Second marker has public access to marking scheme	Coercive	Process	University
08	Marking acceptance	Requester	Second marker is informed of teaching committee's marking acceptance	Personal	Policy	Teaching Committee
10	Assignment mark	Receiver	External marker provides second marker with their assignment mark	Coercive	Data	External marker
12	Marking problems	Receiver	Exam board informs second marker on their marking problems	Coercive	Data	Exam board
14	Decision on refusals	Receiver	Exam board informs second marker on their decision on teaching committee's marking refusal	Coercive	Data	Exam board

6.2.5 External Marker

Stakeholder's Information Transparency REQuirements Specification (Sitreq)						
Stakeholder's Name: External Marker						
IE Label	**IE Name**	**Relationship**	**Requirement Description**	**Transparency Requirement Type**	**Transparency Meaningfulness Type**	**Stakeholders Involved**
01	Assignment	Receiver	External marker receives the assignment for marking	Coercive	Data	Student
03	Assignment mark	Receiver	First marker gives the marking to external marker for feedback	Coercive	Data	First marker
06	Assignment mark	Receiver	Second marker gives the marking to external marker for feedback	Coercive	Data	Second marker
07	Marking scheme	Receiver	External marker has public access to marking scheme	Coercive	Process	University
10	Assignment mark	Producer	External marker gives his marking to first marker for comparison	Coercive	Data	First marker
10	Assignment mark	Producer	External marker gives his marking to second marker for comparison	Coercive	Data	Second marker
10	Assignment mark	Producer	External marker gives his marking to teaching committee in case of disagreement with first and second marker	Coercive	Data	Teaching committee
11	Feedback on marking	Producer	External marker gives feedback on first marker's marking	Voluntary	Data	First marker

6.2.6 Teaching Committee

Stakeholder's Information Transparency REQuirements Specification (Sitreq)						
Stakeholder's Name: Teaching Committee						
IE Label	**IE Name**	**Relationship**	**Requirement Description**	**Transparency Requirement Type**	**Transparency Meaningfulness Type**	**Stakeholders Involved**
01	Assignment	Receiver	Teaching committee receives the assignment for decision on marking	Coercive	Data	Student
03	Assignment mark	Receiver	First marker gives the marking to teaching committee in case of disagreement with second marker	Coercive	Data	First marker
06	Assignment mark	Receiver	Second marker gives the marking to teaching committee in case of disagreement with first marker	Coercive	Data	Second marker
07	Marking scheme	Receiver	Teaching committee has public access to marking scheme	Coercive	Process	University
08	Marking acceptance	Producer	Teaching committee informs first marker on their marking acceptance	Personal	Policy	First marker
08	Marking acceptance	Producer	Teaching committee informs second marker on their marking acceptance	Personal	Policy	Second marker
09	Marking refusal	Producer	Teaching committee informs exam board on marking refusals	Coercive	Policy	Exam board
10	Assignment mark	Receiver	External marker gives the marking to teaching committee in case of disagreement with first and second markers	Coercive	Data	External marker
14	Decision on refusals	Requester	Teaching committee needs the exam board's decision on refusal for their internal processes	Legal	Data	Exam board

6.2.7 Exam Board

Stakeholder's Information Transparency REQuirements Specification (Sitreq)						
Stakeholder's Name: Exam Board						
IE Label	**IE Name**	**Relationship**	**Requirement Description**	**Transparency Requirement Type**	**Transparency Meaningfulness Type**	**Stakeholders Involved**
01	Assignment	Receiver	Exam board receives the assignment in case of complaints, marking problems or marking refusals	Coercive	Data	Student
02	Complaint	Receiver	Students' complaints are handled by the exam board	Coercive	Data	Student
03	Assignment mark	Receiver	First marker gives the marking to exam board in case of disagreement with second marker, marking refusals or students' complaints	Coercive	Data	First marker
06	Assignment mark	Receiver	Second marker gives the marking to exam board in case of disagreement with first marker or marking refusals	Coercive	Data	Second marker
07	Marking scheme	Receiver	Exam board has public access to marking scheme	Coercive	Process	University
09	Marking refusal	Receiver	Exam board deals with marking refusals	Coercive	Policy	Teaching committee
12	Marking problems	Producer	Exam board deals with disagreements between first and second marker	Coercive	Data	First marker
12	Marking problems	Producer	Exam board deals with disagreements between first and second marker	Coercive	Data	Second marker
13	Decision on complaints	Producer	Exam board should not inform first marker on student's complaints and their decisions	Restricted	N/A	First marker
13	Decision on complaints	Producer	Exam board informs student on their decisions on their complaint	Coercive	Data	Student
14	Decision on refusals	Producer	Exam board informs first marker on their decision on marking refusal	Coercive	Data	First marker
14	Decision on refusals	Producer	Exam board informs second marker on their decision on marking refusal	Coercive	Data	Second marker
14	Decision on refusals	Producer	Exam board informs teaching committee on their decision on marking refusal	Legal	Data	Teaching committee

6.3 Final Infolet Specifications

6.3.1 Assignment

INFOrmation eLEment Transparency Specification (Infolet)		
① **Information Element (IE) Label** 01	② **Information Element (IE) Name** Assignment	③ **Information Element (IE) Type** Data
④ **Information Element Description** This information element contains the student's assignment. The assignment is used in order to assess the student's progress throughout the semester.		
⑤ **List of Other Information Elements Using This Information Element** 03: Assignment Mark 04: Feedback on Assignment 06: Assignment Mark 10: Assignment Mark 12: Marking Problems		
⑥ **Information Element Creator/Authority** Student		
⑦ **Information Element Provider** Student		
⑧ **List of Stakeholders Receiving Information Element and Information Element Provision Type** All stakeholders except university: Coercive		
⑨ **List of Stakeholders Requesting Information Element and Information Element Request Type** N/A		
⑩ **List of Stakeholders with Restricted Access to Information Element and Restriction Type** N/A		
⑪ **Information Element Quality Control (Sound, Dependable, Useful, Usable)** ☑ **Free of Error** ☑ **Concise Rep.** ☑ **Completeness** ☑ **Consistent Rep.** ☑ **Timeliness** ☑ **Security** ☑ **App. Amount** ☑ **Relevancy** ☑ **Understandability** ☑ **Objectivity** ☑ **Interpretability** ☑ **Accessibility** ☑ **Believability** ☑ **Ease of Manipulation** ☑ **Reputation** ☑ **Value-added**		
⑫ **Information Element Level of Reach** ☑ **Information Availability (Information is made available to the stakeholders)** ☑ **Information Interpretation (Information is appropriately interpreted for the stakeholders)** ☑ **Information Accessibility (Information is easily accessible by the stakeholders)** ☑ **Information Understandability (Information is comprehended by the stakeholders)** ☑ **Information Perception (Information is perceived credible by the stakeholders)** ☑ **Information Acceptance (Information is believed and accepted by the stakeholders)** ☑ **Information Actionability (Information helps stakeholders in their informed decision-making)**		
⑬ **Information Element Notes** N/A		

6.3.2 Complaint

INFOrmation eLEment Transparency Specification (Infolet)		
① Information Element (IE) Label 02	② Information Element (IE) Name Complaint	③ Information Element (IE) Type Data
④ Information Element Description This information element contains data about students' complaints on their grades. The complaint uses an online form provided by the university on their unit's webpage, and can be accessed only by the exam board. The form is also available offline.		
⑤ List of Other Information Elements Using This Information Element 13: Decision on Complaints		
⑥ Information Element Creator/Authority Student		
⑦ Information Element Provider Student		
⑧ List of Stakeholders Receiving Information Element and Information Element Provision Type Exam Board: Coercive		
⑨ List of Stakeholders Requesting Information Element and Information Element Request Type N/A		
⑩ List of Stakeholders with Restricted Access to Information Element and Restriction Type First Marker: Restricted		
⑪ Information Element Quality Control (Sound, Dependable, Useful, Usable) ☑ Free of Error ◯ Concise Rep. ☑ Completeness ☑ Consistent Rep. ☑ Timeliness ☑ Security ☑ App. Amount ☑ Relevancy ☑ Understandability ◯ Objectivity ☑ Interpretability ☑ Accessibility ☑ Believability ☑ Ease of Manipulation ☑ Reputation ☑ Value-added		
⑫ Information Element Level of Reach ☑ Information Availability (Information is made available to the stakeholders) ☑ Information Interpretation (Information is appropriately interpreted for the stakeholders) ☑ Information Accessibility (Information is easily accessible by the stakeholders) ☑ Information Understandability (Information is comprehended by the stakeholders) ☑ Information Perception (Information is perceived credible by the stakeholders) ☑ Information Acceptance (Information is believed and accepted by the stakeholders) ☑ Information Actionability (Information helps stakeholders in their informed decision-making)		
⑬ Information Element Notes The sample form for filing a complaint can be accessed on the following link.		

6.3.3 Assignment Mark

INFOrmation eLEment Transparency Specification (Infolet)		
① Information Element (IE) Label 03	② Information Element (IE) Name Assignment Mark	③ Information Element (IE) Type Data

④ Information Element Description

This information element contains the first marker's marking results on students' assignments. The marking is performed based on university marking scheme.

