Foundations for Transparency Requirements Engineering

Mahmood Hosseini(✉), Alimohammad Shahri, Keith Phalp, and Raian Ali

Bournemouth University, Poole, UK
{mhosseini,ashahri,kphalp,rali}@bournemouth.ac.uk

Abstract. [**Context & motivation**] Transparency is becoming an essential requirement for business information systems. Transparency is advocated to inspire trust,. increase accountability and reduce corruption. However, it may also lead to negative side effects such as information overload, bias and unnecessary pressure on stakeholders. [**Question/problem**] Despite its distinct characteristics and importance, transparency is still a limitedly explored concept in software engineering and information systems literature, and is often fragmented across adjacent concepts such as privacy, secrecy and regulatory requirements. This limits its representation level and impedes its management. [**Principal ideas/results**] In this paper, we propose four facets for transparency and illustrate their usefulness in guiding transparency requirements engineering. [**Contribution**] These facets help clarify the concept of transparency and provide foundations for its management in information systems engineering as a distinct notion. Initiatives like the open data movement add to the timeliness and potential impact of our contribution.

Keywords: Transparency requirements · Stakeholder transparency · Meaningful transparency · Useful transparency · Information quality

1 Introduction

Transparency can be defined as the open flow of information [6] and the release of information by institutions that is relevant to evaluating these institutions [3]. The positive connotation associated with transparency implies that it is a desirable quality for information. However, transparency has been shown to be an undesirable information quality in certain cases. For example, it is indicated that increased transparency in the relationship between buyers and suppliers may bring about some negative effects such as unwanted exposure of information to competitors [9]. As a result, it is necessary to take precautionary steps towards providing transparency in order to minimise such adverse effects.

In the domain of information systems, 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

M. Daneva and O. Pastor (Eds.): REFSQ 2016, LNCS 9619, pp. 225–231, 2016.
DOI: 10.1007/978-3-319-30282-9_15

requirements. However, in order to better manage transparency requirements of stakeholders, there is a need to study it as a first-class requirement concept.

In this paper, we propose four facets to serve the engineering of transparency requirements in a business information system. These facets relate to the stakeholders in the process and the information flow amongst them, the meaningfulness of the information made transparent, the usefulness of such information for a particular audience, and the quality of the disclosed information. These facets are meant to provide a baseline to measure and manage transparency as a first-class requirements engineering concept. We deduce our facets upon a thorough analysis of a wide range of studies on transparency in multiple disciplines including politics, human relations and psychology. The timeliness of our contribution stems from global trends, e.g., open government, to make *quality* information available in a *meaningful* and *useful* style to the *right audience*.

2 Motivation

A software system is transparent if it makes the information it deals with transparent along with its internal functioning process [13]. In requirements engineering, transparency is generally viewed as a non-functional requirement (NFR) because it is orthogonal to software functionality since it can be viewed as a quality issue, and because software can work with or without it [13]. Furthermore, it is advocated that transparency has to be managed in the context of requirements specification [13]. In one of the early works on transparency as an NFR [2], it is argued that transparency requirements can be managed using the NFR Framework and i^* modelling. The work concludes that i^* modelling is not the final answer to transparency, and certain augmentations may be needed for managing transparency requirements more efficiently.

Furthermore, the concept of transparency ladder is introduced [13] which contains the following five non-functional requirements of accessibility, usability, informativeness, understandability, and auditability, which must be achieved in order to reach transparency. This ladder, however, tends to refer to information quality attributes [10] that must be fulfilled, rather than steps to achieving transparency. Using the NFR Framework, a software transparency softgoal interdependency graph (SIG) is also proposed [13].

3 Four Facets of Transparency

Based on an extensive literature study on transparency, we identified four facets of transparency, as depicted in Fig. 1, which can help requirements engineers in the identification, analysis and specification of transparency requirements. Furthermore, these facets facilitate the modelling of transparency requirements, which can be used for conceptualisation and automated analysis of transparency.

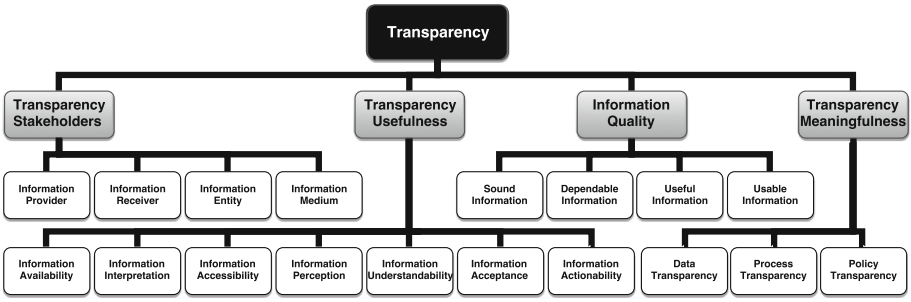

Fig. 1. The four facets of transparency

3.1 Transparency Stakeholders

In order to understand transparency requirements, one essential prerequisite is to identify all 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 which channels are used to relay information.

An initial model of information exchange consists of two entities, **information provider** or source and **information receiver** [16]. The source disseminates the information to the receiver, and the receiver provides feedback based on that information to the source. This model is useful for modelling information exchange, but for the study of transparency two key elements are missing.

The first one is the **information medium** which relays the information. The consideration of an information medium as a technical actor is essential because it is where information can be stored and managed, and is therefore prone to information leakage and unwanted transparency. The example of Ashley Madison website is one of the many examples depicting the significance of information exchange media in a 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 a transparency model of information exchange.

Furthermore, the nature of exchanged information must be considered in a transparency model of information exchange. Not all the information in this model relates to transparency, i.e., information may or may not be related to transparency. These are the concepts which should be considered in a transparency model of information exchange [7,8].

