



Using Theory of Change to evaluate the role of stakeholder engagement towards socially desirable outcomes in ICT research projects

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Abstract:

Information Communication Technologies (ICT) research projects are important in generating breakthrough technologies that translate into solutions for numerous societal grand challenges through research and innovation (R&I). However, to ensure that such solutions are socially desirable, there is a concerted drive for the engagement of different stakeholders, including industry, academia, public and government. In the face of the growing recognition of stakeholder engagement in ICT research projects, particularly as part of Responsible Research and Innovation (RRI), there is a limited discourse on how its consequence could be evaluated. This paper suggests and uses a Theory of Change approach to evaluate the value of stakeholder engagement on the attainment of socially desirable and responsible outcomes in projects, particularly ICT research projects. Using a multi-case study approach, the paper appraises the value of stakeholder engagement in ICT research projects by elucidating the linkages between stakeholder activities and socially desirable outcomes. The findings from the paper could apply to other types of projects apart from ICT research projects in understanding some of the roles stakeholders play in ensuring responsible innovation as an outcome of the projects.

Keywords:

evaluating stakeholder engagement; ICT research projects; theory of change; responsible innovation; socially desirable outcomes.

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1. Introduction

In an increasingly complex world, it has now become imperative for research and innovation initiatives that aspire to change society, to have a ‘theory’ of how this change will happen. These initiatives more often are pushed forward through projects. Every project or initiative is based on at least one assumption or hypothesis. Such an assumption or assumptions make a ‘theory’ of change. Projects or initiatives that aim for a socially responsible implementation involve different stakeholders in the research, development or implementation of innovation. Such projects include those focused on Information Communication Technologies (ICTs). ICT research projects are important in generating breakthrough technologies that translate into solutions for societal grand challenges. With the engagement of different stakeholders, including industry, academia, the public and the government, the solutions are expected to be socially acceptable and desirable. It has been suggested that stakeholder engagement plays an important role in encouraging responsible outcomes of research and innovation (R&I) [1]–[3]. Despite the growing recognition of stakeholder engagement in ICT research projects, particularly as part of Responsible Research and Innovation (RRI) there is limited literature to indicate how its value can be evaluated. There is a need to understand its worth to effectively support and improve activities in R&I, particularly concerning the attainment of socially desirable outcomes. Thus, this paper addresses the research question; how can we evaluate the merit of stakeholder engagement in attaining socially desirable outcomes in ICT research and innovation projects?

Looking through the literature, there are no set models for evaluating stakeholder engagement in this regard as suggested by Smith [4]. This means that when it comes to practical fieldwork, there is not much for practitioners to base the evaluation strategy or use a guide for effective and straightforward evaluation. For example, Mark et al. [5] point out the lack of approaches or a combination of approaches that could be used in evaluation especially in social sciences and qualitative evaluations [4], [6]. Considering such suggestions relating to approaches of qualitative nature, the use of a Theory of Change, as suggested in this paper works towards addressing that gap.

There are not many approaches that are directly geared towards the evaluation of the merit of stakeholder engagement in ICT research projects. Hence, this paper proposes using a theory-based evaluation approach called the Theory of Change. As such, the paper contributes to theory and practice by enhancing analytical skills for mapping the role and merit of stakeholder engagement in supporting the attainment of responsible outcomes in ICT research projects using a Theory of Change. The paper starts by providing a theoretical background on stakeholder engagement and evaluation. This is then followed by an introduction of the method that was used to inform the present paper before discussing the findings from a multi-case study. The results and discussion of the findings include a Theory of Change for stakeholder engagement in the five case projects that were used in the study.

2. Background

2.1 Stakeholder engagement and RRI

Stakeholders are vital in ICT research projects because of their various contributions towards the implementation of research and innovation processes. The concept of a stakeholder has been covered by many authors in different disciplines such as project management and business strategy [7], [8] and concertedly, they emphasize the relevance of stakeholders in making important decisions within an entity such as a project. Historically, stakeholder concepts were inherent in the early work of system theorists, but it was a seminal publication from Freeman [9] through his contribution to stakeholder theory that brought the stakeholder concept to the forefront of academic research [10]. Freeman introduced the concept of stakeholder in a way that shifted beyond the shareholder-centric view of organisations and therefore defined, a stakeholder as ‘any group or individual who can affect or is affected by the achievement of the objectives’ [9, p. 46] of a particular subject such as a project or R&I.

From a responsible research and innovation perspective, stakeholders include groups or individuals such as researchers, funders, local authorities, industry players, end-users and civil society organisations (CSOs). These stakeholders are critical for the success of the R&I [11]. This line of reasoning is usually referred to as instrumental stakeholder theory [12]. Basically, instrumental stakeholder theory provides a basic rationale for stakeholders to be engaged in R&I so that

they contribute towards its direction in relation to certain aspects that affect its success such as finance, procedures and policy [12, p. 65] and the development of artefacts through processes such as user testing [13]–[15]. Of late, there has been a wave of literature on the engagement of stakeholders to contribute towards responsibility in research and innovation in projects under the notion of Responsible Research and Innovation (RRI) [16]–[19].

