So who is impacted anyway – a preliminary study of indirect stakeholder identification in practice

Ingo Müller
Monash University
Clayton, Victoria, Australia
ingo.mueller@monash.org

Waqar Hussain
Monash University
Clayton, Victoria, Australia
waqar.hussain@monash.org

John Grundy
Monash University
Clayton, Victoria, Australia
john.grundy@monash.org

ABSTRACT

Due to the proliferation of disruptive technologies such as AI into almost every aspect of modern society, software systems increasingly affect the lives of people who do not directly use these systems - with potentially serious and harmful consequences. However, current software development practices do not yet account for this trend sufficiently well and frequently overlook indirect stakeholders. This paper presents the results of a preliminary interview-based study of software professionals aimed at understanding the state-of-practice of indirect stakeholder identification in the software industry. Our initial findings confirm that indirect stakeholders are often overlooked due to customer expectations, project constraints, the prevailing technology-centric software engineering culture and a lack of practical methods and tools. Based on these findings, we outline a roadmap for the investigation of methods and tools for the effective and efficient identification of indirect stakeholders.

CCS CONCEPTS

• **Software and its engineering → Requirements analysis**.

1 INTRODUCTION

Robert Williams made the headlines in the US in 2020 when he was wrongly identified by a facial recognition system and arrested as a wanted criminal [11]. The root cause of this appalling violation of Robert's personal rights was traced to a bias in the underlying machine-learning system, which was trained using images of people with a predominantly Northwestern European appearance. Clearly, not enough attention was given to the ethnic diversity of the US population. This example illustrates how people who do not use, or even know about the existence of, a given software system can be affected by its operation.

People like Robert are referred to as *indirect stakeholders* [2]. They are often from minority or vulnerable groups, but depending on the context of a software system, can be anyone with little or no influence on the system or its development, who is nevertheless impacted by its operation. As AI and other disruptive technologies open up many new application areas, often new and unanticipated social implications like in Robert's case seem to have become far too common, judging by the frequency they make the news [7, 8, 17].

We argue that overlooking indirect stakeholders has a profound negative effect on society: if stakeholders remain unknown or are not considered, their values and needs are unlikely to be discovered or met. Something we can no longer accept, given the almost total pervasiveness of software, that laymen and experts alike struggle to understand. This paper reports on a preliminary interview study aimed at determining the state-of-practice of indirect stakeholder identification in the software industry. The objective of the study was to answer the following research questions:

(1) Are indirect stakeholders overlooked in software projects, and if so, what are the implications?
(2) What inhibits the identification of indirect stakeholders?
(3) What methods and tools are used for indirect stakeholder identification?

The key findings of our study corroborate our hypothesis that indirect stakeholders are frequently overlooked. This is due to a combination of social, economic and technical aspects. The former two include a lack of awareness, preconceived customer expectations and common project constraints. While the latter encompass the prevailing software engineering (SE) culture of focusing on outputs (technological artefacts) rather than outcomes (impact on society and environment) and a lack of practical methods and tools. Based on these findings, we propose a roadmap for the systematic and holistic study of the problem of identifying indirect stakeholders. Our contribution is an explicit consideration of economic, social and technical aspects and their dependencies. The ultimate objective of course is the creation of practical methods and tools that help practitioners identify indirect stakeholders effectively and efficiently under real-world conditions.

2 RELATED WORK

The topic of identifying indirect stakeholders is largely ignored in SE standards, textbooks, and industry guidelines. For example, ISO 29148 [15] stipulates the "identification of all stakeholders with a legitimate interest in a system", without defining what a legitimate interest constitutes nor indicating methods for identifying stakeholders. Other standards are equally vague. ISO 12207 [14], the Systems Engineering Body of Knowledge (SEBoK) [19], and the Software Engineering Body of Knowledge (SWEBOK) [4] likewise

generically point out the need to identify *all* stakeholders to ensure a complete set of requirements, while an IREB training handbook [2] at least mentions indirect stakeholders. All of them, however, fail to provide concrete guidance with respect to the identification of indirect stakeholders. SE textbooks, such as Sommerville [20], typically do not cover the topic.

