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Engaging the crowd to solve complex problems in the Public Sector: a bibliometric literature review and an empirical analysis of nine international case studies

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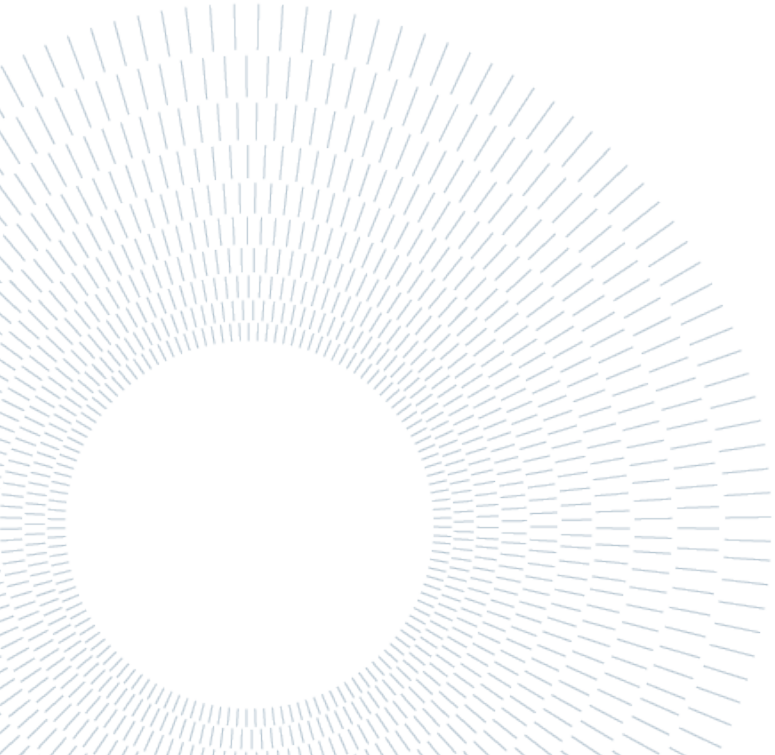


Abstract

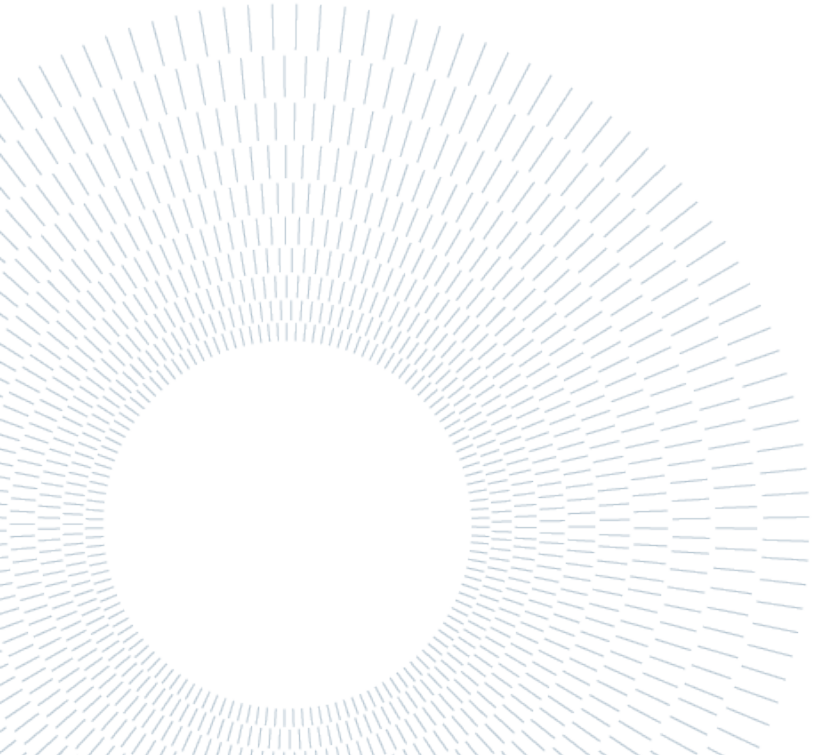
In recent years a new phenomenon has been observed by which public institutions and nonprofit organizations engage citizens to solve often very complex problems. This novel process, which was given the name of "crowd engagement", appears to have some elements in common with the already by the literature explored concepts of "citizen participation", "open innovation" and "crowdsourcing", while also showing a new and distinctive identity. It will be the purpose of the first chapter of this thesis to better understand the boundaries of the theory shaping crowd engagement and to identify what are the characteristics that set it apart from the other three mentioned methodologies, eventually leading to formulating a final definition of the process, while also providing a future research agenda about the topic. To do so, a systematic review of the literature exploring this phenomenon will be conducted, combining the two bibliometric approaches of co-citation analysis and text mining. Moreover, among the research questions provided at the end of the systematic literature review, one was chosen to be explored in the second chapter building the thesis, which will be focused on empirically defining, through qualitative research on a sample of nine case studies, the benefits and challenges of the crowd engagement process. From the results of the co-citation analysis of the systematic literature review, it was concluded that the theoretical foundations of crowd engagement combine knowledge belonging to the theory of "citizen participation", "open innovation", "crowdsourcing" and "co-creation", explored from the perspective of public institutions as initiators, with the concept of sustainability, so shaping its distinctive and novel identity which sets it apart from other existing processes. Furthermore, the results of the text mining highlighted crowd engagement's effectiveness in engaging citizens to support initiators in the decision-making process for the solution of very complex, societal problems. Finally, the qualitative research led to the identification of new challenges and benefits characterizing this phenomenon which did not emerge from the existing literature, while also providing some useful insights to potential initiators of crowd engagement into how to design the process to obtain certain benefits from it, while also anticipating the most relevant challenges that they will have to overcome.