⑤ List of Other Information Elements Using This Information Element

08: Marking Acceptance
09: Marking Refusal
11: Feedback on Marking
12: Marking Problems
13: Decision on Complaints

⑥ Information Element Creator/Authority

First Marker

⑦ Information Element Provider

First Marker

⑧ List of Stakeholders Receiving Information Element and Information Element Provision Type

External Marker: Coercive
Teaching Committee: Coercive
Exam Board: Coercive
Student: Coercive

⑨ List of Stakeholders Requesting Information Element and Information Element Request Type

N/A

⑩ List of Stakeholders with Restricted Access to Information Element and Restriction Type

N/A

⑪ Information Element Quality Control (Sound, Dependable, Useful, Usable)

◯ Free of Error	☑ Concise Rep.	☑ Completeness	☑ Consistent Rep.	
☑ Timeliness	☑ Security			
☑ App. Amount	☑ Relevancy	☑ Understandability	◯ Objectivity	☑ Interpretability
☑ Accessibility	☑ Believability	☑ Ease of Manipulation	☑ Reputation	☑ Value-added

⑫ Information Element Level of Reach

☑ Information Availability (Information is made available to the stakeholders)
☑ Information Interpretation (Information is appropriately interpreted for the stakeholders)
☑ Information Accessibility (Information is easily accessible by the stakeholders)
☑ Information Understandability (Information is comprehended by the stakeholders)
☑ Information Perception (Information is perceived credible by the stakeholders)
☑ Information Acceptance (Information is believed and accepted by the stakeholders)
☑ Information Actionability (Information helps stakeholders in their informed decision-making)

⑬ Information Element Notes

N/A

6.3.4 Feedback on Assignment

INFOrmation eLEment Transparency Specification (Infolet)		
① Information Element (IE) Label 04	② Information Element (IE) Name Feedback on Assignment	③ Information Element (IE) Type Policy
④ Information Element Description This information element contains the first marker's feedback on students' assignments.		
⑤ List of Other Information Elements Using This Information Element N/A		
⑥ Information Element Creator/Authority First Marker		
⑦ Information Element Provider First Marker		
⑧ List of Stakeholders Receiving Information Element and Information Element Provision Type Student: Coercive		
⑨ List of Stakeholders Requesting Information Element and Information Element Request Type N/A		
⑩ List of Stakeholders with Restricted Access to Information Element and Restriction Type N/A		
⑪ Information Element Quality Control (Sound, Dependable, Useful, Usable) ☑ Free of Error ◯ Concise Rep. ☑ Completeness ☑ Consistent Rep. ☑ Timeliness ☑ Security ☑ App. Amount ☑ Relevancy ☑ Understandability ◯ Objectivity ☑ Interpretability ☑ Accessibility ☑ Believability ☑ Ease of Manipulation ☑ Reputation ☑ Value-added		
⑫ Information Element Level of Reach ☑ Information Availability (Information is made available to the stakeholders) ☑ Information Interpretation (Information is appropriately interpreted for the stakeholders) ☑ Information Accessibility (Information is easily accessible by the stakeholders) ☑ Information Understandability (Information is comprehended by the stakeholders) ☑ Information Perception (Information is perceived credible by the stakeholders) ☑ Information Acceptance (Information is believed and accepted by the stakeholders) ☑ Information Actionability (Information helps stakeholders in their informed decision-making)		
⑬ Information Element Notes N/A		

6.3.5 Marking Statistics

INFOrmation eLEment Transparency Specification (Infolet)		
① **Information Element (IE) Label** 05	② **Information Element (IE) Name** Marking Statistics	③ **Information Element (IE) Type** Data
④ **Information Element Description** This information element contains the first marker's provided statistics on students' marks and normally contains the mean, the median, the mode, the maximum and the minimum marks.		
⑤ **List of Other Information Elements Using This Information Element** N/A		
⑥ **Information Element Creator/Authority** First Marker		
⑦ **Information Element Provider** First Marker		
⑧ **List of Stakeholders Receiving Information Element and Information Element Provision Type** N/A		
⑨ **List of Stakeholders Requesting Information Element and Information Element Request Type** Student: Personal		
⑩ **List of Stakeholders with Restricted Access to Information Element and Restriction Type** N/A		
⑪ **Information Element Quality Control (Sound, Dependable, Useful, Usable)** ☑ **Free of Error** ☑ **Concise Rep.** ☑ **Completeness** ☑ **Consistent Rep.** ☑ **Timeliness** ☑ **Security** ☑ **App. Amount** ☑ **Relevancy** ☑ **Understandability** ☑ **Objectivity** ☑ **Interpretability** ☑ **Accessibility** ☑ **Believability** ☑ **Ease of Manipulation** ☑ **Reputation** ☑ **Value-added**		
⑫ **Information Element Level of Reach** ☑ **Information Availability (Information is made available to the stakeholders)** ☑ **Information Interpretation (Information is appropriately interpreted for the stakeholders)** ☑ **Information Accessibility (Information is easily accessible by the stakeholders)** ☑ **Information Understandability (Information is comprehended by the stakeholders)** ☑ **Information Perception (Information is perceived credible by the stakeholders)** ☑ **Information Acceptance (Information is believed and accepted by the stakeholders)** ☑ **Information Actionability (Information helps stakeholders in their informed decision-making)**		
⑬ **Information Element Notes** N/A		

6.3.6 Assignment Mark

INFOrmation eLEment Transparency Specification (Infolet)		
① **Information Element (IE) Label** 06	② **Information Element (IE) Name** Assignment Mark	③ **Information Element (IE) Type** Data
④ **Information Element Description** This information element contains the second marker's marking results on students' assignments. The marking is performed based on university marking scheme.		
⑤ **List of Other Information Elements Using This Information Element** 08: Marking Acceptance 09: Marking Refusal 11: Feedback on Marking 12: Marking Problems 13: Decision on Complaints		
⑥ **Information Element Creator/Authority** Second Marker		
⑦ **Information Element Provider** Second Marker		
⑧ **List of Stakeholders Receiving Information Element and Information Element Provision Type** All stakeholders except university and student: Coercive		
⑨ **List of Stakeholders Requesting Information Element and Information Element Request Type** N/A		
⑩ **List of Stakeholders with Restricted Access to Information Element and Restriction Type** Student: Restricted		
⑪ **Information Element Quality Control (Sound, Dependable, Useful, Usable)** ◯ **Free of Error** ☑ **Concise Rep.** ☑ **Completeness** ☑ **Consistent Rep.** ☑ **Timeliness** ☑ **Security** ☑ **App. Amount** ☑ **Relevancy** ☑ **Understandability** ◯ **Objectivity** ☑ **Interpretability** ☑ **Accessibility** ☑ **Believability** ☑ **Ease of Manipulation** ☑ **Reputation** ☑ **Value-added**		
⑫ **Information Element Level of Reach** ☑ **Information Availability (Information is made available to the stakeholders)** ☑ **Information Interpretation (Information is appropriately interpreted for the stakeholders)** ☑ **Information Accessibility (Information is easily accessible by the stakeholders)** ☑ **Information Understandability (Information is comprehended by the stakeholders)** ☑ **Information Perception (Information is perceived credible by the stakeholders)** ☑ **Information Acceptance (Information is believed and accepted by the stakeholders)** ☑ **Information Actionability (Information helps stakeholders in their informed decision-making)**		
⑬ **Information Element Notes** N/A		

6.3.7 Marking Scheme

INFOrmation eLEment Transparency Specification (Infolet)		
① Information Element (IE) Label 07	② Information Element (IE) Name Mark Scheme	③ Information Element (IE) Type Process

④ Information Element Description

This information element contains the university's marking scheme. The marking scheme is publicly available on university's website.

⑤ List of Other Information Elements Using This Information Element

03: Assignment Mark
06: Assignment Mark
08: Marking Acceptance
09: Marking Refusal
11: Feedback on Marking

⑥ Information Element Creator/Authority

Unknown

⑦ Information Element Provider

University

⑧ List of Stakeholders Receiving Information Element and Information Element Provision Type

Public: Coercive

⑨ List of Stakeholders Requesting Information Element and Information Element Request Type

N/A

⑩ List of Stakeholders with Restricted Access to Information Element and Restriction Type

N/A

⑪ Information Element Quality Control (Sound, Dependable, Useful, Usable)

☑ Free of Error	☑ Concise Rep.	☑ Completeness	☑ Consistent Rep.	
☑ Timeliness	☑ Security			
☑ App. Amount	☑ Relevancy	☑ Understandability	☑ Objectivity	☑ Interpretability
☑ Accessibility	☑ Believability	☑ Ease of Manipulation	☑ Reputation	☑ Value-added

⑫ Information Element Level of Reach

☑ Information Availability (Information is made available to the stakeholders)
☑ Information Interpretation (Information is appropriately interpreted for the stakeholders)
☑ Information Accessibility (Information is easily accessible by the stakeholders)
☑ Information Understandability (Information is comprehended by the stakeholders)
☑ Information Perception (Information is perceived credible by the stakeholders)
☑ Information Acceptance (Information is believed and accepted by the stakeholders)
☑ Information Actionability (Information helps stakeholders in their informed decision-making)

⑬ Information Element Notes

The university marking scheme is available at the following link.

6.3.8 Marking Acceptance

INFOrmation eLEment Transparency Specification (Infolet)		
① Information Element (IE) Label 08	② Information Element (IE) Name Marking Acceptance	③ Information Element (IE) Type Policy

④ Information Element Description

This information element contains the marking acceptance results which is decided by the teaching committee. The decision is initiated when there is a discrepancy between the first maker and the second marker.