SE research literature on the subject is sparse and equally short on detail. The most recent authoritative study by Pacheco and Garcia [16] from 2012 sums it up best by stating that "analyzed approaches still have serious limitations in terms of covering all aspects of stakeholder identification". An exploratory literature review conducted at the time of writing indicated little has changed.

The HCI community has produced a number of Value-Sensitive Design (VSD) approaches, such as e.g. envisioning cards [9] and the stakeholder tokens method [26] that address the identification of indirect stakeholders. However, "many studies [do] not employ a good methodical approach for stakeholder identification" according to Winkler et al. [25] and may result in the "accidental exclusion of stakeholders". Moreover, these approaches have not reportedly seen application in the industry. Their effectiveness and efficiency under real-world conditions are largely unknown.

An active field of SE research is the exploration of how human values such as fairness, equality or transparency may be incorporated into SE practices [23]. Stakeholder identification is not explicitly covered however, despite it being the prerequisite for capturing (stakeholder) values.

In summary, the identification of indirect stakeholders does not receive sufficient attention in the SE domain. There is no sound theory documented in the literature nor are effective and efficient methods and tools readily available in industrial software projects. The purpose of this research is to understand why this is the case and to identify ways to improve the situation.

3 STUDY DESIGN

We conducted a qualitative analysis of expert interviews to answer the research questions outlined in the introduction. We chose thematic analysis for its flexible, lightweight character that was well suited to the exploratory nature of this study.

3.1 Sampling

We identified 20 participants via personal and professional networks on LinkedIn that covered diverse experiences and views based on (a) gender, (b) location, (c) years of work experience, and (d) roles assumed in software projects (cf. Table 1). Seven participants were successfully recruited for this study. All of them confirmed that they have current and past experience with stakeholder identification/analysis (see Q1 in our interview guide in Table 2).

3.2 Data collection

We conducted and recorded the interviews in English via Zoom. Interviews took 45-60 minutes to complete. Each interview started with the introduction of the following two definitions:

"A *stakeholder* is an individual or organization [with] a right, share, claim or interest in a system or in its possession of characteristics that meet their needs and expectations" [15].

An *indirect stakeholder* is a stakeholder that does not operate or use a system directly but is affected by its operation or the consequences arising from its operation.

The interviews were conducted based on the interview guide depicted in Table 2. Each interview was divided into four parts and comprised a total of 16 questions. In the first part, we asked participants about their professional backgrounds. The second part presented participants with a case study in the form of the aforementioned New York Times article about the real-world implications of a facial recognition system [11]. Participants were asked to discuss the relevance of identifying indirect stakeholders, and how they would approach it in the given case study. In part 3 participants were asked to give an example of when and how they identified indirect stakeholders in a project of their own. The final part consisted of follow-up questions aimed at discussing available information and methods for identifying indirect stakeholders, ethical implications, and potential inhibitors.

3.3 Data analysis

A thematic analysis [5] was performed by one author based on hand-written notes taken down during the interviews and audio recordings that were used to review and complete the notes. The collected data was then entered into a spreadsheet which helped to leverage the structure provided by our interview guide during the analysis. Answers were analyzed on a per-question-basis first, before similarities across all collected data were identified and coded. Themes were then formed based on these codes. See Table 3 for examples.

4 STUDY RESULTS

4.1 Theme 1 - Indirect stakeholders need to be better addressed (RQ1)

Six out of seven participants confirmed that the problem of indirect stakeholder identification needs to be addressed with respect to the provided case study and Question 14. Participant D stressed that the identification of indirect stakeholders is crucial in their industry, while both, participants C and D, also indicated that their customers are typically aware of indirect stakeholders and omitting them may lead to incomplete requirements and expensive change requests. Moreover, participant G pointed out a 'race against the clock' as a serious problem because the impact of many new technologies on society is not well understood.