Key-words: crowd engagement; sustainability; co-creation; citizen participation; public sector

Abstract in italiano

Negli ultimi anni è stato osservato un nuovo fenomeno tramite il quale istituzioni pubbliche e organizzazioni non-profit coinvolgono cittadini per risolvere problemi spesso molto complessi. Questo nuovo processo, a cui è stato dato il nome di "crowd engagement", sembra avere, quantunque pare avere alcuni elementi in comune con i concetti di "citizen participation", "open innovation" e "crowdsourcing" - già esplorati dalla letteratura- dimostra una nuova, propria peculiare identità.
La tesi si articola in due capitoli che di seguito vengono esposti in estrema sintesi. Lo scopo del primo capitolo di questa tesi è quello di comprendere meglio i perimetri della teoria del crowd engagement identificando altresì quali sono le caratteristiche che lo distinguono dalle altre tre metodologie citate, giungendo quindi a formulare una definizione finale del processo e a fornire un'agenda di ricerca futura sull'argomento. A tale scopo, verrà condotta una revisione sistematica della letteratura relativa a questo fenomeno, combinando i due approcci bibliometrici dell'analisi delle co-citazioni e del text mining. Tra le domande di ricerca fornite alla fine della revisione sistematica della letteratura, si è proceduto a sceglierne una da esplorare nel secondo studio in cui la tesi si articola, il quale è incentrato sulla definizione empirica dei benefici e delle sfide del processo di crowd engagement attraverso una ricerca qualitativa su un campione di nove casi di studio.
Dai risultati del primo capitolo, si è concluso che le fondamenta teoriche del crowd engagement combinano conoscenze appartenenti alle teorie di "citizen participation", "open innovation", "crowdsourcing" e "co-creation", che, esplorate dalla prospettiva delle istituzioni pubbliche come iniziatori, con il concetto di sostenibilità, ne generano una identità nuova che lo distingue da altri processi esistenti.Inoltre, i risultati del text mining hanno evidenziato l'efficacia del crowd engagement nel coinvolgere i cittadini per sostenere gli iniziatori nel processo decisionale al fine di dare soluzione a problemi di elevata complessità che impattano l'intera società.
Il secondo capitolo, infine, ha portato all'identificazione di nuove sfide e benefici che caratterizzano questo fenomeno, che non eran emersi dalla letteratura già esistente; ha altresì fornito alcune considerazioni che potrebbero aiutare i potenziali promotori del crowd engagement a progettare il processo in modo da sfruttarne determinati benefici, anticipando le sfide più rilevanti che dovranno superare.

Parole chiave: crowd engagement; sustainability; co-creation; citizen participation; public sector



Contents

Introduction

In the past years, companies, non-profit organizations and governmental institutions have often implemented processes with the goal of involving users and citizens in the solution of problems of very diverse nature. Their application ranged from firms seeking solutions to micro-tasks by involving a broad crowd of heterogenous individuals thanks to intermediary platforms like Innocentive, according to the crowdsourcing approach (Howe, 2006), to public institutions organizing events to engage citizens in the decision-making process through citizen participation (Arnstein, 1969), for instance when drafting plans for future urban development (Nyseth et al., 2019).

However, in more recent years a new phenomenon has emerged through which public institutions and nonprofit organizations aim to solve challenges which proved to be more complex, transversal and multi-dimensional (Peach et al., 2019; Ryan et al., 2020) than those usually tackled by more traditional methods like crowdsourcing (Seltzer and Mahmoudi, 2013). Such wicked problems are generally characterized by the fact that it is possible to approached them from multiple perspectives, leading to more than one potential solutions. It is also often very difficult to univocally define them and identify their causes and pertaining authority, since they involve different stakeholders. Moreover, their solution might directly cause new problems which need to be faced as well (Rittel & Webber, 1973). Finally, they are sometimes decentralized and multi-dimensional in nature, and often change at a faster pace than the human's capacity to react (Peach et al., 2019; Ryan et al., 2020). This is the case of the most urgent challenges society is facing nowadays like climate change and the related natural disasters, reaching sustainability targets and, very recently, the Covid-19 pandemic (Peach et al., 2019; Ryan et al., 2020). To cope with these complex societal problems, different organizations tried to adapt existing processes, considering co-creation as a potential solution (Nesti, 2018).