The notion of RRI emerged as a policy discourse at European Union (EU) level around 2011, underpinning key policy strategies and cutting across the Horizon 2020 work programme, which defines tackling societal challenges as one of its main priorities. RRI has emerged as an approach that aims to enhance the integration of science in society, specifically regarding the alignment of research processes and outcomes with the values, needs and expectations of society. There are a variety of definitions that exist in the academic discourse on RRI, and they share several aspects including an emphasis on the dimensions of anticipation, stakeholder inclusion, reflexivity and responsiveness [20]. Therefore, drawing on the review of the literature on RRI and a variety of definitions of RRI, a conclusion can be made that RRI in ICT research projects can be characterised by having stakeholder engagement with a focus on addressing societal needs and challenges. The stakeholder engagement supports ensuing research and innovation processes within ICT projects that actively engage and respond to a range of societal needs. Thus, stakeholder engagement facilitates a combined effort to anticipate potential problems, identify alternatives, reflect on underlying values and having a willingness from relevant stakeholders to act and adapt accordingly [21, p. 1164].

As such, stakeholder engagement as part of RRI is important in ICT research projects for the following reasons. Firstly, it can contribute to raising the level of discussion from an individual level to a collective or societal level aimed at considering both societal needs and implications of the project's outputs and outcomes for society [18]. Secondly, stakeholder engagement allows stakeholders to take a step back to illuminate and reflect on the underlying values that are important in ICT research projects [22], [23]. Thus, it could be claimed that stakeholder engagement can be useful in identifying, assessing and deliberating on issues that need to be reflected upon within ICT research projects.

2.2 Importance of ICT research projects

With growing societal issues, there is always a need for innovative solutions that can address them. For these solutions to materialize, ICT research projects are drivers for the ideas and processes that bring them about. In ICT research projects, new enabling artefacts and applications are emerging, which have the potential to improve society and address some of the pressing societal challenges met by society nowadays [24]. These novel technology artefacts will continue to play an important role in responding to major societal challenges such as an ageing population, health and social care, sustainable energy, inclusion, education and security. The importance of ICT research projects has been acknowledged by governments and many scholars [24]–[27]. For example, the EU has stated that ICT research is important because it enables mastering and shaping the future developments of ICTs so that the demands of society are met. In the same light scholars has pointed out the importance of ICT research projects in the development of these technologies. Some scholars have acknowledged the importance of ICT research projects in improving society wellbeing [28], economy [29], health [25], productivity [30] and of late they have been a surge of ICT research projects that are directed towards creating a sustainable environment [27], [31]. On top of this, the outcomes and outputs from these projects have an impact on social behaviours, democratic processes, economy and policies [24]. Therefore, considering the motivation of this paper, ICT research projects provides a readily available arena to explore and understand how stakeholder engagement contribute towards socially desirable outcomes in R&I.

2.3 Understanding the value of stakeholder engagement

Considering the discourse on the role of stakeholder engagement in ICT research, it is pertinent to understand its value. However, there are not many approaches that are directly geared toward such an endeavour. Hence, this paper used a theory-based evaluation approach called the Theory of Change. In general, evaluation is about generating knowledge about a phenomenon [5], that could be used for learning and improvement [5], [32]. The phenomenon or subject being evaluated is sometimes referred to as an evaluand [4]. In this paper, the evaluand is the value of stakeholder engagement in ICT research projects with regards to the attainment of socially desirable outcomes. There is a lot said about the purpose of evaluation in research projects including those related to ICT. For example, some have suggested that evaluation may be used to pose certain questions on the relative merit of a specific aspect of R&I in projects [33]. Also,

it may be used to ascertain the difference an evaluand such as stakeholder engagement is going to make, for example in R&I or society [34], [35]. Besides, evaluation can also be used to assess society's learning, change of behaviour and success towards specified goals in ICT research projects [36]. In a nutshell, 'evaluation provides evidence that an evaluand such as stakeholder engagement has achieved a particular end' [33, p. 12].

2.4 Theory of Change

One approach to evaluation is the theory-based approach (TBA) [37], [38]. There are numerous strands of TBA and their discussion is outside the scope of this paper [39], [40]. That said, this paper uses one of the strands of TBA called a Theory of Change. The basis for the theory-based approach is that the assumptions and beliefs that are fundamental to an evaluand such as stakeholder engagement can be expressed in terms of a series of causes and effects [39]. Theory of Change is defined in several ways. For instance, Weiss [39] defines a Theory of Change as 'a theory of how and why an initiative works' [40, p. 502]. On the other hand, Kubisch and Connell [41] define it as 'a systematic and cumulative study of the links between activities, outcomes, and contexts of the evaluand' [41, p. 2]. Recently, Rogers [42] defined a Theory of Change as 'an explanation of how activities are understood to produce a series of results that contribute to achieving the final intended impact' [42, p. 1]. The cross-cutting theme in these definitions indicates that the Theory of Change can be used to evaluate stakeholder engagement by determining its intended outcomes, the engagement activities expected to achieve those outcomes and the contextual factors that may affect the implementation of activities [43, p. 2].

Therefore, Theory of Change as a theory-based approach helps us understand how stakeholder engagement contributes towards an intended change or outcome. Using a Theory of Change, the evaluation not only shows how much change has occurred as a result of a project but also tells how the change occurred, therefore, highlighting areas along the line where there are failures affect the intended outcomes [41], [44], [45]. Nonetheless, a drawback of using a Theory of Change is the inability of many stakeholders to make plausible and non-contentious assumptions about linkages between their engagement activities and outcomes [46]. The feasibility of the Theory of Change is determined by the capacity of the project's stakeholders and evaluators to identify, prioritize, and then assess the key activities and contextual factors. In most cases, evaluators and stakeholders tend to look back on the evaluand and then construct convincing tales of why an outcome materialized or not.