⑤ List of Other Information Elements Using This Information Element

N/A

⑥ Information Element Creator/Authority

Teaching Committee

⑦ Information Element Provider

Teaching Committee

⑧ List of Stakeholders Receiving Information Element and Information Element Provision Type

N/A

⑨ List of Stakeholders Requesting Information Element and Information Element Request Type

First Marker: Personal

Second Marker: Personal

⑩ List of Stakeholders with Restricted Access to Information Element and Restriction Type

N/A

⑪ Information Element Quality Control (Sound, Dependable, Useful, Usable)

☑ Free of Error	☑ Concise Rep.	☑ Completeness	☑ Consistent Rep.	
☑ Timeliness	☑ Security			
☑ App. Amount	☑ Relevancy	☑ Understandability	◯ Objectivity	☑ Interpretability
☑ Accessibility	☑ Believability	☑ Ease of Manipulation	☑ Reputation	☑ Value-added

⑫ Information Element Level of Reach

☑ Information Availability (Information is made available to the stakeholders)
☑ Information Interpretation (Information is appropriately interpreted for the stakeholders)
☑ Information Accessibility (Information is easily accessible by the stakeholders)
☑ Information Understandability (Information is comprehended by the stakeholders)
☑ Information Perception (Information is perceived credible by the stakeholders)
☑ Information Acceptance (Information is believed and accepted by the stakeholders)
☑ Information Actionability (Information helps stakeholders in their informed decision-making)

⑬ Information Element Notes

N/A

6.3.9 Marking Refusal

INFOrmation eLEment Transparency Specification (Infolet)		
① **Information Element (IE) Label** 09	② **Information Element (IE) Name** Marking Refusal	③ **Information Element (IE) Type** Policy
④ **Information Element Description** This information element contains the marking refusal results which is decided by the teaching committee. The decision is initiated when there is a discrepancy between the first maker and the second marker.		
⑤ **List of Other Information Elements Using This Information Element** 14: Decision on Refusals		
⑥ **Information Element Creator/Authority** Teaching Committee		
⑦ **Information Element Provider** Teaching Committee		
⑧ **List of Stakeholders Receiving Information Element and Information Element Provision Type** Exam Board: Coercive		
⑨ **List of Stakeholders Requesting Information Element and Information Element Request Type** N/A		
⑩ **List of Stakeholders with Restricted Access to Information Element and Restriction Type** N/A		
⑪ **Information Element Quality Control (Sound, Dependable, Useful, Usable)** ☑ Free of Error ☑ Concise Rep. ☑ Completeness ☑ Consistent Rep. ☑ Timeliness ☑ Security ☑ App. Amount ☑ Relevancy ☑ Understandability ◯ Objectivity ☑ Interpretability ☑ Accessibility ☑ Believability ☑ Ease of Manipulation ☑ Reputation ☑ Value-added		
⑫ **Information Element Level of Reach** ☑ Information Availability (Information is made available to the stakeholders) ☑ Information Interpretation (Information is appropriately interpreted for the stakeholders) ☑ Information Accessibility (Information is easily accessible by the stakeholders) ☑ Information Understandability (Information is comprehended by the stakeholders) ☑ Information Perception (Information is perceived credible by the stakeholders) ☑ Information Acceptance (Information is believed and accepted by the stakeholders) ☑ Information Actionability (Information helps stakeholders in their informed decision-making)		
⑬ **Information Element Notes** N/A		

6.3.10 Assignment Mark

INFOrmation eLEment Transparency Specification (Infolet)		
① Information Element (IE) Label 10	② Information Element (IE) Name Assignment Mark	③ Information Element (IE) Type Data
④ Information Element Description This information element contains the external marker's marking results on students' assignments. The marking is performed based on university marking scheme.		
⑤ List of Other Information Elements Using This Information Element 08: Marking Acceptance 09: Marking Refusal 12: Marking Problems 13: Decision on Complaints		
⑥ Information Element Creator/Authority External Marker		
⑦ Information Element Provider External Marker		
⑧ List of Stakeholders Receiving Information Element and Information Element Provision Type First Marker: Coercive Second Marker: Coercive Teaching Committee: Coercive		
⑨ List of Stakeholders Requesting Information Element and Information Element Request Type N/A		
⑩ List of Stakeholders with Restricted Access to Information Element and Restriction Type N/A		
⑪ Information Element Quality Control (Sound, Dependable, Useful, Usable) ◯ Free of Error ☑ Concise Rep. ☑ Completeness ☑ Consistent Rep. ☑ Timeliness ☑ Security ☑ App. Amount ☑ Relevancy ☑ Understandability ◯ Objectivity ☑ Interpretability ☑ Accessibility ☑ Believability ☑ Ease of Manipulation ☑ Reputation ☑ Value-added		
⑫ Information Element Level of Reach ☑ Information Availability (Information is made available to the stakeholders) ☑ Information Interpretation (Information is appropriately interpreted for the stakeholders) ☑ Information Accessibility (Information is easily accessible by the stakeholders) ☑ Information Understandability (Information is comprehended by the stakeholders) ☑ Information Perception (Information is perceived credible by the stakeholders) ☑ Information Acceptance (Information is believed and accepted by the stakeholders) ☑ Information Actionability (Information helps stakeholders in their informed decision-making)		
⑬ Information Element Notes N/A		

6.3.11 Feedback on Marking

INFOrmation eLEment Transparency Specification (Infolet)		
① Information Element (IE) Label 11	② Information Element (IE) Name Feedback on Marking	③ Information Element (IE) Type Data

④ Information Element Description

This information element contains the external marker's feedback on the first marker's marking and the second marker's marking.

⑤ List of Other Information Elements Using This Information Element

N/A

⑥ Information Element Creator/Authority

External Marker

⑦ Information Element Provider

External Marker

⑧ List of Stakeholders Receiving Information Element and Information Element Provision Type

First marker: Voluntary

⑨ List of Stakeholders Requesting Information Element and Information Element Request Type

N/A

⑩ List of Stakeholders with Restricted Access to Information Element and Restriction Type

N/A

⑪ Information Element Quality Control (Sound, Dependable, Useful, Usable)

☑ Free of Error	◯ Concise Rep.	☑ Completeness	☑ Consistent Rep.	
☑ Timeliness	☑ Security			
☑ App. Amount	☑ Relevancy	☑ Understandability	◯ Objectivity	☑ Interpretability
☑ Accessibility	☑ Believability	☑ Ease of Manipulation	☑ Reputation	☑ Value-added

⑫ Information Element Level of Reach

- ☑ Information Availability (Information is made available to the stakeholders)
- ☑ Information Interpretation (Information is appropriately interpreted for the stakeholders)
- ☑ Information Accessibility (Information is easily accessible by the stakeholders)
- ☑ Information Understandability (Information is comprehended by the stakeholders)
- ☑ Information Perception (Information is perceived credible by the stakeholders)
- ☑ Information Acceptance (Information is believed and accepted by the stakeholders)
- ☑ Information Actionability (Information helps stakeholders in their informed decision-making)

⑬ Information Element Notes

N/A

6.3.12 Marking Problems

INFOrmation eLEment Transparency Specification (Infolet)		
① **Information Element (IE) Label** 12	② **Information Element (IE) Name** Marking Problems	③ **Information Element (IE) Type** Data
④ **Information Element Description** This information element contains exam board's decision on marking problems. The exam board periodically investigates marking problems in order to raise marking standards of the university.		
⑤ **List of Other Information Elements Using This Information Element** N/A		
⑥ **Information Element Creator/Authority** Exam Board		
⑦ **Information Element Provider** Exam Board		
⑧ **List of Stakeholders Receiving Information Element and Information Element Provision Type** First marker: Coercive Second marker: Coercive		
⑨ **List of Stakeholders Requesting Information Element and Information Element Request Type** N/A		
⑩ **List of Stakeholders with Restricted Access to Information Element and Restriction Type** N/A		
⑪ **Information Element Quality Control (Sound, Dependable, Useful, Usable)** ☑ Free of Error ☑ Concise Rep. ☑ Completeness ☑ Consistent Rep. ☑ Timeliness ☑ Security ☑ App. Amount ☑ Relevancy ☑ Understandability ☑ Objectivity ☑ Interpretability ☑ Accessibility ☑ Believability ☑ Ease of Manipulation ☑ Reputation ☑ Value-added		
⑫ **Information Element Level of Reach** ☑ Information Availability (Information is made available to the stakeholders) ☑ Information Interpretation (Information is appropriately interpreted for the stakeholders) ☑ Information Accessibility (Information is easily accessible by the stakeholders) ☑ Information Understandability (Information is comprehended by the stakeholders) ☑ Information Perception (Information is perceived credible by the stakeholders) ☑ Information Acceptance (Information is believed and accepted by the stakeholders) ☑ Information Actionability (Information helps stakeholders in their informed decision-making)		
⑬ **Information Element Notes** N/A		

6.3.13 Decision on Complaints

INFOrmation eLEment Transparency Specification (Infolet)		
① **Information Element (IE) Label** 13	② **Information Element (IE) Name** Decision on Complaints	③ **Information Element (IE) Type** Data
④ **Information Element Description** This information element contains exam board's decision on student's complaints. The exam board's decision is final.		
⑤ **List of Other Information Elements Using This Information Element** N/A		
⑥ **Information Element Creator/Authority** Exam Board		
⑦ **Information Element Provider** Exam Board		
⑧ **List of Stakeholders Receiving Information Element and Information Element Provision Type** Student: Coercive		
⑨ **List of Stakeholders Requesting Information Element and Information Element Request Type** N/A		
⑩ **List of Stakeholders with Restricted Access to Information Element and Restriction Type** First marker: Restricted		
⑪ **Information Element Quality Control (Sound, Dependable, Useful, Usable)** ☑ **Free of Error** ☑ **Concise Rep.** ☑ **Completeness** ☑ **Consistent Rep.** ☑ **Timeliness** ☑ **Security** ☑ **App. Amount** ☑ **Relevancy** ☑ **Understandability** ☑ **Objectivity** ☑ **Interpretability** ☑ **Accessibility** ☑ **Believability** ☑ **Ease of Manipulation** ☑ **Reputation** ☑ **Value-added**		
⑫ **Information Element Level of Reach** ☑ **Information Availability (Information is made available to the stakeholders)** ☑ **Information Interpretation (Information is appropriately interpreted for the stakeholders)** ☑ **Information Accessibility (Information is easily accessible by the stakeholders)** ☑ **Information Understandability (Information is comprehended by the stakeholders)** ☑ **Information Perception (Information is perceived credible by the stakeholders)** ☑ **Information Acceptance (Information is believed and accepted by the stakeholders)** ☑ **Information Actionability (Information helps stakeholders in their informed decision-making)**		
⑬ **Information Element Notes** N/A		