This was for instance the case of EUvsVirus, a hackathon of unprecedented size sponsored by the European Commission which brought citizens, businesses and public organizations together, to show unity in the response to the Covid-19 pandemic (Gama, 2021). The event, which took place in April 2020 and was led by the European Innovation Council, brought together civil society, innovators, partners and investors from across Europe with the purpose of developing innovative solutions to challenges related to the COVID-19 virus in an effort to show that the European Community was truly united in the fight against the pandemic. The initiative managed to involve over

30.000 people from the EU and beyond and led to the design of solutions belonging to different thematic areas.

EUvsVirus is just one of the many events showing how in recent years public institutions, but also non-profit organizations, have increasingly tackled complex societal problems by involving citizens and other stakeholders in a novel kind of process that, while sharing some features with other existing approaches, seems to have its own distinctive identity.

Indeed, initiators seem to have combined in these innovative initiatives elements that are typical of the methodologies of "open innovation" (OI) and "crowdsourcing", traditionally more associated with the corporate world (Chesbrough and Appleyard, 2007), with distinctive traits of "citizen participation". Traits of OI can in fact be recognized in the integration of knowledge coming from sources which are external to the public institution or nonprofit organization in their internal knowledge creation process (Seltzer and Mahmoudi, 2013). Moreover, these events are often organized through online platforms and promote the inclusion of a broad and heterogenous crowd, both characteristics defining crowdsourcing (Estellés-Arolas & González-Ladrón-De-Guevara, 2012). Finally, an element in common with citizen participation is instead the involvement of citizens in the planning process to support decision-making (Baum, 2001).

Since such complex problems, like Covid-19, often impact society at large, these initiatives also show the characteristic of generally having a multi-stakeholder nature. Indeed, they often involve multiple public, private and third sector actors that have different knowledge, skills and experience, which can be combined to improve the understanding of the problem, while contributing to solving it. Moreover, being so diverse, the stakeholders might even differ in terms of the set of goals and agenda motivating them to participate, therefore requiring the initiator to find a common ground between them (Ansell et al., 2022).

It follows from such considerations that the described process appears to be something novel and with its own identity, that puts it apart from other traditional methodologies like crowdsourcing. It was therefore decided to use the name "crowd engagement" when referring to it in this thesis.

Given its recent nature, much about the phenomenon has yet to be discovered. In particular, there appears to be a gap regarding the theory characterizing this topic that needs to be addressed. Consequently, to better understand the theoretical boundaries defining crowd engagement and to identify what are the characteristics that differentiate it from the other three mentioned methodologies, it was decided to conduct a systematic literature review, which will be discussed in the first chapter of this thesis. To do so, it was decided to follow both bibliometric approaches of co-citation analysis and text mining (Randhawa et al, 2016). The former's goal is to investigate the knowledge in which the process is rooted while the latter makes it

possible to explore at a more granular level the literature, therefore letting the most relevant concepts discussed in the papers emerge. The combination of these two methodologies will make it possible to reach the objectives of the first chapter, which are to understand how the literature has defined the characteristics of this phenomenon, leading to formulating a final definition of crowd engagement, while also building a future research agenda on the topic to guide researchers into deepening the knowledge about this novel process.

Furthermore, after having discussed the results of the systematic literature review, a second research, discussed in the second chapter, was devoted to answering one of the questions that emerged from the previous future research agenda, which called for an exploration of crowd engagement's benefits and challenges. Indeed, the conclusions of the systematic literature review discussed how crowd engagement combines specific elements from open innovation, crowdsourcing, citizen participation and co-creation with the concept of sustainability, shaping so its distinctive identity, which puts crowd engagement in a unique position with respect to the other mentioned concepts. Consequently, it is reasonable to expect that crowd engagement's defining challenges and benefits will show some differences and peculiarities with respect to those of the other processes. This suggests that there is still a gap in crowd engagement's theory that needs to be filled, motivating the effort to go beyond the analysis of existing literature and conduct qualitative research on a sample of case studies to answer the following research questions:

RQ 1: "What are the challenges of crowd engagement?"

RQ 2: "What are the benefits of crowd engagement?

The first chapter of the thesis, which is dedicated to the systematic literature review, starts with a section providing an explanation of some concepts to build a theoretical background upon which crowd engagement can be properly interpreted. The second section is focused on explaining the design of the research, providing an explanation of the process that led to the building of the sample on which the research is based, and the theory behind the two bibliometric approaches chosen for the review. The third section is instead dedicated to the results of the analysis performed on the sample, starting with a descriptive one conducted on the sample and following with the co-citation and text-mining. The fourth and final section provides the conclusions drawn from the previous analyzes. Moreover, two sub-sections are dedicated to exploring first the theoretical and then the practical implications of the research. Finally, the research agenda sub-section builds solid foundations for potential research objectives and is followed by a discussion about the limitations of the conducted systematic literature review.