In general, Weiss [39] and Nakrošis [47] mentions that a Theory of Change aims to describe the actual mechanisms that relate to desirable outcomes. For example, as an assumption, if stakeholder engagement is associated with increased ethical consideration in R&I within ICT research projects, the mechanism may be the 'consultation' and linkages might be the 'knowledge' and 'awareness' that the consultation provides. This kind of cause-and-effect process and the description of the mechanisms and their related outcomes are normally illustrated through the construction of models that depict how an evaluand (stakeholder engagement) work and they are used to guide the formulation of evaluation knowledge [39], [45], [48]. The Theory of Change facilitates a segmental approach in understanding the different elements of stakeholder engagement to get a full picture at the end of the process. Thus, using a Theory of Change draws attention to the key areas to focus on in evaluating stakeholder engagement in ICT research projects when it comes to producing socially desirable outcomes.

2.5 Evaluating stakeholder engagement using the RRI lens

Although extensive research has been carried out on the evaluation of stakeholder engagement in many contexts of research projects including those involved with ICT [49]–[51], no single study exists which specifically looks at the evaluation of stakeholder engagement through the lens of RRI. The RRI lens is informed by different accounts of RRI [17], [18], [20] and provide a starting point for incorporating RRI into evaluation. In these different accounts of RRI, there are cross-cutting key conceptual features that give a concerted picture of what could be regarded as socially desirable in ICT research projects.

These key conceptual features include:

- Engagement of stakeholders: ensures an acceptable and socially desirable production and uptake of the outputs and outcomes of ICT research projects in society, diverse views from stakeholders should be considered [18, p. 11].
- Openness and transparency: involves a balanced and meaningful discussion of research and its implications in order to facilitate stakeholders' understanding and examination of R&I that exists in ICT research projects [17].
- Anticipation and reflection: involves deliberating on assumptions and values underpinning R&I in support of anticipation [18, p. 13].
- Responsiveness: encourages the sensitivity to the unfolding of a diversity of value positions and the absence of a consolidated knowledge for responsible innovation processes and practices Stilgoe et al. [20].

Evaluating stakeholder engagement by using the RRI lens is necessary to understand how stakeholder engagement plays a role in the attainment of socially desirable and acceptable outcomes in ICT research. This will help in improving the implementation of responsible innovation in ICT research. Evaluating stakeholder engagement in light of RRI provides a reflection point for both theory and practice.

As pointed earlier in this paper, RRI in ICT research projects ensures that R&I activities and outcomes should be acceptable and desirable and one way of achieving such goals is by engaging stakeholder engagement to address the grand societal challenges that concern society. This then raises a need for understanding and assessing whether, and in what way the stakeholder engagement is likely to address these grand societal challenges. Many scholars [6], [52], [53] hold the view that evaluation provides an understanding of stakeholder engagement in research projects and the outcomes that result from it. Proportionately, evaluating stakeholder engagement within the context of RRI may be useful for understanding the outcomes that relate to the attainment of responsible outcomes and support framing stakeholder engagement in ICT research projects.

3. Method

3.1 Case study approach

The paper used a case study approach because it was ideal for investigating stakeholder engagement that exists in a 'real-life context within a boundary' [54, p. 23] which are the ICT research projects used as cases. The case study strategy was also ideal because it gave the participants (stakeholders) an authoritative and in-depth explication of their views on how they think or interpret their engagement in ICT research projects in light of responsible research and innovation without the researcher's control. Although the case study strategy is considered ideal, one of the argument against its use is that the findings from the case studies cannot be generalised to other contexts [55]. This was nevertheless addressed by using five cases [54] which are identified in Table 1 below. The five case projects have a variety of contextual factors for stakeholder engagement, and therefore findings could be applied to other ICT research projects that are related. Also, the issue with reliability and validity of findings from case studies [56, p. 123] was addressed by combining data sources. The data was sourced from documents, questionnaires and semi-structured interviews with participants from the case projects.

Table 1 describes the sample of the cases that were considered for the case study based on purposive sampling. Five projects out of the 10 were purposely selected to be part of the case study based on their accessibility. The selected cases were Projects D, E, F, G and I. Most importantly, the cases were selected because the contextual conditions of the cases were similar and pertinent to understanding the phenomenon under inquiry which was the role of stakeholders in ensuring that their aims were responsibly achieved. Also, these cases were selected for literal replication [57], that is, there were selected to predict similar results.

Table 1: Description of the cases

Project	Social Challenge	Aim	Accessibility
A	Health	To improve the communication channels and social connections of children with a degenerative disease through the use of Brain and Neural Computer Interface (BNCI)	No
B	Health	To link Brain/Neural Computer Interaction (BNCI) technologies with other novel and emerging types of ICTs. to develop technologies that would support severely disabled users	No
C	Health	To establish how ICT can be used for patients suffering from a chronic organ-related condition	No
D	Environmental degradation	To use ICTs to support environmental sustainability through energy optimization	Yes
E	Gender/ Education	To foster gender inclusivity in STEM subjects such as ICT	Yes
F	Education	To determine and improve the use of ICT in transforming education provision in secondary schools	Yes
G	Health impairment	To use ICT to improve hearing aid technologies	Yes
H	Health impairment	To exploit ICT and other technologies in assessing and treating the Autistic Spectrum Disorder in children in a more "natural" home environment where non-obtrusive techniques will be used	No
I	Environmental degradation	To use ICT in developing a dynamic traffic management system to improve air quality	Yes

3.2 Data collection and analysis

Data were collected in two phases and was analysed following an interpretivist viewpoint. This means the paper views social reality as embedded within social settings such as projects and that reality can be interpreted from subjective opinions, views and values rather than a hypothesis testing process [58].

The first phase involved 20 semi-structured interviews with purposively selected key stakeholder informants and then there was a follow-up phase which involved a further eight semi-interviews with a sample of key stakeholder informant from the first phase. Also, 50 evaluation questionnaires were given to different stakeholders that were in the case projects to understand their experiences. Documents such as project reports and web pages were also used to understand the context of the stakeholder engagement.