6.3.14 Decision on Refusals

INFOrmation eLEment Transparency Specification (Infolet)		
① **Information Element (IE) Label** 14	② **Information Element (IE) Name** Decision on Refusals	③ **Information Element (IE) Type** Data
④ **Information Element Description** This information element contains exam board's decision on marking refusals submitted from the teaching committee. The exam board's decision is final.		
⑤ **List of Other Information Elements Using This Information Element** N/A		
⑥ **Information Element Creator/Authority** Exam Board		
⑦ **Information Element Provider** Exam Board		
⑧ **List of Stakeholders Receiving Information Element and Information Element Provision Type** First marker: Coercive Second Marker: Coercive		
⑨ **List of Stakeholders Requesting Information Element and Information Element Request Type** Teaching Committee: Legal		
⑩ **List of Stakeholders with Restricted Access to Information Element and Restriction Type** N/A		
⑪ **Information Element Quality Control (Sound, Dependable, Useful, Usable)** ☑ **Free of Error** ☑ **Concise Rep.** ☑ **Completeness** ☑ **Consistent Rep.** ☑ **Timeliness** ☑ **Security** ☑ **App. Amount** ☑ **Relevancy** ☑ **Understandability** ☑ **Objectivity** ☑ **Interpretability** ☑ **Accessibility** ☑ **Believability** ☑ **Ease of Manipulation** ☑ **Reputation** ☑ **Value-added**		
⑫ **Information Element Level of Reach** ☑ **Information Availability (Information is made available to the stakeholders)** ☑ **Information Interpretation (Information is appropriately interpreted for the stakeholders)** ☑ **Information Accessibility (Information is easily accessible by the stakeholders)** ☑ **Information Understandability (Information is comprehended by the stakeholders)** ☑ **Information Perception (Information is perceived credible by the stakeholders)** ☑ **Information Acceptance (Information is believed and accepted by the stakeholders)** ☑ **Information Actionability (Information helps stakeholders in their informed decision-making)**		
⑬ **Information Element Notes** N/A		

7 Information Sheet

Study Title:

Evaluation of the Usefulness of TranspLan

Aims of the Research

The aim of the research is to empirically evaluate how TranspLan, which is a modelling language for the engineering of transparency requirements in business information systems, can help requirements engineers in the discovery of transparency requirements. The study is being conducted as part of the PhD focused on the modelling and analysis of transparency requirements in business information systems.

Invitation

You are being invited to consider taking part in this research study. This project is being undertaken by *Mahmood Hosseini.*

Before you decide whether or not you wish to take part, it is important for you to understand why this research is being done and what it will involve. Please take time to read this information carefully and discuss it with friends and relatives if you wish. Ask us if there is anything that is unclear or if you would like more information.

Why have I been chosen?

You have been chosen because you play a role as one of the stakeholders in the case study designed to elicit and clarify the transparency requirements of several stakeholders in a university marking process settings.

Do I have to take part?

You are free to decide whether you wish to take part or not. If you do decide to take part you will be asked to sign a consent form. You are free to withdraw from this study at any time and without giving reasons and without there being any negative consequences, up to the point where the data are processed and become anonymous, so your identity cannot be determined.

What will happen if I take part, and what do I have to do?

You are expected to take part in an interview and discuss your transparency requirements in a given scenario. You will receive the scenario and related information through email, and will be asked to think of your transparency requirements before a short interview takes place for clarification and confirmation purposes. The interview will be audio recorded.

What are the benefits (if any) of taking part?

You will be contributing to the knowledge of transparency requirements modelling and analysis.

What are the risks (if any) of taking part?

There are no speculated risks for participating in this study.

How will information about me be used?

The data collected will be stored securely, and will be used only for the purpose of this study and for a maximum of two years. The data will be completely anonymised before it appears in any type of publication. The audio recordings of your activities made during this research will be used only for analysis. No other use will be made of them without your written permission, and no one outside the project will be allowed access to the original files.

Who will have access to information about me?

Your confidentiality will be safeguarded during and after the study. Only the research team including three people will have access to your data. The data will be stored securely (sheets of paper and questionnaires in a locked filing cabinet, and the audio files on a password protected computer) and destroyed and deleted immediately after use.

Who is funding the research?

The research is funded by Bournemouth University and by an FP7 Marie Curie CIG grant (the Sociad project).

What if there is a problem?

If you have a concern about any aspect of this study, you may wish to speak to the researcher who will do their best to answer your questions. You should contact *Mahmood Hosseini* on *mhosseini@bournemouth.ac.uk.* Alternatively, if you do not wish to contact the researcher, you may contact his supervisor, *Dr Raian Ali* on *rali@bournemouth.ac.uk*.

If you remain unhappy about the research and/or wish to raise a complaint about any aspect of the way that you have been approached or treated during the course of the study please write to Professor Matt Bentley who is the Bournemouth University's deputy dean research and professional practice for complaints regarding research at the following address:-

Professor Matt Bentley

Deputy Dean Research & Professional Practice

Christchurch House C227

Talbot Campus, Fern Barrow, Poole, BH12 5BB

E-mail: mbentley@bournemouth.ac.uk

Tel: 01202 962203

8 Consent Form

Title of Project: *Evaluation of the Usefulness of TranspLan*

Name and contact details of Principal Investigator:

Mahmood Hosseini
Poole House, Talbot Campus, Fern Barrow, Poole, BH12 5BB, United Kingdom
mhosseini@bournemouth.ac.uk

Please tick box if you agree with the statement:

1	I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions.	☐
2	I understand that my participation is voluntary and that I am free to withdraw at any time (without giving reason and without there being any negative consequences) up to the point where the data are processed and become anonymous, so my identity cannot be determined.	☐
3	I agree to take part in this study.	☐
4	I understand that data collected about me during this study will be anonymised before it is submitted for publication. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the outputs that result from the research.	☐
5	I agree to the interview session being audio recorded.	☐
6	I agree to allow the dataset collected to be used for future research projects.	☐
7	I agree to be contacted about possible participation in future research projects.	☐

_____	_____	_____
Name of participant	Date	Signature
_____	_____	_____
Researcher	Date	Signature

9 Interview Questions

The interview was conducted in a semi-structured way, with certain questions already prepared by the investigator and with the ability to follow up on certain questions for further clarifications. The main questions to be asked from the participants in this case study are listed below.

1. What is your role in this case study?
2. What are the information pieces you produce?
3. Do you know who (or which roles) usually has access to your information pieces? Do you know anything about the nature of the access, e.g., whether it is obligatory or optional?
4. Are there any roles which you actively do not want to have access to your information pieces? Why do you think this role (or these roles) should not have access to your information pieces?
5. (Showing them the information piece they provide, receive or request) Could you clarify the "transparency requirements type" of this information piece?
    a. (if providing) That is, do you provide the information because you have some obligations such as legal obligations, or is it a voluntary information provision?
    b. (if receiving or requesting) That is, do you receive or request the information because it is a legal demand, or is it a personal demand of information?
6. (Showing them the information piece they provide, receive or request) Could you please clarify the "transparency meaningfulness type" of this information piece?
    a. (if providing) That is, are you providing information which contains only data, or does it contain processes explaining how, or does it contain policies explaining why?
    b. (if receiving or requesting) That is, do you want information which contains only data, or does it contain processes explaining how, or does it contain policies explaining why?
7. (Showing them the list of information quality attributes) Do you think the information you have provided (or received, or requested) has these quality attributes?
8. Did the information you receive (or request) useful in helping you make a decision or act based on the information?
9. Is there anything else you would like to discuss and clarify?

Appendix Two: Quality of TranspLan: Plan Details for the Empirical Evaluation of TranspLan

1 Prologue: Participants' invitation and preparation

(Props: Working email)

Prologue aim: To familiarise participants with the modelling language constructs and to let participants study the foundations and constructs of the language before the empirical study and familiarise themselves

Prologue conduct: The moderator explains the constructs of the modelling language in an informal session to the participants and then emails the two papers (and their corresponding slides) to the participants at least one week before the beginning of the study and asks them to skim the papers before their participation.

(Paper 1: Foundations for Transparency Requirements Engineering)

(Paper 2: A Modelling Language for Engineering Transparency Requirements in a Business Information System)

2 The Empirical Study

(Props: Computer and a projector screen, A3 papers, pens and pencils, scenario and model sheets, TranspLan quick reference guide, personal notes, questionnaire sheets, two audio recording devices, camera)

2.1 Part 1: Introduction to TranspLan

2.1.1 Section 1: Showing slides on the constructs of TranspLan

Section 1 aim: To introduce TranspLan or refresh the participants' minds on TranspLan

Section 1 conduct: The moderator will present the slides.

2.1.2 Section 2: Giving a small modelling task to complete collaboratively

Section 2 aim: To ensure participants have a shared understanding of the transparency modelling process.

Section 2 conduct: The moderator gives a scenario and the TranspLan quick reference card, and runs some tasks.

Section 2 Scenario: *A bank customer is in the process of opening a current account. What is most important to her are the interest rate and whether there are annual or monthly fees for the account, both of which should be legally provided to her. She calls one of the bank branches and the bank clerk gives her details of the information she needs, plus he also tells her voluntarily that the current account gives her the cash back opportunity.*

Section 2 Task 1: Determine information provider, information entity, information medium and information receiver.