The qualitative research to which the second chapter of the thesis is dedicated, starts with a section focused on providing an overview of the benefits and challenges of the crowd engagement process discussed in the literature. This part will be based on the sample of publications used for the systematic literature review. In the second section the research methodology will be discussed in all its details. It will provide a description of the sample of the cases that have been chosen for this research and explain how the data has been collected and analyzed. The third section is instead dedicated to discussing the results of the previous data collection and analysis phase, describing all the benefits and challenges of the crowd engagement process that have emerged from the interviews. The fourth and final section provides the conclusions drawn from the previous analysis. Moreover, two sub-sections are dedicated to exploring first the managerial and then the practical implications of the research. Finally, the research agenda and limitations sub-section builds solid foundations for potential research objectives while discussing the main limitations of the performed research.

1 Systematic literature review

The first chapter of the dissertation is dedicated to a systematic and comprehensive literature review on the crowd engagement process. Multiple publications about the process' application have been collected and analyzed to explore its theoretical boundaries and provide a definition of the process. To do so, the review combines two bibliometric approaches, namely co-citation analysis and text mining, to systematically analyze the existing knowledge on the topic and its evolution over time.

The first section provides an explanation of some concepts to build a theoretical background upon which crowd engagement can be properly interpreted.

The second section is focused on explaining the design of the research. It starts with a general overview of the process and then explains more in detail the steps that led to the building of the sample on which the research is based, and the theory behind the two bibliometric approaches chosen for the review.

The third section is instead dedicated to the results of the analysis performed on the sample. It starts with a descriptive analysis providing some insights into the set of publications. It then moves on to the co-citation analysis, the aim of which is to better understand the academic foundations on which the considered publications are based. Finally, the text mining subsection makes it possible to understand more in detail the concepts and themes explored in the sample.

The fourth and final section starts provides the conclusions drawn from the previous analysis. Moreover, two sub-sections are dedicated to exploring first the theoretical and then the practical implications of the research. Finally, the research agenda sub-section builds solid foundations for potential research objectives. Among these, one research question has been selected to be answered in the second chapter of the dissertation, acting as a bridge to the following qualitative research. In conclusion, a sub-section is dedicated to discussing the main limitations of the systematic literature review.

1.1. Theoretical Background

As discussed in the introduction to the thesis, crowd engagement appears to take some elements from the processes of open innovation, crowdsourcing and citizen participation and combine them in a novel way. The aim of this section is to introduce and explain some important concepts related to crowd engagement to build a theoretical background upon which this phenomenon can be better interpreted. The chosen terms to be explored are: "*citizen participation*", "*open innovation*", "*crowdsourcing*", "*co-creation*" and "*collective intelligence*". Indeed, as will be discussed in the upcoming analyzes, also the last two mentioned concepts will play an important role in the research as they can be used as "proxies" for crowd engagement since they share with it some elements, as will be discussed more in detail in the "sample selection" sub-section.

As anticipated, the first concept to be defined is "citizen participation", which can be described as involving citizens in public decision-making (Baum, 2001). This kind of participation is aimed at engaging inactive people, as explained by Arnstein in "A ladder of citizen participation", who states how citizen participation is strictly related to the concept of "citizen power". Indeed, through this engagement process, it is possible to actively involve citizens who have been excluded from the political world thanks to the redistribution of power (Arnstein, 1969). However, nowadays, it has come to refer also to autonomous citizen actions, like community development and social planning (Baum, 2001). A key characteristic of citizen participation initiatives is that the users, who are citizens acting in the context of cities and communities, are involved to support the planning process (Seltzer and Mahmoudi, 2013). Indeed, the applications of such process are numerous and include for instance urban planning (Nyseth et al., 2019) and policymaking (Vetulani-Cęgiel and Meyer, 2021). Finally, it should be highlighted how in more recent years, planners have started to exploit the Internet to support citizen participation initiatives. However, for projects of this nature, web-based engagement processes should be implemented to complement traditional approaches instead of substituting them (Seltzer and Mahmoudi, 2013)

"Open innovation" (OI) is the second concept that needs to be defined and it can be described as the process through which ideas and applications are cooperatively developed outside of the boundaries of a company (Gassman and Enkel, 2004). Three types of open innovation exist (Gassman and Enkel, 2004):

- Outside-in OI: integrating external knowledge created beyond the firm's boundaries with the internal one
- Inside-out OI: providing ideas generated internally to external actors
- Coupled OI: a combination of the previous two

As with citizen participation, open innovation seeks to expand the initiator's perspective by involving external actors (Seltzer and Mahmoudi, 2013). However, while the former takes place in a public environment, engaging citizens and being organized by governmental institutions, the latter is focused on the corporate world. Indeed, it is intended as a response by companies to very uncertain markets in which a closed approach to innovation, where all knowledge is developed internally by firms, is doomed to fail (Chesbrough, 2004) and should be substituted by an "open strategy", balancing open innovation with the firm's need to be profitable (Chesbrough and Appleyard, 2007).