This paper used a hybrid thematic data analysis. With the hybrid thematic data analysis, codes were developed both inductively and deductively in Nvivo. The hybrid approach deductive codes shown in Table 2 below were used to give the researcher a starting point for the coding process. The high-level deductive codes were determined based on stakeholder theory and RRI literature.

Table 2: High-level deductive codes

Code label	Column A
Nature of engagement stakeholder	The form and type of stakeholder engagement activities conducted by the stakeholders that were engaged in the ICT research projects.
Rationale for engaging stakeholders	The reason and motive for engaging the stakeholders in the ICT research projects. This includes a look at their role in the research process.
Outcomes of stakeholder engagement	The results for engaging the stakeholders in the projects, particularly those that would relate to RRI
Context of stakeholder engagement	The circumstances that form the setting for the stakeholder engagement in the ICT research projects. These circumstances are those which can be fully understood and assessed.
Stakeholder identification	The process and identification process aspects of the stakeholders
RRI application	The relevance of the key RRI features as developed in the RRI literature.

Once the deductive codes were established, based on a predefined coding frame [59], they were then applied to the text in transcripts to identify meaningful fragments of text. Through an iterative cross-case data analysis, inductive codes emerged from the data that was collected through the interviews emerged. Analysis of the text at this stage was guided, but not confined, by the predefined codes. During the coding of transcripts, inductive codes were assigned to segments of data and categorised to describe a new theme observed in the text [60, p. 9]. The themes then informed the construction of a Theory of Change for stakeholder engagement in the case projects.

4. Results and discussion

This section presents a discussion of the results from a cross-case analysis of the five individual case projects including Project D, E, F, G and I. The results, analysis and discussion inform the Theory of Change for the value of stakeholder engagement in the attainment of socially desirable outcomes in ICT research projects. The section begins by presenting a construct depicting the Theory of Change in Figure 1 below and then it is followed by a discussion of the elements that are part of the Theory of Change. The Theory of Change is constructed based on the key elements for evaluating stakeholder engagement with reference to an application of RRI that were analysed using the deductive codes in Table 2 above.

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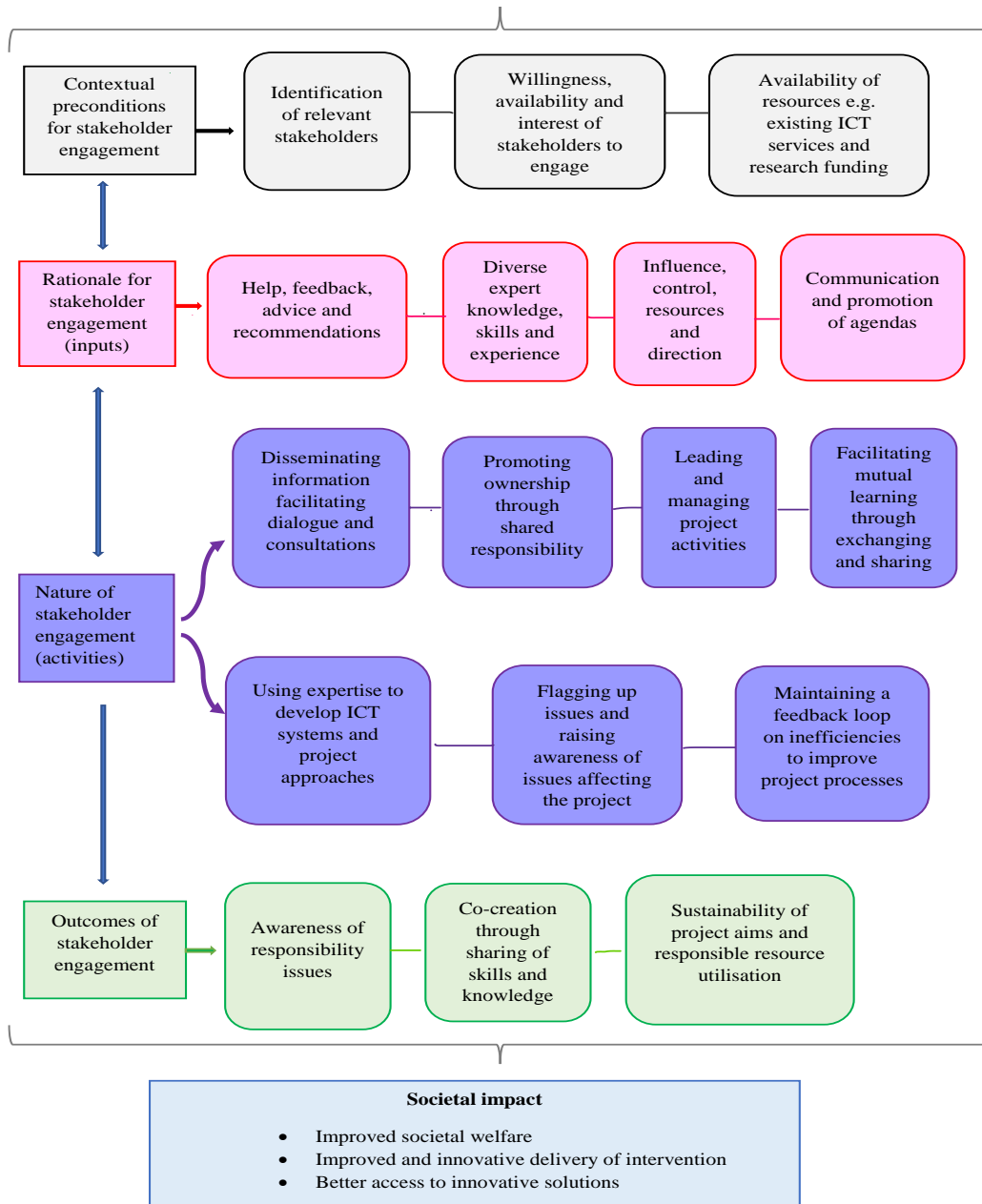