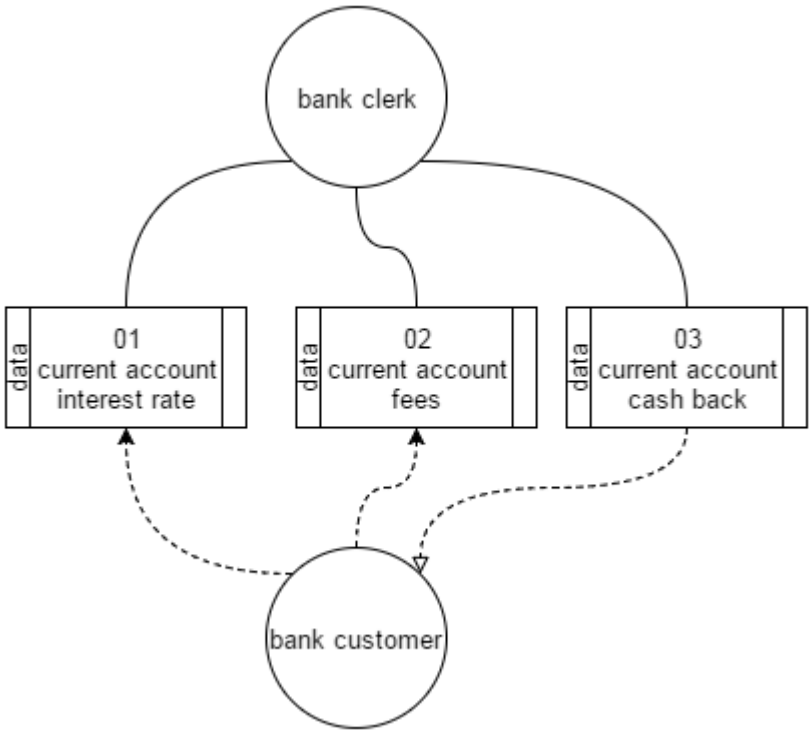
Answer: The bank clerk, current account (or alternatively, the bank), telephone, and customer, respectively.

Section 2 Task 2: Determine the requested information and provided information.

Answer: Interest rate and annual or monthly fees are requested information. They, plus cash back opportunity are provided information.

Section 2 Task 3: Provide a TranspLan model for the information exchange.

Answer: It should look similar to the following figure:



2.1.3 Section 3: Discussing the models as a group

Section 3 aim: To allow participants to discuss their models, and therefore observe each other's viewpoints, similarities and differences

Section 3 conduct: The moderator lets participants discuss their models with others, and may also participate in discussions for clarification issues. Participants also answer some general questions.

2.2 Part 2: TranspLan modelling based on a scenario, Scenario Building Based on a Model

2.2.1 Section 1: Modelling the first part of a given scenario in TranspLan and Writing down the scenario for a part of a given model

Group 1:

Section 1 aim: To model transparency requirements of stakeholders using TranspLan

Section 1 conduct: The moderator gives a scenario and each participant should model separately on a piece of paper, without help from other participants

Section 1 scenario: A financial institution plans to introduce several improvements to their current Customer Relationship Management (CRM) plans. As part of the improvement, they are introducing customer categories based on existing customer information on their databases. The categorisation is meant to amend their existing transparency policies of the institution, providing information to customers in a way that minimises information overload and maximises their decision making power.

The **CRM management** has identified three types of customers:

- **Class A customers**: they have at least three financial products (e.g., current account, saving account, ISA account, mortgage, Loans, and credit card) with the institution. They are usually the most loyal customers, are very important and beneficial to the institution, and are very important for the financial institution to keep. Their informational needs must be always met, and they must be updated instantly with new products and services.
- **Class B customers**: they are customers with a current account and at most one more product. The institution policy is to encourage them to take up more new products with them, and increase their interaction, and therefore increase their loyalty to the institution.
- **Class C customers**: they are ex-customers who have no financial services and products with the financial institution at the moment.

There are three information types usually communicated to these stakeholders:

- Information on new products and services: This information is mainly communicated to class B customers to encourage them to engage more with the institution and to increase their loyalty. This information is available to class A customers only on demand. The provision of this information is legal or coercive.

- Information on updates to existing products and services: This information is mainly communicated to Class A customers, but also to class B customers. The provision of this information is optional.

- Information on Xclusive Club benefits: The new scheme of the institution (Called Xclusive Club) is a legal necessity to provide an exclusive club with exclusive benefits (such as high cash back rates and holiday flights) only to Class A customers, and this must not be communicated to class B or class C customers.

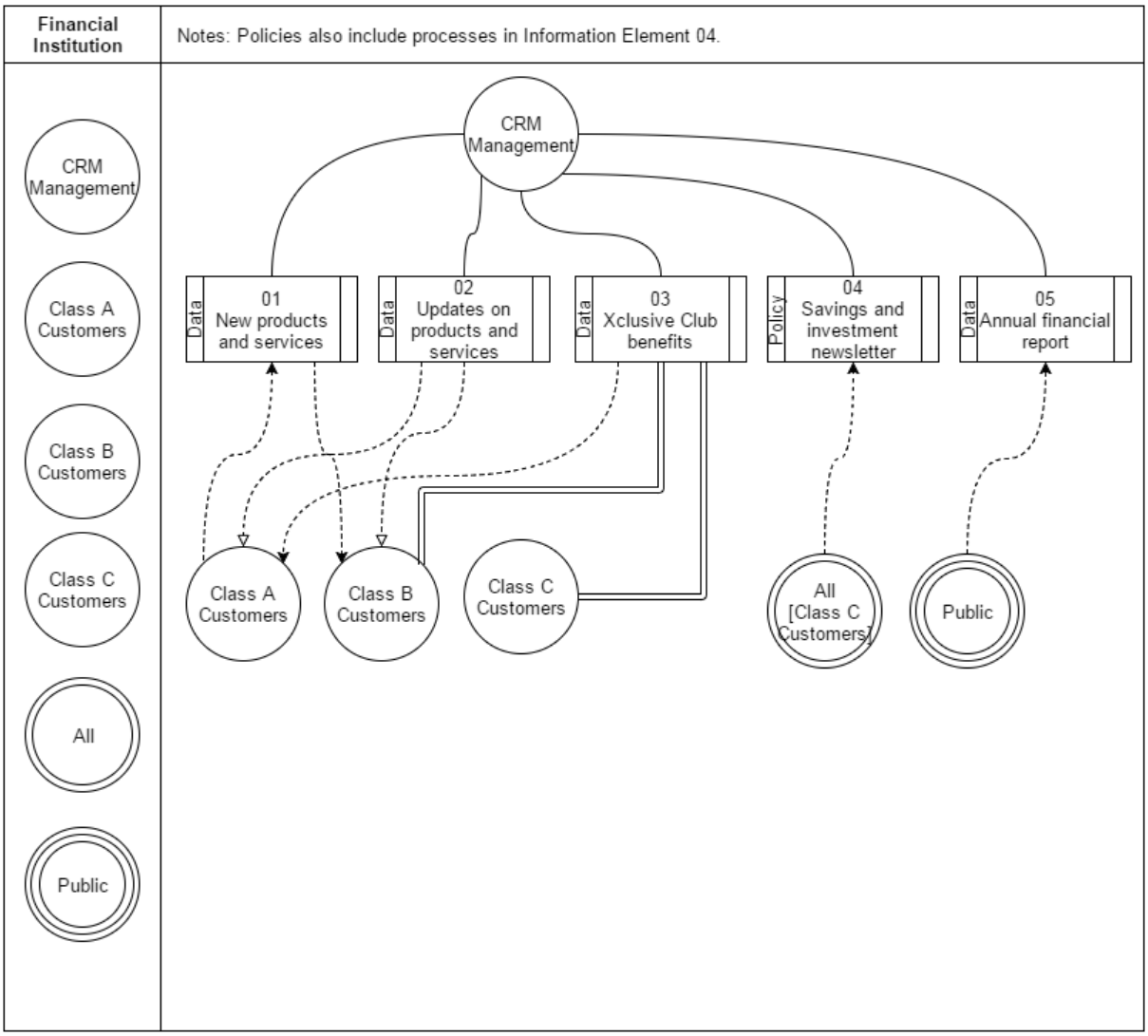
Furthermore, the CRM management has decided to provide the following information to customers, based on legal demands:

- Savings and investment newsletter: including process and policies, and available on demand (i.e., subscription via institution website) to all customers except Class C.

- Institution annual financial report: To everyone (customer or otherwise) with an access to the website.

Section 1 task: Model transparency provision and requests from the CRM management viewpoint (i.e., with the CRM management as the information provider)

Section 1 possible solution: A possible solution could be as follows:

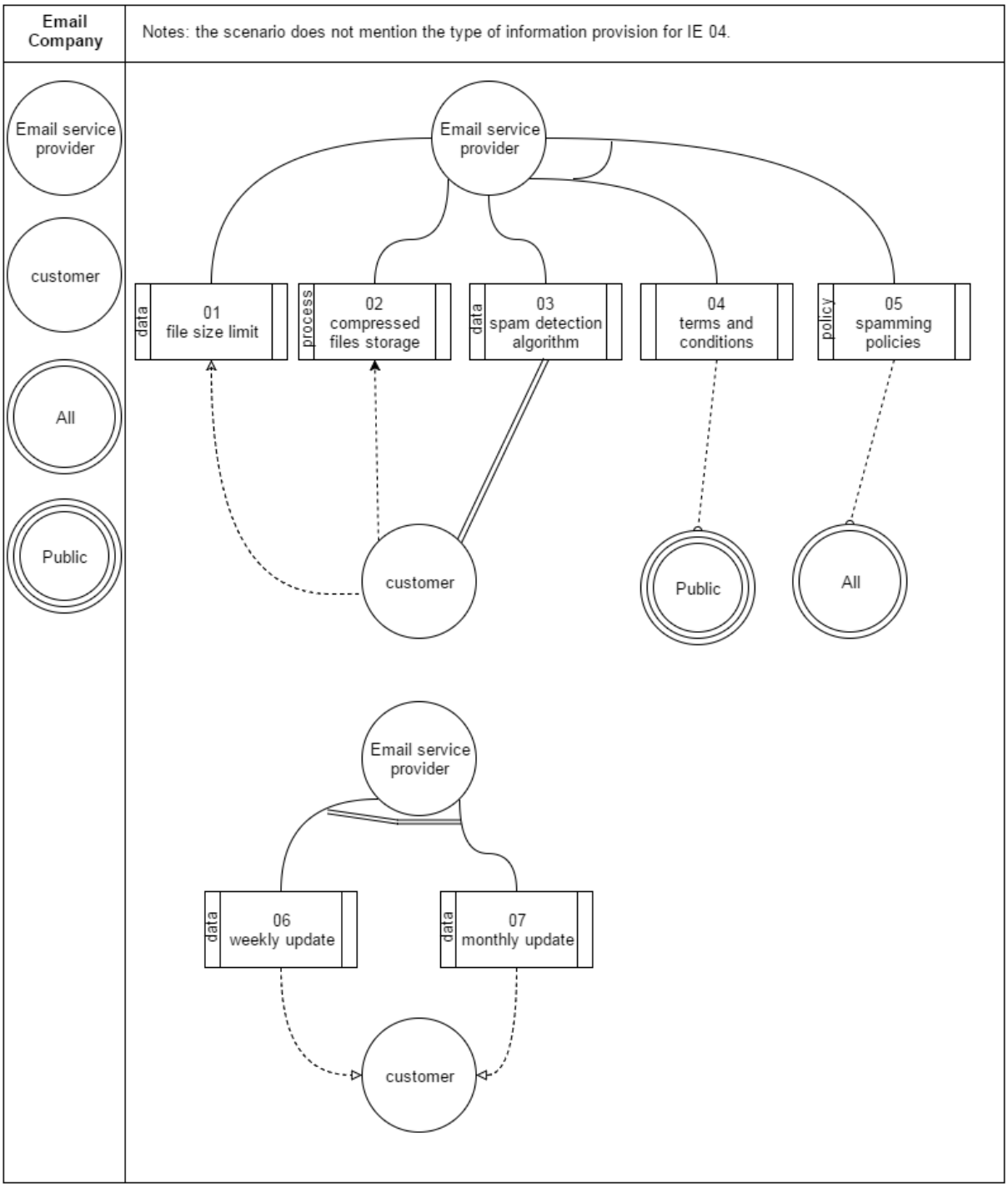


Group 2:

Section 1 aim: To write the possible scenario based on the understandings of the presented model

Section 1 conduct: The moderator gives the model to participants and asks them to write the scenario from which the model was derived. Each participant should do it separately.

Section 1 model: The model is as follows:



Section 1 task: An email service provider (e.g., Google) receives several requests of information (ROI) and they also provide some information to their stakeholders. Based on the following model, please provide a scenario for information exchange and transparency provision amongst stakeholders and the email service provider. You may write a sentence or two for each information exchange you see in the model, considering the provision type and the information type.

Section 1 scenario: A possible scenario is as follows:

A new email provider company has received several requests of information (ROI) from its customers. Some of these requests are:

1) ROI regarding the attached file size limit, and total file size limit.

    a. The company is not legally obliged to provide such information, so these are personal requests by customers only. But they always provide the information to increase trust and customer base.

2) How they process compressed files in terms of possible temporary extraction of files on servers for virus scanning and how they delete those temporary files after scanning, generally called “processing of compressed files storage”

    a. The company is legally obliged to answer questions regarding data storage and data security. Therefore these ROIs are always answered.

3) Their spam detection algorithm

    a. The company policy dictates that their spam detection algorithms cannot be disclosed to customers because of the potentials of losing their ground-breaking algorithms to competitors. Therefore, this type of ROI is refused.

Furthermore, the email provider company provides one or both of the following information on their website:

1) Terms and conditions: Everyone has access to terms and conditions.

2) Spamming policies: All customers can view this by clicking on a link in their homepage after they have signed in.

The email service provider also provides customers with either a weekly update on their account or a monthly update. The update provision is optional.

2.2.2 Section 2: Starting the Other Modelling/Scenario-Building Task

Section 2 aim: To let each group do the other task as well.

Section 2 conduct: The two groups then change to the other task.

2.3 Intermittence:

Intermittence aim: To let the participants have refreshments and prepare for the next phase.

Intermittence conduct: Refreshment is served.

2.4 Part 3: Evaluating the model or Scenario of another participant

2.4.1 Section 1: Evaluating the model of another participant

Section 1 aim: To evaluate how other participants have modelled the scenario based on evaluation metrics. Questions on similarity target social quality on modelling (when participants assume the model they are evaluating is correct).

Section 1 conduct: Participants answer, tick, and rate the questions, and provide free-text reflecting their thoughts

Section 1 metrics: In the questionnaire (Evaluating the given model)

Section 1 sources:

- (Similarity of Business Process Models: Metrics and Evaluation: Dijkman et al)
- (Wording for rating scales http://www.uwex.edu/ces/4h/evaluation/documents/Wordingforratingscales.pdf)

2.4.2 Section 2: Evaluating the scenario of another person

Section 2 aim: To allow participants to compare and contrast their scenarios with others and find possible issues in interpretation of the same model. Questions on similarity target social quality on model interpretation (when participants assume the scenario they are evaluating is correct). Other questions target round-trip translation (i.e., empirical quality based on error frequencies in model interpretation and social pragmatic quality) and scenario's usefulness (which can also be linked to empirical quality)

Section 2 conduct: Participants write where their story differs from the other person and may provide the possible source of the problem.

Section 2 metrics: In the questionnaire (Evaluating the given scenario)

2.5 Part 4: Answering some questions of the TranspLan modelling language

2.5.1 Section 1: Evaluating the model Building

Section 1 aim: To get participants' opinions on modelling using TranspLan after seeing another person's model

Section 1 conduct: Moderator hands in the questionnaire and waits for the participants to finish

Section 1 metrics: In the questionnaire (Evaluating TranspLan modelling language)

Section 1 source: (On the ontological expressiveness of information systems analysis and design grammars: Wand and Weber) [Ontological evaluation]

Section 1 source: (Evaluating a formal modelling language: Ruiz et al)

2.5.2 Section 2: Answering some questions about model understandability

Section 2 aim: To find sources of differences in interpretation of a model

Section 2 conduct: Participants answer some questions on model-to-scenario translation difficulties

Section 2 metrics: In the questionnaire (Evaluating scenario building)

2.6 Part 5: Open Discussion on Modelling

2.6.1 Section 1: Open discussion of modelling issues

Section 1 aim: To get the participants to share their modelling experience with others and openly discuss strengths and weaknesses

Section 1 conduct: The moderator opens the floor for discussion, and rarely intervenes.

2.6.2 Section 2: Open discussion of the model-to-scenario translation

Section 2 aim: To get the participants to share their scenario building experience with others and openly discuss strengths and weaknesses of the language in terms on understandability and interpretability

Section 2 conduct: The moderator opens the floor for discussion, and rarely intervenes.

2.6.3 Section 3: General Open discussion

Section 3 aim: To get the participants to share their opinions on general TranspLan concepts, modelling, etc., and to close the session afterwards.

Section 3 conduct: The moderator opens the floor for discussion, and rarely intervenes.

3 Epilogue: Closing the session

(Props: Amazon vouchers if ready)

Epilogue aim: To show appreciation for the participants' time for participating in the study and closing the session

Epilogue conduct: The moderator thanks everyone for taking part in the study, gives or promises Amazon vouchers of £20 value, asks participants to hand in all papers and questionnaires, and stops and checks the recordings.

4 Questionnaire

This questionnaire consists of five parts. Each part has an instruction. Please read the instructions and then answer each part carefully and truthfully. Some parts of the questionnaire may need an explanation from the moderator. In this case, please listen to the instructions and explanations carefully before proceeding to answer the questions.

You may refrain from answering any question without giving any reasons. However, we would appreciate it if you answer as many questions as possible, which will help us in our analysis and evaluation.

If you have any doubts about a question, or you need more explanations for a question, please ask the moderator before answering the question.

Part 1: General Questions (3 Questions)

***. Please write down your name:**

***. Please write down your experience years in software systems analysis and design:**

***. Please rate your modelling skills (e.g., in UML, BMPN, Goal Modelling):**

☐ Very Poor

☐ Poor

☐ Fair

☐ Good

☐ Very Good

☐ Excellent

Part 2: Evaluating the Given Model (7 Questions)

Before answering these questions, please pay attention to the moderator's comments on the meaning of syntactic, semantic, and contextual correctness and similarity.

1. The model under evaluation is syntactically correct (i.e., it is using the correct modelling constructs and notations).

☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

2. The model under evaluation is syntactically similar to your own model (i.e., it is using similar modelling constructs and notations as your own model).

☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

3. The model under evaluation is semantically correct (i.e., it is using the right constructs for the right concepts, e.g., a white-head arrow for an information element that is optionally provided, and the combinations of these concepts are also correct).

☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

4. The model under evaluation is semantically similar to your own model (i.e., it is using similar words and expressions, and similar combinations of these concepts as your model)?

☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

5. The model under evaluation is contextually correct (i.e., it is reflecting the given scenario as it should)?

☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

6. The model under evaluation is contextually similar to your own model (i.e., it is reflecting the given scenario similar to your own model).

☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

7. Please provide any comments below or tick the box.

☐ No comments

Part 3: Evaluating the Given Scenario (5 Questions)

Before answering these questions, please pay attention to the moderator's comments on the meaning of round-trip translation and scenario usefulness.

8. The scenario under evaluation describes the model correctly.

☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

9. The scenario under evaluation describes the model similarly as your own scenario?

☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

10. If you draw a model based on the scenario under evaluation, it will be the same as the original model.

[Back translation or round-trip translation]

☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

11. The scenario under evaluation reveals transparency actors (i.e., the information provider and the information receiver), the disclosed information and its type (i.e., data, process and policy), and the type of information disclosure (e.g., optional/personal and coercive/legal disclosure)?

[Scenario usefulness]

☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

12. Please provide any comments below or tick the box.

☐ No comments

Part 4: Evaluating TranspLan Modelling Language (9 Questions)

In this part, the moderator will explain each question before you answer them. Please pay attention to the explanations. If you need more explanation, please ask the moderator.