The third concept to be defined is the one of "crowdsourcing". Its initial definition was given by Howe in its seminal work "The rise of crowdsourcing", where it was defined from cases like InnoCentive as the act of a company to outsource a function traditionally performed by employees to a generally large and undefined group of people in the form of an open call (Howe, 2006). Since then, this process has been defined by many authors, the efforts of which have been analyzed by Estellés-Arolas & González-Ladrón-De-Guevara to formulate an exhaustive and comprehensive definition of the process. Hence, crowdsourcing is defined as an online participatory process through which a company, a non-profit organization or an institution proposes to a crowd of people, the knowledge and number of which may vary, the undertaking of a task in the form of an open call (Estellés-Arolas & González-Ladrón-De-Guevara, 2012). Such definition highlights some important characteristics of the process. First, it states that crowdsourcing is a participatory process that takes place mainly online and not physically. Secondly, it explains how its goal is to solve tasks. However, for the process to be successful, the problem should be clearly defined and kept simple, and the initiative generally organized in form of a challenge that has a precise and normally rather short time horizon (Seltzer and Mahmoudi, 2013). Moreover, in accordance with the goals of this dissertation, it states that the initiators of this process are not only companies but also governments and non-profit organizations, which can use it as a tool to exploit the collective intellect and innovative ideas of citizens to support planning (Brabham, 2009). Crowdsourcing can therefore be applied also in public contexts like in the cases of MindMixer and NeighborLand, where the process was used respectively for city planning and participation and neighborhood organization. Even though crowdsourcing shares some aspects with citizen participation, it must be highlighted how, while the latter is generally applied for planning, the former appears to work best when there is a well-defined problem. Therefore, to identify issues or solve loosely defined problems, citizen participation is the more suited process of the two (Seltzer and Mahmoudi, 2013).

Finally, even though there are many commonalities between open innovation and crowdsourcing, it is argued that the main difference between the two lies in the initiator's lack of control over the participants in the case of the latter (Zhao and Zhu, 2012).

Based on the works of Prahalad and Ramaswamy (2000) and Vargo and Lusch (2004), co-creation is defined as actively involving end-users in different phases of the production process (Voorberg et al., 2014). To avoid confusion, it is important to underline that co-

creation and co-production are often used as interchangeable words, with no striking difference between the two, as concluded by Voorberg et al. in their systematic review of the two concepts published in 2014.

Co-creation has been implemented in both private and public sectors. In the former, it is mainly used by companies to increase efficiency by including the customers in the production process and as a way to add value to the organization through the clients' experience with the products and services, involving customers both in the definition and creation of value (Prahalad and Ramaswamy, 2004).

When co-creation is applied in the public sector, the users are the citizens, which emerge as important partners in public service delivery (Voorberg et al., 2014). It is interesting to notice how, when applied in the public field, the involvement of citizens which comes with such process, is considered to be a virtue itself. In other words, while still being applied with the goals of increasing effectiveness and efficiency, co-creation in the public sector often comes with the act of involving citizens as the purpose itself (Voorberg et al., 2014).

Finally, another concept that can be associated with crowd engagement is "collective intelligence" (CI). As stated by Nesta, the UK's innovation agency for social good, collective intelligence is the result of the collaboration between people, frequently with the aid of technology, to mobilize a greater range of knowledge, ideas, and insights to overcome societal challenges (Peach et al., 2019). The underlying rationale is that different people have different skills, information and perspectives, as a result of the fact that knowledge is distributed and that by combining these different pieces, it is possible to create a better picture of the problem and eventually solve it (Peach et al., 2019; Ryan et al., 2020). CI is therefore rooted in the understanding that a diverse group of people is collectively more intelligent than its single member. In other words, the final combination of each contribution is greater than the sum of their parts (Peach et. al, 2019). By doing so, it is possible to solve different challenges ranging from learning to decision-making.

Pivotal for the evolution and success of CI is technology. Indeed, through the internet it is possible to connect people who are geographically very distant, enabling the idea-generation process by bringing together different information and perspectives. Technology also makes it possible to have new sources of data while artificial intelligence can be exploited to handle the huge amounts of data generated, making it possible to extract value from it, enhancing human intelligence (Peach et al., 2019). CI itself includes multiple approaches to involve multiple actors to solve a problem, like crowdsourcing, deliberative democracy and citizen science (Peach et al., 2019; Ryan et al., 2020). Moreover, this process will be of paramount importance to face some of the urgent challenges our society is confronted with nowadays. Indeed, while humans are generally good at applying linear and logical thinking to solve complicated technological tasks, solving complex social or environmental problems appears to be harder. This is because of their decentralized and multi-dimensional nature, and the fact that they often change at a faster pace than the human's capacity to react (Peach et al., 2019; Ryan et al., 2020). These are all characteristics defining the most important problems society is facing today, like reaching sustainability,

fighting climate change and managing natural disasters. Collective intelligence might be applied to overcome such complex challenges by bringing together people, transcending geographical or political boundaries, making it possible to generate solutions at a faster rate (Nesta's centre for collective intelligence design, 2019).