4.2 Theme 2 - Social, economic and technical aspects affect stakeholder identification (RQ2)

A number of comments referred to the influence of software engineering culture on the identification of indirect stakeholders. Participant G said that indirect stakeholders are often forgotten for the sake of technology. G continued that the software industry is revenue driven (economic aspect) and focuses on building capabilities (technological output), while also stressing that software professionals should consider the environment and inclusiveness more (societal outcomes). G provided an example of the impact of e-cars on car mechanics that either lose their jobs or need to be

Table 1: Professional backgrounds of the participants of this study

Participant	Role	Software Categories	Industries
A (female)	Requirements engineer	Enterprise software, global information systems	Telecommunications
B (male)	Requirements engineer, project manager	Safety-critical systems, satellite communication systems	Telecommunications
C (male)	Business analyst	B2C applications	Telecommunications
D (female)	Business analyst lead	Web/mobile apps	Finance, insurance
E (male)	Business analyst, project manager, integration consultant	Web/mobile apps	Healthcare, CRM, HR, automotive, gaming
F (male)	Systems engineer, project manager	Satellite communication systems incl. navigation, communication and earth observation	Telecommunications, space & defense
G (male)	Product manager	Embedded systems, visual modelling tools, cyber security tools	New markets, incl. automotive, industrial and aviation
Total # of Participants 7 | Europe (Luxembourg, Belgium, Germany) 3 | Indo-Pacific (Australia, India) 3 | North America (US, Canada) 1			
Work experience in years min = 3 | max = 30 | avg = 11.86			

Table 2: Interview guide

Part I – Professional experience
1. Is stakeholder identification/analysis part of your work?
2. In what role did you gain the most experience in this area?
3. How many years of experience do you have in this role?
4. In which country/countries did you work in this role?
5. What type of software system did you work on in this role?
6. Which application domain(s) were involved in this role?

Part II – Provided case study
   Please review the provided article [11] and consider
7a. What role stakeholder identification plays in this case.
7b. How you would identify indirect stakeholders in this case.
7c. What methods, techniques or tools you would use.

Part III – Participant-provided example
8a. Can you give an example of how you have identified indirect stakeholders of a disruptive technology in a project?
8b. What indirect stakeholders did you identify?
8c. What methods, techniques and tools did you use?

Part IV – Follow-up questions
9. Are you aware of industry standards, guidelines or similar for identifying indirect stakeholders?
10. When identifying indirect stakeholders. Do you consider human values and needs [18]? If yes, which and how?
11. Do you consider the technical characteristics of disruptive technologies and their implications when identifying indirect stakeholders?
12. Do you raise awareness of the (ethical, legal, other) implications of technology on society at large or specific groups/indirect stakeholders to your customers?
13. In your experience, are customers aware of / or concerned with indirect stakeholders and their values and needs?
14. Do you consider missing indirect stakeholders a problem? If yes, is this problem communicated to your customers?
15. What inhibits the identification of indirect stakeholders in your experience?
16. Is there anything else you would like to add?

retrained to obtain an entirely new skill set required for repairing such cars. Participant A gave an example of disregard for social aspects of software systems by talking about a case when technical experts rejected her 'academic' needfinding methods.

Several participants indicated that they raise awareness of ethical issues that may impact indirect stakeholders with their customers. In this context, participant C expressed that this is a journey not a destination, which means that project constraints typically impact on if and how ethical aspects are addressed. Participants C and D who work in more strictly regulated industries indicated that their customers are typically aware of ethical implications, especially in the form of privacy, fraud, and infosec concerns.

Participant G concedes that inclusiveness is expensive and related ethical considerations need more attention. Participant F argues that the involvement of indirect stakeholders is often not realistic given prevailing project constraints. He believes that government organizations should defend/protect people but concedes that some communities do not have strong representation. F referred to the George Floyd case in the US as an example and mentioned the Matthew Effect [24] which states that those who have a lot will receive more, while those with little often miss out.

4.3 Theme 3 - Lack of readily available methods and tools (RQ3)

The majority of participants stated that they are not aware of available industry standards or guidelines for the identification of indirect stakeholders. Participant C said that it is not always possible to develop a holistic picture (including indirect stakeholders) and that a set of guidelines would be highly beneficial. Some participants suggested potential sources such as ITIL v3, 6Sigma, BABOK, the Systems Engineering Handbook, and Google AI guidelines [1, 10, 12, 13, 22]. After reviewing them, we can conclude that none discusses concrete relevant methods and tools. The Google AI guidelines come closest by suggesting the avoidance of bias.