3.2 Transparency Meaningfulness

Transparency requirements can be divided into three main categories [1], which represent how meaningful the provided transparency is. These categories are meant to deal with primarily 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 whether attachments are scanned for viruses or not.
- **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 despite the impact on the delivery speed of the mail, encryption is needed for delivering secure mail, or why virus scanning is necessary for attachments.

In [1], it is pointed 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.

3.3 Transparency Usefulness

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 [4]. However, there are many steps between information availability and information actionability to be catered for. These steps are as follows:

- **Information availability** means that the information provider must disclose information for the use of the information receivers.
- **Information interpretation** refers to the interpretation of available information by information providers in a way that can be understood easily by information receivers.
- **Information accessibility** refers to the degree to which information can be easily located by information receivers, and is sometimes referred to as information visibility [12].
- **Information perception** refers to information receivers' perception of the transparency provided by the information. It acts at the cognitive level of stakeholders and is therefore difficult to assess [17].
- **Information understandability** means that for achieving useful transparency, the perceived information should also be understood and comprehended by information receivers. Therefore, understandability is sometimes considered as one of the two crucial dimensions of transparency [6].

- **Information acceptance** 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 new information changes those beliefs nonetheless.
- **Information actionability**, also referred to as informed decision making, 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 [11].

There is a substantial difference between meaningful transparency and useful transparency. Meaningful transparency argues that stakeholders must know the actions and reasons behind the provided information, (e.g., as expressed by [5]), while useful transparency discusses that information provision should lead to stakeholders' actionability and help their decision-making, or facilitate change in their perception of the information provider (e.g., as expressed by [15]).

3.4 Information Quality in Transparency

Information quality in transparency is a crucial facet, as without it, transparency can hardly be reached. The literature on transparency does discuss the importance of information quality and provides some facets for it [5,14]. However, the inter-dependencies between these information quality dimensions and other facets of transparency have not been investigated, e.g., information believability, as an information quality dimension, has a clear link with information acceptance as a step in transparency usefulness. Furthermore, 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, we briefly discuss four categories of information quality which can be used in transparency and the dimensions associated with them [10]:

- **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*.

4 Conclusion

In this paper, four facets for engineering transparency as a first-class requirement were discussed. These facets are meant to provide a foundation for transparency as an emerging software requirement in business information systems. They cover the level of stakeholders' engagement in transparency, the level of meaningfulness of the information provided to stakeholders, the steps to take in order to achieve useful transparency, and the information quality for transparency. As part of the future research, the authors will provide reference models based on these facets, and will build a modelling language based on these reference models.

Acknowledgements. The research is supported by an FP7 Marie Curie CIG grant (the SOCIAD project).

References

1. Bannister, F., Connolly, R.: The trouble with transparency: a critical review of openness in e-government. Policy Internet **3**(1), 1–30 (2011)
2. Cappelli, C., do Prado Leite, J.C.S., Oliveira, A.d.P.A.: Exploring business process transparency concepts. In: 15th RE Conference, pp. 389–390 (2007)
3. Florini, A., Birdsall, N., Flynn, S., Haufler, V., Lipton, D., Morrow, D., Sharma, S.: Does the invisible hand need a transparent glove? the politics of transparency. In: World Banks Annual Conference on Development Economics, pp. 163–184 (2000)
4. Frentrup, M., Theuvsen, L.: Transparency in supply chains: is trust a limiting factor. In: Fritz, M., Rickert, U., Schiefer, G. (eds.) Trust and Risk in Business Networks, pp. 65–74. ILB-Press, Bonn (2006)
5. Griffith, J.C.: Beyond transparency: New standards for legislative information systems. Citeseer (2006)
6. Holzner, B., Holzner, L.: Transparency in Global Change: The Vanguard of the Open Society. University of Pittsburgh Press, Pittsburgh (2006)
7. Hosseini, M., Shahri, A., Phalp, K., Ali, R.: Towards engineering transparency as a requirement in socio-technical systems. In: 23rd RE Conference (2015)
8. Hosseini, M., Shahri, A., Phalp, K., Ali, R.: Transparency as a requirement. In: 21st REFSQ Conference - Poster and Demo Track (2015)
9. Hultman, J., Axelsson, B.: Towards a typology of transparency for marketing management research. Ind. Mark. Manage. **36**(5), 627–635 (2007)
10. Kahn, B.K., Strong, D.M., Wang, R.Y.: Information quality benchmarks: product and service performance. Commun. ACM **45**(4), 184–192 (2002)
11. McManus, T., Holtzman, Y., Lazarus, H., Anderberg, J., Simon, C.: Corporate information transparency: the synthesis of internal and external information streams. J. Manage. Dev. **25**(10), 1029–1031 (2006)
12. Michener, G., Bersch, K.: Conceptualizing the quality of transparency. In: 1st Global Conference on Transparency (2011)
13. do Prado Leite, J.C.S., Cappelli, C.: Software transparency. Bus. Inf. Syst. Eng. **2**(3), 127–139 (2010)
14. Rawlins, B.: Give the emperor a mirror: toward developing a stakeholder measurement of organizational transparency. J. Public Relat. Res. **21**(1), 71–99 (2008)

15. Scauer, F.: Transparency in three dimensions. Univ. Ill. Law Rev. **2011**, 1339 (2011)
16. Stuart, H.C., Dabbish, L., Kiesler, S., Kinnaird, P., Kang, R.: Social transparency in networked information exchange: a theoretical framework. In: Proceedings of the ACM CSCW Conference, pp. 451–460 (2012)
17. Tagiuri, R., Kogan, N., Bruner, J.S.: The transparency of interpersonal choice. Sociometry **18**, 368–379 (1955)