13. In TranspLan, do you think it is possible to use one modelling construct to represent two different concepts (e.g., to use a circle both for an actor and for another concept)?

(Ontological clarity: construct overload)

☐ Yes ☐ No ☐ I do not know

If you say yes, please give details below:

14. In TranspLan, do you think it is possible to use two or more design constructs to represent a single concept (e.g., to model the same information in the scenario both with a circle and a rectangle or model one information provision type by using different arrows types)?

(Ontological clarity: construct redundancy)

☐ Yes ☐ No ☐ I do not know

If you say yes, please give details below:

15. In TranspLan, do you think there are modelling constructs that have no real-world corresponding concepts (e.g., is there an arrow type that can never be used in practice and is therefore useless)?

(Ontological clarity: construct excess)

☐ Yes ☐ No ☐ I do not know

If you say yes, please give details below:

16. In TranspLan, do you think there can be a real-world concept related to transparency that has no corresponding modelling construct (i.e., is there a transparency concept in a scenario that cannot be modelled using the existing notation provided in TranspLan)?

(Ontological completeness: construct deficit)

☐ Yes ☐ No ☐ I do not know

If you say yes, please give details below:

17. In TranspLan, do you think certain concepts are difficult to express (i.e., even when TranspLan is able to model the concept, it does not effectively convey the meaning of that concept)?

(Expressiveness)

☐ Yes ☐ No ☐ I do not know

If you say yes, please give details below:

18. In TranspLan, do you think it is possible to make a certain modelling mistake several times (e.g., because of ambiguity, difficulty, counter-intuitiveness, etc. in the language and its notation)?

(Frequency of error)

☐ Yes ☐ No ☐ I do not know

If you say yes, please give details below:

19. In TranspLan, do you think a change in part of a model could require changes in the other parts of the model to maintain the consistency and correctness of the overall model (e.g., changing an arrowhead in part of the model necessitates changes in arrowheads, or actors involved in information exchange in another part of the model)?

(Locality of change)

☐ Yes ☐ No ☐ I do not know

If you say yes, please give details below:

20. In TranspLan, do you think parts of, or the entire model, could be reused (e.g., a TranspLan excerpt for an information exchange between two actors in a hotel booking system could be used, maybe with little customisation, in a flight reservation system)?

(Reusability)

☐ Yes ☐ No ☐ I do not know

If you say yes, please give details below:

21. In TranspLan, do you think the guidelines and formal specifications of the modelling language and modelling process are incomplete for drawing a model (i.e., something should be added to them), and do you think anything is missing in the provided guidelines for TranspLan modelling?

(Guidelines)

☐ Yes ☐ No ☐ I do not know

If you say yes, please give details below:

Part 5: Evaluating Scenario Building (5 Questions)

Before answering these questions, please pay attention to the moderator's comments on the meaning of scenario extraction and scenario expressiveness.

22. In the scenario building task, the scenario is easy to build from a given model (e.g., the model is not overly nested, recursive or cyclic to make scenario building difficult).

(Scenario extraction)

☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

23. In the scenario building task, the scenario is expressive enough and effectively conveys the meaning of concepts in a given model (i.e., the scenario effectively reveals transparency actors, the information exchange amongst them, and the nature of information exchange).

(Scenario expressiveness)

☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

24. In the scenario building task, it is possible to make a certain mistake several times (e.g., because of ambiguity, similarity in meaning, and subtle differences which may be overlooked or tolerated, in the model).

(Frequency of error)

☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

25. In the scenario building task, the guidelines and formal specifications of the modelling language are helpful in writing the scenario.

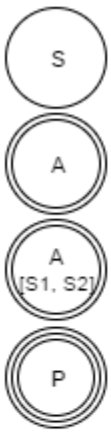
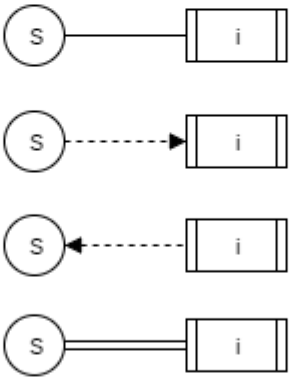
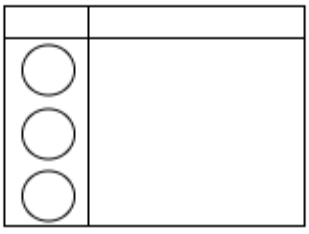
(Guidelines)

☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

26. Please provide any comments below or tick the box.

☐ No comments

5 TranspLan Quick Reference Card

Visual Syntax	Semantics	Visual Syntax	Semantics
Stakeholders		Information Elements	
	stakeholder *S* all stakeholders in the diagram all stakeholders in the diagram (except *S1*, *S2*) public stakeholders		information element *i* containing data information element *i* containing a process information element *i* containing a goal unspecified information element *i*
Relationships		Stakeholder/Information Relations	
	*AND* relationship *OR* relationship *eXclusive OR* relationship		stakeholder *S* producing information *i* stakeholder *S* requesting information *i* stakeholder *S* receiving information *i* information *i* not intended for stakeholder *S*
Relation Types		Information Exchange System	
	*Obligatory* relationship: Coercive Provision / Legal Demand *Optional* relationship: Voluntary Provision / Personal Demand *Undecided* relationship: Unknown Provision or Demand		information exchange system boundary with the list of stakeholders

6 Information Sheet

Study Title:

TranspLan Evaluation

Aims of the Research

The aim of the research is to empirically evaluate TranspLan, a modelling language for engineering transparency requirements in business information systems. The study is being conducted as part of the PhD focused on the modelling and analysis of transparency requirements in business information systems.

Invitation

You are being invited to consider taking part in the research study *TranspLan Evaluation.* This project is being undertaken by *Mahmood Hosseini.*

Before you decide whether or not you wish to take part, it is important for you to understand why this research is being done and what it will involve. Please take time to read this information carefully and discuss it with friends and relatives if you wish. Ask us if there is anything that is unclear or if you would like more information.

Why have I been chosen?

You have been chosen because of your expertise in computer engineering in general, and your familiarity with modelling (e.g., UML, BMPN, Goal Modelling) in particular. You will join a team of at most 9 more people during the study.

Do I have to take part?

You are free to decide whether you wish to take part or not. If you do decide to take part you will be asked to sign two consent forms, one is for you to keep and the other is for our records. You are free to withdraw from this study at any time and without giving reasons and without there being any negative consequences, up to the point where the data are processed and become anonymous, so your identity cannot be determined.

What will happen if I take part, and what do I have to do?

You are expected to do parts of the study individually, and other parts of the study in a pair work or in a group. You will be drawing models, writing scenarios, and evaluating other people's models and scenarios. There will be group discussions during the study as well. You are also expected to complete a questionnaire during the study. The whole session will be audio recorded. Some photos will also be taken.

What are the benefits (if any) of taking part?

To show our gratitude for your participation, all participants will be given a £20 Amazon voucher at the end of the study. You will also be contributing to the knowledge of transparency modelling and analysis.

What are the risks (if any) of taking part?

There are no speculated risks for participating in this study.

How will information about me be used?

The data collected will be stored securely, and will be used only for the purpose of this study and for a maximum of two years. The data will be completely anonymised before it appears in any type of publication. The audio recordings of your activities made during this research will be used only for analysis. No other use will be made of them without your written permission, and no one outside the project will be allowed access to the original recordings. Some photos will be used as a proof of session held, and you can always opt out of being your photos taken.

Who will have access to information about me?

Your confidentiality will be safeguarded during and after the study. Only the research team including three people will have access to your data. The data will be stored securely (sheets of paper and questionnaires in a locked filing cabinet, and the audio files on a password protected computer) and destroyed and deleted immediately after use.

Who is funding the research?

The research is funded by Bournemouth University and by an FP7 Marie Curie CIG grant (the Sociad project).

What if there is a problem?

If you have a concern about any aspect of this study, you may wish to speak to the researcher who will do their best to answer your questions. You should contact *Mahmood Hosseini* on *mhosseini@bournemouth.ac.uk.* Alternatively, if you do not wish to contact the researcher, you may contact his supervisor, *Dr Raian Ali* on *rali@bournemouth.ac.uk*.

If you remain unhappy about the research and/or wish to raise a complaint about any aspect of the way that you have been approached or treated during the course of the study please write to Professor Matt Bentley who is the Bournemouth University's deputy dean research and professional practice for complaints regarding research at the following address:-

Professor Matt Bentley

Deputy Dean Research & Professional Practice

Christchurch House C227

Talbot Campus, Fern Barrow, Poole, BH12 5BB

E-mail: mbentley@bournemouth.ac.uk

Tel: 01202 962203

7 Consent Form

Title of Project: *TranspLan Evaluation*

Name and contact details of Principal Investigator:

Mahmood Hosseini
Poole House, Talbot Campus, Fern Barrow, Poole, BH12 5BB, United Kingdom
mhosseini@bournemouth.ac.uk

Please tick box if you agree with the statement:

1	I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions.	☐
2	I understand that my participation is voluntary and that I am free to withdraw at any time (without giving reason and without there being any negative consequences) up to the point where the data are processed and become anonymous, so my identity cannot be determined.	☐
3	I agree to take part in this study.	☐
4	I understand that data collected about me during this study will be anonymised before it is submitted for publication. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the outputs that result from the research.	☐
5	I agree to the study session being audio recorded.	☐
6	I agree to allow the dataset collected to be used for future research projects.	☐
7	I agree to be contacted about possible participation in future research projects.	☐
8	I agree that my photos be taken during the study session.	☐

_____	_____	_____
Name of participant	Date	Signature
_____	_____	_____
Researcher	Date	Signature

Appendix Three: Evaluating the Structured Feedback Elements Used in Stream Method

1 Invitation Email

Dear All

I am Mahmood Hosseini, a third-year PhD student in Bournemouth University, and I am looking for participants for the evaluation of elicited feedback on transparency, investigating the perception of information in terms of its meaningfulness, usefulness and quality. In total, you should read four short scenarios, and write two paragraphs (or more if you want) for each scenario. In total, it should take between 20-30 minutes, and you can answer it in one go, or gradually.