A number of methods and tools were mentioned during the interviews. Most prominently, brainstorming, meeting, scenarios, user stories, customer journey, personas, stakeholder mapping, stakeholder interviews/snowballing, and 5-Why. None of them are

tailored to the identification of indirect stakeholders and thus do not address contextual, social and environmental aspects essential for the creation of a deeper understanding and consequently, the identification of indirect stakeholders. Some methods are even unsuitable. For example, meetings and interviews are only possible after indirect stakeholders have been identified. Meetings and interviews with known stakeholders may, however, not reveal indirect stakeholders in the first place.

4.4 Limitations

The sample size is very small and limited in its representativeness, e.g. we did not interview professionals who assume UX roles in modern SE teams. The sample size also affects saturation. However, given the observed convergence of sentiment across all participants, we intend to extend our study based on a Grounded Theory [21] approach and conduct future iterations with refined sets of questions. The selected case study may bee seen as a source of bias in this study. The case and thus the underlying article was a deliberate choice because (i) it is topical, (ii) relates directly to societal risks of software and (iii) discusses the incident in sufficient depths, e.g. mistakes during development and user errors are mentioned. In fact, there is no direct mentioning of the term stakeholder. Finally, we used a structured interview format and did not mix up the order of some parts to reduce bias. We also did not ask participants to clarify or give feedback on the data analysis as it emerged.

5 ROADMAP

5.1 Study of social, economic and technical dependencies

As software engineers, our ultimate goal is the creation of methods and tools that enable practitioners to work more effectively and efficiently, in particular, given the obvious lack of methods and tools for the identification of indirect stakeholders (cf. Theme 3). However, delving straight into the creation of such methods and, especially, tools seems ill-advised given the complex environment of interdependent social, economic and technical aspects. There are deeper reasons for the observed lack. If we fail to understand them, we may not be able to identify suitable approaches and to evaluate them in realistic industry settings. Our research outputs may fail to address real-world needs and thus may simply not be used, leaving us without data and practitioners empty-handed.

In other words, a culture shift away from a technology-centric worldview is required. We propose the *multidisciplinary* exploration of the problem space discussed by Theme 2. We need to better understand, for example (i) if and why customers and practitioners omit indirect stakeholders, (ii) what social (e.g. personality, cultural diversity or team-internal/team-customer dynamics) and economic (e.g. budget, time and resource constraints) factors play a role in technical decision making and (iii) what indirect stakeholders are relevant/critical in specific contexts from a societal perspective. Theories and methods from the social sciences such as the Soft Systems Methodology (SSM) [6] may play a crucial role in enriching indirect stakeholder identification practices. This exploration effort will complement Barry Boehm's Value-Based Software Engineering [3] approach and contribute a specific perspective on the values and needs of indirect stakeholders.

5.2 Raising awareness for indirect stakeholders

After having gained a better understanding of the current situation, the next step is to develop training materials to raise awareness among industry practitioners and to enable industry practitioners to incentivize their customers to consider indirect stakeholders. We anticipate this work to be a bottom-up (practice-driven) approach that complements existing top-down (theory-driven) approaches from, for example, the human values in SE and ethical AI domains. Knowledge accumulated in the previous step will help to select suitable theories from the social sciences and economics, including game-theoretical approaches, and to apply them to the creation of training material.

5.3 Development of lightweight guidelines

Theme 1 confirms that indirect stakeholders are frequently overlooked. A mix of time and budget constraints, and customer expectations dictate how much time is dedicated to developing a complete picture of the situation that a software system will address. As much as these limitations are unavoidable, a lack of practical methods and tools forms a major barrier for improving the current situation as Theme 4 suggests. Practitioners are unlikely to include indirect stakeholders in their considerations unless they have effective tools at their disposal that do not decrease their productivity. We plan to develop a set of lightweight industry and technology-specific guidelines and checklists to enable practitioners to take the first step towards identifying indirect stakeholders of their systems.