Figure 1: Theory of Change for Stakeholder engagement in ICT Research Projects

4.1 Key elements for evaluating stakeholder engagement

The elements for evaluating stakeholder engagement were realised from the theoretical and empirical insights to provide the analytical framework for constructing a Theory of Change (Figure 1). The Theory of Change was used in understanding the socially desirable outcomes of engaging stakeholders in the projects, project activities expected to achieve those outcomes and the contextual factors that influenced the activities. Thus, 17 cross-cutting themes emerged

from the five case projects. From these themes, five main common insights were derived, and they were termed key elements. The five key elements to consider when evaluating stakeholder engagement were contextual factors; identification of stakeholders; nature of stakeholder engagement; the rationale for stakeholder engagement and the outcome of stakeholder engagement. These will be discussed below.

4.1.1 Contextual factors

In all the five case projects contextual factors were very important for stakeholder engagement to be effective towards the attainment of socially desirable outcomes in the ICT research projects. This concurs with the suggestion by Connell and Kubisch [41] that contextual factors are likely to influence the effectiveness of stakeholder engagement activities and outcomes that result from those activities. As such, contextual factors are an important element to evaluate. The stakeholder engagement activities were taking place within a context of action, which was the ICT research projects. Therefore, as suggested by Stufflebeam and Shinkfield [61], it was essential to understand the different aspects of the context of action in which the stakeholder engagement was taking place. This was necessary because the lessons that were learnt from the five cases could be extrapolated to future project evaluation activities and stakeholder engagement efforts. Therefore, what was learnt in the five cases could be used to identify, prioritize, and then assess the key stakeholder engagement activities and contextual factors that are likely to influence a valuable engagement [41], [43], [44] towards the attainment of socially desirable outcomes in ICT research projects.

Principally, two main areas of focus under contextual factors emerged in all five ICT research projects and are discussed below.

4.1.1.1 Resources as an enabling factor

It was recognized that resources are a fundamental enabling factor that is necessary for stakeholder engagement to be effective. The availability of research resources was paramount in ensuring that the stakeholder engagement and its associated activities were effectively organized to carry out the scope of work that achieved beneficial change. For the stakeholder engagement to be of value, necessary resources (financial, human or material) for the stakeholders to come together and work towards specific aims were provided in some of the projects.

For example, in Project D, for the stakeholders to have a fruitful engagement, there was a provision of research funding and an existing ICT infrastructure to support the research on the ICT system that was being developed. In all five projects, the funding was accessed through research funding institutions and industry partners. In the case of the infrastructure, this was mainly important in three projects, Projects D, E and F due to the nature of their research. Also, for valuable stakeholder engagement, there was a requirement for human resources, which was crucial in ensuring that the process was efficient and effective towards achieving positive goals [62], [63].

4.1.1.2 Willingness to assume expected roles

Another important area was the uptake of expected roles by stakeholders that were engaged. Despite the expectation by the project sponsors and principal researchers to involve stakeholders that would assume different roles, sometimes the engagement was not as successful as would have been expected. From all cases, the two main issues were the appropriateness and willingness of the stakeholders to take up the different roles as part of their engagement. Core to these issues was a lack of interest by some identified stakeholders. Stakeholders that were expected to be highly engaged in the ICT research projects were prioritising other commitments. Therefore, to improve stakeholder engagement, perhaps it is necessary to make the engagement process more interesting and provide ample resources to support the stakeholder engagement process [64]. As a result, this could yield positive uptake of roles. Such positive examples of role uptake may include increased attendance of stakeholder engagement activities, providing timely feedback or constructive comments on progress and projects' deliverables.

4.1.1.3 Identification of stakeholders

The identification of stakeholders is essential for the effectiveness of the stakeholder engagement process because it helps the ICT research projects to achieve their aims by scoping which stakeholders will support the attainment of different outcomes [63], [65], [66]. In all the five ICT research projects, the identification of stakeholders for engagement was similar. The identification of relevant stakeholders for engagement was mainly based on two broad thematic categories, the process of identification and timing of the identification.

With regards to the process, in all five cases, stakeholders were identified based on existing networks. Stakeholders were mostly identified because there was someone who knew them either because of a past encounter or was known to have some experience or expertise that was relevant to the aims of the ICT research projects [66]. This was a trend in all the cases where stakeholders' experience or expertise was crucial in identifying the stakeholders to take up roles (as mentioned by Bryson et al. [63]). These roles were wide enough to include those who were actively involved in research in all five cases and those who were there to represent the public interests [65] for example, researchers and end-users.

In all the five ICT research projects, stakeholders were identified ex-ante [67, p. 24] that is, the stakeholder identification took place in advance. However, it also emerged that in some of them there was an ad-hoc identification of stakeholders that is, the identification took place as the project activities progressed. In Project I, stakeholders were only identified ex-ante, and none were identified during the research. Perhaps this was due to the nature of the research that was being undertaken in the research project. The research in Project I only needed to have the stakeholders identified at the beginning and be engaged throughout the whole R&I process until the final output and outcomes were achieved. This was contrary to Project D, G and F where the identification was happening iteratively at all stages of the research process as recommended by Reed and Curzon [67].