1.2. Research Design

The systematic literature review is based on different methodologies which are intended to provide, through their combination, an analysis which, while starting superficially, progressively expands its depth, leading to an insightful and robust understanding of the topic. This section is dedicated to the explanation of how the research was designed. It starts with describing the process that led to the creation of the sample of publications to be studied. The section then proceeds to explain the theory behind the two bibliometric approaches adopted by this review, starting with the co-citation analysis and then providing an overview of the procedure of text mining.

1.2.1. Sample Selection

The sample analyzed throughout this systematic literature review has been built using the Scopus database (Randhawa et al., 2016). The goal was to create on one hand the main sample enabling the analysis of the crowd engagement process implemented by governmental institutions or nonprofit organizations, while on the other hand assembling another literature of publications representing how companies apply open innovation and crowdsourcing in the private sector, making it so possible to make comparisons between the two. The latter, while not being part of the final sample about crowd engagement, still builds the literature of the research, as it was of paramount importance to compare the novel process with those applied by corporations with which it shares some elements to better define its distinctive features.

To do so, it was necessary to define a set of keywords that, if searched for in the database, would have led to a pool of documents within which it was possible to find enough material that could be in line with our research, to build the sample.

As a result of the novelty of crowd engagement, the literature to be analyzed had to be selected using some "**proxies**" for the phenomenon as keywords. Indeed, given the very recent nature of the phenomenon, it was expected that it had not been explored by the literature under the new name of "crowd engagement", leading to the selection of terms referring to other processes with which the novel phenomenon shares some elements, that could have helped to provide the final definition of crowd engagement. To make the selection as robust as possible, all keywords have been approved, with some of them being even directly suggested, by a panel of academics and experts in open innovation,

crowdsourcing and citizen participation, who considered them as valid proxies to support the explanation of crowd engagement.

The final configuration of keywords (Table 1) was therefore the result of a process that started with an in-depth analysis of previous research and literature reviews on the concepts with which crowd engagement shares some elements, which were discussed in the "theoretical background" section (e.g., Randhawa et al., 2016), and preliminary trials on Scopus using different research strings to evaluate their effectiveness. Then, to assess the validity of the results and possibly improve it, it was decided to ask a panel of experts (Magistretti et al., 2018) for feedback, which was collected through a Qualtrics survey. A research string was shared with them, asking them to evaluate whether the selection of the terms was correct or not, in the sense that they could be used as proxies for the phenomenon of "crowd engagement", and leaving room for suggestions about potential concepts to be added. This led to the elimination of some terms and the to the inclusion of some new keywords. The result of this process led to the following final configuration of keywords, finally validated by the academics and experts contacted.

Table 1 Final composition of the search terms

Category A: crowd engagement process	**Category B: application sectors**
Open innovation	Public
Co creat*	Private
Collaborative innovation	Government*
Collaborative research	Firm*
Participatory design	Incumbent
Quadruple helix	Compan*
Crowdsourcing	Organization*
Citizen engagement	
Collective Intelligence	

The group on the left is made of terms defining different types of processes implemented by public or private initiators to engage the crowd in the creation of knowledge for different purposes which can be considered proxies for crowd engagement, while the one on the right helps distinguish the initiators of the processes between companies and governmental institutions or nonprofit organizations.

In the research string, all words within a group are connected by the logical operator "OR" while the two groups are connected by the operator "AND". By doing so, the research string made sure that all results found on Scopus should have had at least one word per group in their title, keywords or abstract.

Starting with the left part of the table, the selection of the terms was based on the goal of find "proxies" for the concept of crowd engagement. This led to the selection of the terms: "crowdsourcing", "open innovation" and "co creat*" in the first group of words. The same is true for "collaborative innovation" and "collaborative research".

Moreover, "citizen engagement" had often been used in articles describing efforts taken by the government to engage large crowds for public projects which would have otherwise been excluded by the research since they had not been associated with the keywords "open innovation" or "crowdsourcing", therefore motivating the decision to put it in the left group as well.

Based on the feedback gathered through the Qualtrics survey, the terms "participatory design", "quadruple helix model" and "collective intelligence" were included in the first group to expand its concepts. Indeed, they both added to the results articles which were about the involvement of crowds in co-creation processes.

Moving to the group on the right of the table, its concepts are used to make sure that it is possible for every publication included in the sample to identify whether the initiator of the process is either a governmental institution or nonprofit organization, or a private company. Being able to clearly distinguish between these two possibilities is of paramount importance for the research as it will enable a thorough comparison between the two. This motivates the inclusion of the terms "public" and "private" and of the words "government", "firms" and "incumbents" which have been used as their synonyms, as demonstrated by their joint appearance in the keywords, abstract and title of many of the articles found during the preliminary research which were considered as in scope. "Compan*" and "organization*" proved useful to include articles referring to the application of crowdsourcing by companies, by providing some alternatives to the term "firm*", as suggested by the survey's responses.