5.4 Development of a visual modelling tool

Theme 3 shows that ethical issues can arise due to conflicting customer expectations and stakeholder needs. Regulatory compliance concerns seem to compel customers to consider indirect stakeholders and their needs. Non-regulated aspects receive less attention. While the majority of participants indicated that they raise awareness of ethical issues around indirect stakeholder needs, none of them mentioned an effective method or tool to do so. Methods and tools to help practitioners identify and communicate ethical issues that related to indirect stakeholders can help streamline and simplify potentially difficult conversations with customers. We plan to complement above guidelines with a visual modelling notation and tool to enable practitioners to visualize and document identified indirect stakeholders and their needs in a manner that (i) simplifies the communication of such findings to their customers and (ii) integrates with agile tools such as user stories and epics.

5.5 Development of a review method

Software systems that incorporate disruptive technologies often affect the lives of diverse groups of indirect stakeholders. Although people, society, the environment and related circumstances change over time, we have not identified an approach that stipulates a structured review of software systems with respect to how they adjust to changing indirect stakeholder groups and how they meet the values and needs of these indirect stakeholders on an ongoing basis. We plan to address this gap such that practitioners have effective means for regular reviews of the impact of software systems on indirect stakeholder groups.

Table 3: Examples of the thematic analysis of interview answers

Raw Data/Answers	Code	Theme
Q9 Are you aware of industry standards, guidelines or similar for identifying indirect stakeholders?		
"Stakeholders are often forgotten for the sake of technology."	SE culture constraint	Social, economic and technical aspects limit indirect stakeholder identification
Q13 In your experience, are customers aware of / or concerned with indirect stakeholders and their values and needs?		
Customers are not aware. "They focus on financial aspects that have clear priority."	Economic constraint	"　　　"　　　"
Q15 What inhibits the identification of indirect stakeholders in your experience?		
Lack of clarity and lack of communication.	Social constraints	"　　　"　　　"
"A holistic view is not always possible" [in terms of complexity]. The participant indicates that a set of *guidelines would be beneficial.*	Technical constraint Tools unknown	"　　　"　　　" No readily available methods and tools

6　SUMMARY

This paper presents the initial results of a qualitative interview-based study of software professionals aimed at understanding the state-of-practice of indirect stakeholder identification in the software industry. Our findings confirm that indirect stakeholders are often overlooked, which can have potentially serious consequences especially due to the ongoing expansion of disruptive technologies such as AI into areas where they increasingly affect people who do not interact directly with, or are unaware of the effects of, a software system. We outline a roadmap for the creation of practical methods and tools to help practitioners identify indirect stakeholders without constraining their productivity. We believe it is essential to acknowledge immediate causes such as project constraints, customer expectations and the prevailing technology-centric SE culture and to design and evaluate methods and tools in close collaboration with industry, leveraging design thinking methods and co-design activities.