In all the five case research projects there was a wide range of stakeholders identified. From the data collected it could be seen that there were stakeholders who were identified because of their expert knowledge as scientists, researchers and project managers. Apart from expert knowledge, some stakeholders were identified because of their experiences. These stakeholders were engaged in the research projects to share their lived experiences, values and expectations in developing or implementing desirable ICTs [1], [68]. For example, Project G engaged teachers who were not experts in ICT but were capable of bringing rich knowledge that was necessary for the effective implementation of ICTs in secondary school education. The identification of a wide range of stakeholders was ideal for matching the users' expectations and the usability of the ICT systems that were being developed or implemented in the ICT research projects [69].

4.1.2 Rationale for stakeholder engagement

One noticeable thing was that the rationale for the engagement varied according to the stage of the project and the objectives that the research projects were trying to achieve at a respective stage [63]. From the analysis of the five cases, it was realised that the main rationale for stakeholder engagement is to bring together different stakeholders to embed anticipation and reflection into practice within the R&I processes to stimulate new ways of addressing societal challenges and therefore achieve socially desirable outcomes [1], [19], [72]. In the five cases, the rationale for stakeholder engagement included the following.

4.1.2.1 Consultation

Different stakeholders were brought together to consult on how the projects could address the societal challenge that each ICT research project was focusing on respectively. Corresponding to Bryson et al. [63], stakeholders were engaged so that they could provide feedback on the different aspects of the ICT research projects. Also, there was a consultation to raise awareness of the potential responsibility issues and how they affect society [18]. As an example, in Project D building users and researchers were engaged in consultative interactions throughout the whole R&I process to develop an ICT interface that was easy to use and understand. The consultation was either conducted during promotional activities at stakeholder engagement events or through the project's dedicated online forum. Similarly, in Project F, the

rationale behind stakeholder engagement was to have consultations with an aim to bring in different perspectives from the stakeholders who had different experiences and backgrounds [73].

Regarding the socially desirable outcomes, the consultation was very supportive towards realizing them in all the five ICT research projects because it facilitated inclusiveness in the research processes. The consultation afforded the anticipation of moral concerns about the research's intended outputs including issues with potential harm.

4.1.2.2 *Control and direction*

Some of the stakeholders were engaged to control and direct the research projects towards the attainment of their aims in a desirable way. The control and direction were dependent on the expertise, experience and background of the stakeholders. For example, in Projects I and F, for some of the stakeholders, their engagement predominantly was in the form of directing the research efforts towards managing the implementation of a methodology and coordination of different tasks. As a result of such coordination, there was a lot of co-creation and inclusion of different perspectives from those who were engaged in the project.

4.1.2.3 *Mutual learning*

The other rationale for stakeholder engagement was that stakeholders should learn from each other. Learning among the stakeholders was common in all five cases. From the findings, it was established that different stakeholders were engaged, on the one hand, to share their expertise and knowledge, and on the other, to learn things that they were not aware of, or had limited knowledge about before the engagement (see [20], [66]). For example, in Project G the rationale for stakeholder engagement was that different stakeholders from industry, academia and local authority combined their knowledge to come up with a solution for improving air quality using ICT. Similarly, in Projects D, G and F, the motive behind stakeholder engagement was to bring in stakeholders other than the experts to learn and get information on the issues that were affecting the society such as seclusion because of hearing loss, reduced education performance in secondary and high carbon dioxide (CO₂) emissions in buildings. These stakeholders learnt a lot through the dialogue (as mentioned by Blok [71]) that was taking place in the ICT research projects through fora, blogs and stakeholder engagement events. By being part of the dialogue, they provided feedback, knowledge and shared experiences with those who had the expertise to learn and implement the research successfully [20]. Concerning achieving socially desirable outcomes, mutual learning helped those engaged to pre-empt societal concerns and provide innovative suggestions to the dilemmas of R&I in ICT.

4.1.2.4 *Resourcing*

Although resourcing was not explicitly mentioned as a rationale in the interviews, it was clear from the document analysis that in all the five ICT research projects, one of the main reasons for stakeholder engagement was the provision of resources that were necessary for the implementation of the research (as suggested by Durham et al. [65]). The resources were in three forms. Firstly, the resources were in the form of materials, as was the case particularly in Projects D, E, and F. In these case projects, there was a need for the existence of ICT infrastructures to support the research. Secondly, the motive for stakeholder engagement in all five cases was the human resource it brought to ICT research projects. For example, in all the cases, stakeholders had the right skills, expertise, knowledge and experiences that were essential for different aspects of the research process. Thirdly, some stakeholders such as the local authority and industry were engaged in the ICT projects because of the financial resources that they could bring into the research. In relation to the attainment of socially desirable outcomes in the ICT research projects, each type of resources was relevant and crucial. For instance, the materials provided were crucial for providing the capacity to adapt and respond to changing circumstances [20] within the research environments in which all the ICT research projects were being implemented.

4.1.3 *Nature of stakeholder engagement*

In evaluating the nature of stakeholder engagement, the focus was on the activities which the stakeholders were undertaking in their respective research projects. It was important to evaluate whether the activities were relevant for attaining the socially desirable outcomes in the ICT research projects or not (see [41], [42] on Theory of Change). From the cross-case analysis, the following five different types of stakeholder activities describing the nature of stakeholder engagement emerged.