To sum up, the left set of keywords all refer to ways in which governmental institutions, nonprofit organizations and private companies organize processes to involve external actors in knowledge creation with which crowd engagement shares some elements, therefore making them valid "proxies" for the phenomenon. At the same time, the group on the right has the functional aim of making it possible for every publication included in the sample to clearly identify the nature of the initiator as discussed above. The underlying rationale is that such configuration would make sure that the articles found on Scopus would have in their title, abstract or keywords at least one term belonging to the group on the left and one belonging to the group on the right.

The results so obtained have been filtered to narrow their scope by limiting the research to the fields of:

- Business, Management and Accounting
- Computer science

- Social sciences

Moreover, only results belonging to the Scopus categories of "gold", "hybrid gold" or "bronze" have been considered. Among these, it was decided to keep only articles or book chapters. Finally, the research was limited only to documents marked as "final" and written in English.

These filtering decisions were shared with the panel of experts as well, who approved their implementation.

The so obtained final research string led to the inclusion of 2177 publications. The following steps of selecting the results based on screening the documents' abstracts and texts led to a final sample of 194 publications about crowd engagement. While performing these steps, additional 112 articles about the application of similar processes by private companies were kept to build the separate literature for comparisons. These articles were labeled as "private" to distinguish them from those belonging to the final sample about crowd engagement, which was instead given the label "public." Moreover, it stood out how the processes described by the documents belonging to the primary sample always defined the participants as citizens. This is remarkably different from what is discussed in the "private" labeled documents, which instead gave to the external actors involved by the companies the role of customers of the initiators. This signals how there might be a difference between how public institutions and nonprofit organizations engage the citizens while doing crowd engagement concerning how private companies involve their clients when performing open innovation and crowdsourcing, which needs to be further explored in the following analysis.

The whole selection process can be seen in the following picture, represented as a funnel (Figure 1).

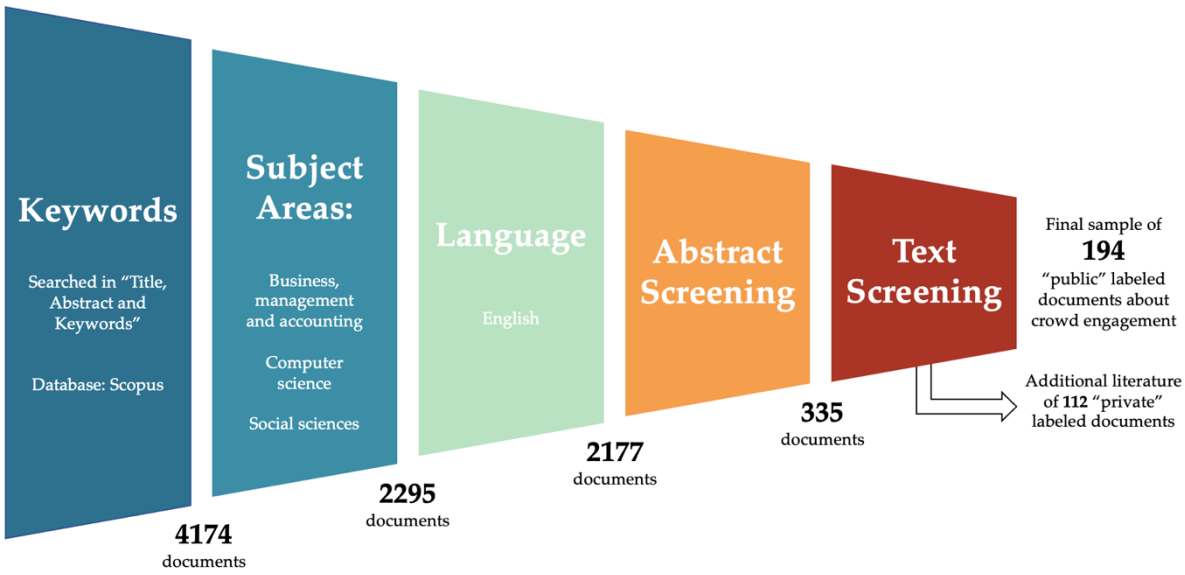


Figure 1 Funnel of the filtering process and definition of the final sample

1.2.2. Co-citation analysis

Co-citation analysis is a bibliometric method that has the goal of analyzing the theory in which the documents of the sample are grounded. It does so by looking for pairs of articles that are cited together by single papers in their references. It is so possible to grasp the correlation between references and their contribution to the theorization of a concept. It is therefore different from bibliographic coupling which instead happens when two articles both have in their references a third common one.