ACKNOWLEDGMENTS

REFERENCES

[1] Simon Adams, Alison Cartlidge, Ashley Hanna, Stuart Rance, and John A. Sowerby. 2008. *ITIL V3 Foundation Handbook.* Stationery Office Books, London, UK.
[2] Bernd Aschauer, Peter Hruschka, Kim Lauenroth, Markus Meuten, and Gareth Rogers. 2018. *Handbook of RE@Agile According to the IREB Standard.* IREB.
[3] Barry Boehm. 2006. Value-Based Software Engineering: Overview and Agenda. In *Value-Based Software Engineering*, Stefan Biffl, Aybüke Aurum, Barry Boehm, Hakan Erdogmus, and Paul Grünbacher (Eds.). Springer, Berlin Heidelberg, 3–14.
[4] Pierre Bourque and Richard E. Fairley (Eds.). 2014. *Guide to the Software Engineering Body of Knowledge Version 3.0.* IEEE Computer Society.
[5] Virginia Braun and Victoria Clarke. 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology* 3, 2 (2006), 77–101.
[6] Peter Checkland and John Poulter. 2010. Soft Systems Methodology. In *Systems Approaches to Managing Change: A Practical Guide*, Martin Reynolds and Sue Holwell (Eds.). Springer in association with the Open University, London, UK.
[7] Stacey Cowley. 2021. *Racial Bias Skewed Small-Business Relief Lending, Study Says.* New York Times. Retrieved January 30, 2022 from https://www.nytimes.com/2021/10/11/business/ppp-loans-covid-racial-bias.html
[8] Elizabeth Fernandez. 2020. *Who Is Responsible In A Crash With A Self-Driving Car?* Forbes. Retrieved January 30, 2022 from https://www.forbes.com/sites/fernandezelizabeth/2020/02/06/who-is-responsible-in-a-crash-with-a-self-driving-car/?sh=5fb004584b2b
[9] Batya Friedman and David G. Hendry. 2019. *Value Sensitive Design: Shaping Technology with Moral Imagination.* MIT Press.
[10] Google. 2022. *Google AI principles.* Google. Retrieved January 30, 2022 from https://ai.google/principles/
[11] Kashmir Hill. 2020. *Wrongfully Accused by an Algorithm.* New York Times. Retrieved January 30, 2022 from https://www.nytimes.com/2020/06/24/technology/facial-recognition-arrest.html
[12] IIBA. 2015. *A Guide to the Business Analysis Body of Knowledge, 3rd Edition.* International Institute of Business Analysis.
[13] INCOSE. 2015. *Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities, 4th Edition.* John Wiley & Sons, New York, NY, USA.
[14] International Standard Organization (ISO). 2017. *ISO/IEC/IEEE 12207:2017 International Standard – Systems and software engineering – Software life cycle processes.* ISO, Geneva, Switzerland.
[15] International Standard Organization (ISO). 2018. *ISO/IEC/IEEE 29148:2018, International Standard – Systems and software engineering – Life cycle processes – Requirements engineering.* ISO, Geneva, Switzerland.
[16] Carla Pacheco and Ivan Garcia. 2012. A systematic literature review of stakeholder identification methods in requirements elicitation. *Journal of Systems and Software* 85 (2012), 2171–2181. Issue 9.
[17] Fred Schulte and Erica Fry. 2019. *Death By 1,000 Clicks: Where Electronic Health Records Went Wrong.* Kaiser Health News. Retrieved January 30, 2022 from https://khn.org/news/death-by-a-thousand-clicks/
[18] Shalom H Schwartz. 2012. An Overview of the Schwartz Theory of Basic Values. *Online readings in Psychology and Culture* 2, 1 (2012), 1–20.
[19] SEBoK Editorial Board. 2021. *Guide to the Systems Engineering Body of Knowledge (SEBoK).* BKCASE Governing Board. Retrieved January 30, 2022 from https://www.sebokwiki.org/wiki/Guide_to_the_Systems_Engineering_Body_of_Knowledge_(SEBoK)
[20] Ian Sommerville. 2016. *Software Engineering* (10th ed.). Pearson, Harlow, UK.
[21] Klaas-Jan Stol, Paul Ralph, and Brian Fitzgerald. 2016. Grounded Theory in Software Engineering Research: A Critical Review and Guidelines. In *Proceedings of the 38th International Conference on Software Engineering (ICSE '16).* Association for Computing Machinery, New York, NY, USA, 120–131.
[22] P.A. Keller T. Pyzdek. 2014. *Six sigma handbook: a complete guide for green belts, black belts, and managers at all levels, 4th Edition.* McGraw-Hill Education, New York, NY, USA.
[23] Jon Whittle, Maria Angela Ferrario, William Simm, and Waqar Hussain. 2021. A case for human values in software engineering. *IEEE Software* 38, 1 (Jan 2021), 106–113.
[24] Wikipedia. 2022. *Matthew effect.* Wikipedia, The Free Encyclopedia. Retrieved January 30, 2022 from https://en.wikipedia.org/wiki/Matthew_effect
[25] Till Winkler and Sarah Spiekermann. 2021. Twenty years of value sensitive design: a review of methodological practices in VSD projects. *Ethics and Information Technology* 23, 1 (2021), 17–21.
[26] Daisy Yoo. 2021. Stakeholder Tokens: A constructive method for value sensitive design stakeholder analysis. *Ethics and Information Technology* 23, 1 (2021), 63–67.