4.1.3.1 *Dissemination of information*

In all five cases, the stakeholder engagement provided a platform where the different stakeholders could disseminate information among those engaged in the ICT research projects. For instance, the information that was disseminated was about the intended outcomes of R&I process or the activities that were taking place as part of the research. In the case of the former, an example was given in Project D, where as part of the stakeholder engagement, stakeholders were given the information about the intended innovative solutions for solving the societal challenge of air pollution and traffic congestion. While for the latter, an example was shown in Project F in which information was disseminated as part of knowledge exchange among the stakeholders that were engaged in the ICT research project. This was very important in achieving outputs and outcomes which could be acceptable and desirable for society.

4.1.3.2 *Facilitation of dialogue and consultation*

In all five cases, stakeholder engagement was a good platform for facilitating dialogue and consultation on different aspects that were related to the research processes, for example, the choice of effective implementation methodologies. For example, in Project D, Project I and Project F, the respondents that were interviewed said that as part of the stakeholder engagement, there was a lot of consultation with those who would be the end-users of the ICT systems that were either being developed (as in the case of Project D and Project I) or being implemented (as in the of Project F).

Facilitating dialogue and consultative actions such as blogs and events were supportive towards achieving the different outcomes for the ICT research projects. The consultations and dialogue were an inclusive process of establishing different ways of creating possible future scenarios which could help minimize possible future negative outcomes of the research by providing viable alternatives [70].

4.1.3.3 *Offering expertise*

When it came to offering expertise as a stakeholder engagement activity, in all five cases, stakeholders had some form of expertise that they provided towards the research process and ultimately towards the intended outputs and outcomes of the ICT research projects. For example, in Project G, Project D and Project I some of the stakeholders were engaged to provide their technical expertise in developing ICT systems that were expected to address the societal challenges which these ICT research projects were focusing on, respectively. With respect to RRI, engaging stakeholders that offer expertise is an anticipative approach that ensures that the planned methodology and its outcome is acceptable [17]. The different expertise that is offered as part of stakeholder engagement is vital in the co-creation and responsiveness of ICT research projects to social impacts.

4.1.3.4 *Providing feedback and advice*

Another stakeholder engagement activity that was overarching in all five cases was the provision of feedback and advice (as suggested by Bryson et al. [63]). The stakeholders engaged in the ICT research projects provided feedback on the ICT systems that there were being developed. For example, in Project D and Project F there were fora where the stakeholders could discuss the research and its outputs, and in so doing provide feedback that was used to improve the R&I processes and in the long run the final results.

This resonates with Bryson et al. [63] who asserted that stakeholders provide feedback about alternatives and decisions on how certain processes should be carried out, for instance, to mitigate societal harm. The focus on such feedback is on

the procedures that R&I follows in the ICT research projects. This is indicative of reflection and inclusiveness in the ICT research projects, which are crucial elements for attaining socially desirable and desirable outcomes [71].

4.1.3.5 Promoting ownership

Through their engagement, stakeholders understood the need for the research they took ownership of either the research process or the results that came from it. For instance, as part of the stakeholder engagement in Project I, information for change was provided to different stakeholders in the ICT research project. The provided information was used by the stakeholders to change perspectives on societal problems and went deeper into discussions of how the issues could be addressed using technology, and also how they could contribute toward that solution.

Similarly, in Project F, some of the stakeholders that were engaged promoted the research agenda and the outcomes that were being realised. Because of such promotion, other stakeholders were encouraged to be part of the efforts that the ICT research project was working on. In terms of achieving socially desirable goals, this is significant because it encourages mutual learning and knowledge exchange between stakeholders [15] when responding to the calls of the ICT research projects, particularly to address the societal challenge.

4.1.4 Outcome of stakeholder engagement

As suggested by Weiss [39], evaluation is about assessing the outcome of a certain activity or activities. One way of achieving this in projects is by using an approach such as a Theory of Change to identify the linkages (the rationale) between the activities (nature) of stakeholder engagement and the outcomes (in this case the socially desirable outcomes). In all five cases, there were some overarching socially desirable outcomes of stakeholder engagement in the ICT research projects and they are discussed next.

4.1.4.1 Awareness of responsibility issues

Awareness of responsibility issues is very important in building the capacity of stakeholders to adapt and respond to changing circumstances and it encourages responsible innovation in ICT research projects. Stakeholders were engaged in dialogue through consultations which provided them with information. The information provided made them more aware of the societal challenges that the individual ICT research projects were aiming to address and the responsibility issues that were related to the causes of the research. As a result, the stakeholders were able to change their behaviours and attitudes towards the respective challenges that each ICT research project was dealing with [1]. For example, in Project D, the interaction with a dashboard (ICT system) that was developed in the project, stakeholders were able to see patterns of their behaviours on energy consumption. After receiving feedback from the ICT systems, the stakeholders were discussing the results and ways of changing their behaviours through an online forum and during consultative engagement events. Thus, the awareness made the stakeholders responsive to the issues that were being flagged up by the ICT systems and also during deliberation.

4.1.4.2 Sustainability of project aims

The stakeholders that were engaged in all the five cases brought with them a variety of skills, capabilities and knowledge. Among some of the inputs from the stakeholders that were engaged in the ICT research projects, were leadership, knowledge and management of the research process. One of the things that resulted from such contributions from certain stakeholders was a better utilization of resources and knowledge that was shared during the engagement processes. As an example, in Projects D and F, stakeholders' expertise and knowledge were central to providing control and direction. Controlling and directing the research process was necessary for the sustainability of the project's aims and better resource utilization during and beyond the research through a change in behaviour and attitudes. Engaging the stakeholders in the five ICT research projects, meant that what the stakeholders co-created and learnt through their engagement had a chance to continue beyond the lifespan of the respective ICT research projects. The ICT systems that were developed (as is the case of Projects D, E and F) and those that were implemented in all the five projects were likely to be accepted by the stakeholders because they were involved in the R&I processes. With such involvement, there was buy-in across the stakeholders.