You are kindly requested to participate in my study, which is **optional**, and you can find the Information Sheet, Consent Form and the Evaluation Sheet attached to this email. If you wish to participate, please return the **Evaluation Sheet** and **signed Consent Form** to me (mhosseini@bournemouth.ac.uk) by Wednesday *August 3rd*.

Whether you personally are interested in this study and willing to help, please **feel free to send this email to anyone** who might be interested. You will find the following information in the Evaluation Sheet as well.

Best regards and do not forget to distribute!

Mahmood Hosseini

You are given four scenarios.

Read each scenario. Write two paragraphs (or more) about the transparency of the provided information.

In the first paragraph, explain in detail whether your questions (in "What you want to know" section) are **answered** and whether you can **make a decision** or act based on the information.

In the second paragraph, explain in detail whether the provided information contains (or lacks) certain **quality attributes** (i.e., your thoughts on the quality of the information).

You may write your paragraphs directly under each scenario in "Your Thoughts" section, or separately in a new file.

Participation is optional. If you wish to participate, please send back your answers and the signed consent form by **August 3rd** to mhosseini@bournemouth.ac.uk**.**

Thank you in advance!

---

2 Evaluation Sheet

2.1 Personal Information:

Please type in your personal information:

- **NAME:**
- **EMAIL:**
- **AGE:** Under 18 ☐ 18- 25 ☐ 26-35 ☐ 36-45 ☐ 46-55 ☐ 56-65 ☐ Over 65 ☐

2.2 Your Task:

Read each scenario. Write two paragraphs (or more) about the transparency of the provided information.

In the first paragraph, explain in detail whether your questions (in "What you want to know" section) are **answered** and whether you can **make a decision** or act based on the information.

In the second paragraph, explain in detail whether the provided information contains (or lacks) certain **quality attributes** (i.e., your thoughts on the quality of the information).

You may write your paragraphs directly under each scenario in "Your Thoughts" section, or separately in a new file.

Participation is optional. If you wish to participate, please send back your answers and the signed consent form by **Wednesday August 3rd** to mhosseini@bournemouth.ac.uk.

Thank you in advance!

2.3 Scenario One:

What you want to know:

1. You want to get some information on how to get a mortgage to buy a house.
2. You want to know why there is a difference between first-time buyers and regular buyers.
3. You want to know if you can buy a house based on your deposit.
4. You want personal advice on how to apply for a mortgage.

What and how much information you get:

- Source: A mortgage pamphlet with **50 pages** that you find **after a very long search**

Excerpts from the pamphlet: … The capital gains tax may defer certain buy-to-let mortgage seekers to apply for the mortgage …Customers should look at droplock and drawdown rules and regulations … In certain cases, a redemption administration fee or a valuation administration fee may apply … It is subject to either a homebuyer's survey or a full structural survey … You may also have to consider the deed of postponement in this case … Gazumping and gazundering will be prohibited after an agreed time and date …

Your Thoughts:

2.4 Scenario Two:

What you want to know:

1. You want to download and install a banking app and you want to know their privacy policy on where they store your username and password.
2. You want to know whether you can uninstall the app any time you want.
3. You want to get your answers before you install the app.
4. You want a reliable source of information.

What and how much information you get:

- Source: An **anonymous blogger**'s opinion **not** representing the bank
- Time: **Before you install** the banking app.

I used to work with the banking app, and I should tell you it is totally harmful for your privacy. First, they store all the passwords on their servers without any protection such as encryption (this is what I have heard even though they do not admit it). Second, I have heard that their banking app is full of bugs and errors. Third, you cannot uninstall the app any time you want and you have to go to a branch for full uninstallation.

Your Thoughts:

2.5 Scenario Three:

What you want to know:

1. You want to buy a ticket to a football match and you want to know what the different ways to get a discount are. There are actually three ways to get a discount, becoming a member, buying at least 10 tickets at the same time, or buy a ticket at least two months in advance.
2. You want to know how you can become a member.
3. You want to buy one ticket to a match two months in advance to get a discount.
4. You want a reliable source of information.

What and how much information you get:

- ❖ Source: The website of the **football club**
- ❖ Time: **One month before the match** the information is available on the website.

You can purchase tickets safely from official Club websites or ticket offices, in person or over the phone. Clubs will also provide details of any authorised ticket partners on their official site. To get a discount, you can become a member, buy group tickets (at least 20) or buy an early bird ticket (at least two months in advance):

- You may want to become a member because you want to enjoy the benefits of priority access to tickets.
- You can buy group tickets (20 tickets or more) for you and your companions.
- You may buy a ticket to a match at least two months advance.

Your Thoughts:

2.6 Scenario Four:

What you want to know:

1. You are reading an online member-exclusive travel brochure and you only want to find a suitable date when you can travel to a European destination with a reasonable price for 2017. You already know the booking process.
2. You want to know if the hotel price is inclusive of local taxes.
3. You want a reliable source of information.

What and how much information you get:

- Source: The website of the **member-exclusive hotel booking**

Hotel	Available From	Available To	Country	Stars Rating
Blue Atlanta	January 12, 2017	January 18, 2017	Spain	4
Heavenly Sky	2017-09-18	2017-09-22	Germany	4
Precious Gem	09/10/2017	14/10/2017	Wales	4
Spring Hotel	June 2017	August 2017	France	4

The booking process starts when you click on Book Now on the bottom of the page. You need to follow three very easy steps: 1) choose you hotel and date, 2) enter your exclusive membership number you find on your card, and 3) enter your credit card info. Our amazing members of staff will do the rest and ensure you will have the most wonderful stay in your exclusively prepared hotel during your visit.

Your Thoughts:

2.7 More Comments:

3 Information Sheet

Study Title:

Evaluation of the structured feedback used in the Transparency Requirements Engineering Method

Aims of the Research

The aim of the research is to empirically evaluate the feedback obtained from people for the engineering of transparency requirements in business information systems, which is the initial part of the *Stream* method in eliciting, analysing and evolving transparency requirements. The study is being conducted as part of the PhD focused on the modelling and analysis of transparency requirements in business information systems.

Invitation

You are being invited to consider taking part in this research study. This project is being undertaken by *Mahmood Hosseini.*

Before you decide whether or not you wish to take part, it is important for you to understand why this research is being done and what it will involve. Please take time to read this information carefully and discuss it with friends and relatives if you wish. Ask us if there is anything that is unclear or if you would like more information.

Why have I been chosen?

You have been chosen because of your probable interest in helping the PhD candidate in better understanding the transparency requirements of stakeholders in a business information system.

Do I have to take part?

You are free to decide whether you wish to take part or not. If you do decide to take part you will be asked to sign a consent form. You are free to withdraw from this study at any time and without giving reasons and without there being any negative consequences, up to the point where the data are processed and become anonymous, so your identity cannot be determined.

What will happen if I take part, and what do I have to do?

You are expected to read four scenarios and write at least two paragraphs for each scenario, explaining your transparency requirements and whether they are met or not. You will receive the scenarios and related information through email, and will submit your answers through email as well. You will not be contacted by any other means, such as via telephone, text, or post.

What are the benefits (if any) of taking part?

You will be contributing to the knowledge of transparency requirements elicitation and the structure of the feedback.

What are the risks (if any) of taking part?

There are no speculated risks for participating in this study.

How will information about me be used?

The data collected will be stored securely, and will be used only for the purpose of this study and for a maximum of two years. The data will be completely anonymised before it appears in any type of publication. No other use will be made of them without your written permission, and no one outside the project will be allowed access to the original files.

Who will have access to information about me?

Your confidentiality will be safeguarded during and after the study. Only the research team including three people will have access to your data. The data will be stored securely (sheets of paper and questionnaires on a password protected computer) and destroyed and deleted immediately after use.

Who is funding the research?

The research is funded by Bournemouth University and by an FP7 Marie Curie CIG grant (the Sociad project).

What if there is a problem?

If you have a concern about any aspect of this study, you may wish to speak to the researcher who will do their best to answer your questions. You should contact *Mahmood Hosseini* on *mhosseini@bournemouth.ac.uk.* Alternatively, if you do not wish to contact the researcher, you may contact his supervisor, *Dr Raian Ali* on *rali@bournemouth.ac.uk*.

If you remain unhappy about the research and/or wish to raise a complaint about any aspect of the way that you have been approached or treated during the course of the study please write to Professor Matt Bentley who is the Bournemouth University's deputy dean research and professional practice for complaints regarding research at the following address:-

Professor Matt Bentley

Deputy Dean Research & Professional Practice

Christchurch House C227

Talbot Campus, Fern Barrow, Poole, BH12 5BB

E-mail: mbentley@bournemouth.ac.uk

Tel: 01202 962203

4 Consent Form

Title of Project: *Evaluation of the structured feedback used in the Transparency Requirements Engineering Method*

Name and contact details of Principal Investigator:

Mahmood Hosseini
Poole House, Talbot Campus, Fern Barrow, Poole, BH12 5BB, United Kingdom
mhosseini@bournemouth.ac.uk

Please tick box if you agree with the statement:

1	I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions.	☐
2	I understand that my participation is voluntary and that I am free to withdraw at any time (without giving reason and without there being any negative consequences) up to the point where the data are processed and become anonymous, so my identity cannot be determined.	☐
3	I agree to take part in this study.	☐
4	I understand that data collected about me during this study will be anonymised before it is submitted for publication. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the outputs that result from the research.	☐
5	I agree to allow the dataset collected to be used for future research projects.	☐
6	I agree to be contacted about possible participation in future research projects.	☐

_____	_____	_____
Name of participant	Date	Signature
_____	_____	_____
Researcher	Date	Signature