4.1.4.3 Co-creation

The stakeholder engagement process in all five of them allowed the projects to bring in different stakeholders, harness their capabilities, knowledge and potential in creating solutions to the societal challenges that each project was aiming to address. In Projects D and I, computer experts worked together with a sample of users in developing the ICT systems that they were developing so that they could come up with desirable technologies that meet the needs of society [68]. One way to ensure that the outcomes of ICT research are socially desirable is through co-creation. The reason behind this is that with co-creation, stakeholders bring together their knowledge, experiences, values and perspectives to come up with solutions that tend to be accepted by society [27], [31].

To round up, from the Theory of Change shown in Figure 1, it can be seen that for effective stakeholder engagement to take place there are contextual factors or rather enabling factors that support the engagement of stakeholders in ICT research projects [45]. Thus, for the stakeholders to contribute towards desirable outcomes of the research and innovation process, there is a need for effective identification. This entails identifying the stakeholders who will have roles that are vital for a respective ICT research project to achieve specific goals [65]. Despite the identification, stakeholders have to be interested and show a willingness to engage otherwise the identification will result in ineffective engagement [31]. On top of the stakeholders' willingness, there is a need for resources that will enable and support the engagement activities that are necessary to achieve particular outcomes including socially desirable ones.

The activities that are necessary to achieve socially desirable outcomes are based on the motives behind stakeholder engagement. These motives or rationale for stakeholder engagement are depicted by the inputs that the stakeholders provide to the ICT research projects [15], [63], [74]. These include control, feedback, expert advice and recommendations on the research and innovation process. Based on the rationale of the stakeholder engagement, the stakeholders carry out different activities that work towards achieving a range of intended and sometimes non-intended outcomes from the research and innovation process [16], [18], [20], [75]. For instance, the activities may include disseminating information, facilitating dialogue and consultation with other stakeholders, therefore, acting as a bridge and providing diverse expert knowledge and experience.

Using the Theory of Change, assumptions are made on the linkages between such activities and the desirable outcomes that result from them [42], [76]. In the case of the five cases, the Theory of Change in Figure 1, shows that as the result of the different stakeholder engagement activities some desirable goals came about. For example, through facilitating mutual learning by exchanging and sharing knowledge, there was co-creation. This resonates with the RRI discourse which advocates that stakeholder engagement can support co-creation in research and innovation [77], [78]. The co-creation helps in collectively highlighting some of the issues that may impact the research and innovation process as well as the society. Other socially desirable outcomes that result from stakeholder engagement such as responsibility through learning and reflection and awareness of the societal issues that the ICTs were aiming to address also corresponds with the reasons for having stakeholder engagement in ICT research as suggested by Jirotko et al. [17].

5. Conclusions

The paper has contributed to theory around project management, by suggesting how an approach such as Theory of Change can be used to evaluate the merit of stakeholder engagement and establish different linkages between inputs from the stakeholder engagement, favourable contextual preconditions for the engagement, the relevance of stakeholder engagement activities within the project, the rationale behind the engagement, and the attainment of socially desirable outcomes in projects. Using evaluation approaches such as the Theory of Change helps practitioners in projects to understand the value of stakeholder engagement towards the intended and non-intended socially desirable outcomes of the research and innovation process that is taking in different types of projects, including ICT research projects. In all the five key conceptual features advanced, it can be established that stakeholders are crucial within ICT research projects and therefore it is necessary to evaluate and understand their contribution towards positive outcomes of R&I within the context of RRI.

Thus, this paper contributes to practice and theory by emphasizing the vital interrelation between stakeholders and the achievement of responsible outcomes in ICT R&I. The paper guides better alignment of stakeholder engagement and

R&I processes within ICT research projects in achieving positive outcomes for the society. Using a Theory of Change as suggested in this paper could be helpful in practice to identify specific elements of stakeholder engagement which practitioners should focus on to promote stakeholder engagement towards ensuring better R&I outcomes in projects. Furthermore, the paper has shown how evaluation theory can support understanding the value of stakeholder engagement in R&I within the context of responsible research and innovation by applying it to a multi-case study of ICT research projects. Such an understanding has the potential to guide effective stakeholder identification and design of stakeholder activities that will have links to particular outcomes in projects. Despite using ICT research projects in the paper, the insights can apply to other types of projects apart from ICT research projects in understanding some of the roles stakeholders play in ensuring responsible innovation as an outcome of the projects.

5.1 Limitations of the study and future work

In most cases a Theory of Change is best constructed as and when the project is being implemented. However, due to the timing of the study, the projects' life cycles and the lack of cooperation from most project participants to take part in constructing the Theory of Change, its significant proportion was constructed retrospectively through post-project or post-phase interviews and secondary research. Some participants did not accept the invitation to partake in the evaluative study, reducing the possible number of contributions for a comprehensive Theory of Change.

Another limitation was that the sampled case projects were limited to those funded by the European Commission due to the nature of the study and therefore having a Euro-centric perspective and could be biased. The sample could be biased towards government-funded ICT research projects that are being implemented in Europe, neglecting the perspectives of those in industry and other parts of the world. Such bias could influence the results and therefore the resulting Theory of Change.

Future work could explore the role of stakeholder engagement towards socially desirable outcomes in other types of ICT projects such as those in industry and different parts of the world. Also, future studies could employ action research methodology to avoid a retrospective enquiry and provide a better evaluation of the role of stakeholder engagement in such type of projects as suggested above.

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