To perform the co-citation analysis, it was chosen to use the software called "Vosviewer", developed by Leiden University, which makes it possible to visualize as output a network of the most cited articles of the sample. The final result will depend on some parameters which can be controlled by the user. Especially important is the minimum number of citations for a certain article, which needs to be chosen before running the analysis, and which acts as a threshold that must be exceeded for it to appear as a node of the graph. Each publication will be represented in the network as a bubble which, the more citation that article has, the bigger it will be on the map. Moreover, the connections between articles are based on their number of co-citations, whereas the length of the connecting path will represent their distance.

To create the final output, the smart moving algorithm "Louvain" is used by the software to identify clusters of related publications within the network structure. (Waltman et al., 2010).

Quite often it is the case that the same article is written differently in the references of different publications. This is a problem for Vosviewer which cannot recognize them as being the same reference and will therefore underestimate the count and importance of some articles. To overcome this issue, it was necessary to define a Thesaurus, which made it possible for the software to associate different alternatives of the same reference to a single version of it, therefore leading to the correct results of the analysis.

The co-citation analysis has been performed twice: once on the sample formed by all "public" labeled publications and once on the literature made of the "private" labeled ones. This decision was taken to make it possible to identify and compare the articles shaping the theoretical background of crowd engagement performed by public institutions or nonprofit organizations with similar processes organized by companies in the private sector.

One crucial thing to keep in mind while conducting a co-citation analysis is that not all references in a given publication are equally significant, and they may even be quite unrelated. References continue to serve as proxies for concepts influencing a publication, even though a sufficiently broad sample decreases the random "noise" inherent in citation patterns (Schildt et al., 2006). This is the key motivation for combining this bibliometric analysis with text-mining to carry out this systematic review, as suggested by Randhawa et al. (2016).

1.2.3. Text mining analysis

Text mining is a form of unstructured ontological discovery which provides a systematic, unbiased and content-driven review of the literature (Biesenthal and Wilden, 2014; Randhawa, 2016). It does so by shifting the level of analysis from authors and their citations to the actual words used by authors (Randhawa et al., 2016). The underlying assumption is that words are defined by the context within which they occur, and words that co-occur express categories (i.e., concepts) with peculiar meanings (Randhawa et al., 2016). The software chosen to perform this analysis is Leximancer 4.0, which applies a Bayesian learning algorithm to find the most frequently used concepts within a body of text and their relationships. To do so, the software defines a thesaurus of words strictly related to a concept. These concepts should not be thought of as mere keywords but as a collection of words that carry related meanings (Campbell et al., 2011). The relationships between the concepts are then aggregated into themes, leading to the main output of Leximancer which is called the "map of meaning". This map shows all the concepts, grouped into clusters (themes) which are represented as circles whose size and brightness of color approximate their importance. Within clusters, the concepts are represented as nodes of variable size and connected by lines, to better highlight their relationships. The distance between concepts approximates how closely they are associated. Accordingly, concepts that are semantically strongly related will be mapped closely together (Campbell et al., 2011; Rooney, 2005). Moreover, not only does the presence of a concept carry meaning, but also its absence (Randhawa et al. , 2016) from the map. Using seed words that are taken from the documents during text analysis, this method systematically unveils the most important concepts of crowd engagement's use in the public sector. Moreover, it analyzes the relationships between words by examining the frequency and co-occurrence of words in each context.

Similarly, to what has been done for the co-citation analysis, the text mining analysis has been performed twice, once on the sample of "public" labeled papers and once on the "private" labeled ones. The focus was in this case put on the interpretation of the results coming from the first analysis, comparing them with the results coming from the second one.

1.3. Results

The following section is dedicated to the description and discussion of the results of the above-mentioned analyses. Every step of each analysis is described in a dedicated sub-section, each of which explains how the corresponding step has been executed, discusses its results and ends with describing the conclusions drawn from them.

First of all, the sample is explored through the process of descriptive analysis, allowing for the formulation of some early insights.

The research then proceeds with the co-citation analysis of the sample, through which it was possible to define the academic foundations of crowd engagement.

Finally, based on the text mining analysis, the main features of the crowd engagement process' application will be discussed and then compared with the results of the "private" labeled publications to highlight what differences have emerged, allowing to increase the depth of the research once more.

It was so possible, through the combination of these methodologies, to reach insights at different granularity levels.

1.3.1. Sample descriptive analysis

The goal of this sub-section is to provide insights gathered from the descriptive analysis of the sample of documents. The oldest articles of the sample were published in the year 2011 (e.g. Maier-Rabler and Huber, 2011). This immediately highlights the fact that all documents have been written in recent years. Indeed, from 2014 on, the number of publications per year grew steadily, with an impressive spike in 2021 (Figure 2). This is probably, amongst other factors, also related to the Covid-19 pandemic, which, as discussed in some articles (Gama, 2021), triggered the exploration of crowd engagement initiatives by the government to solve related challenges. The downfall in 2022, is caused by the fact that the sample was built in April of that year, therefore not taking into account the documents published in the whole of 2022.

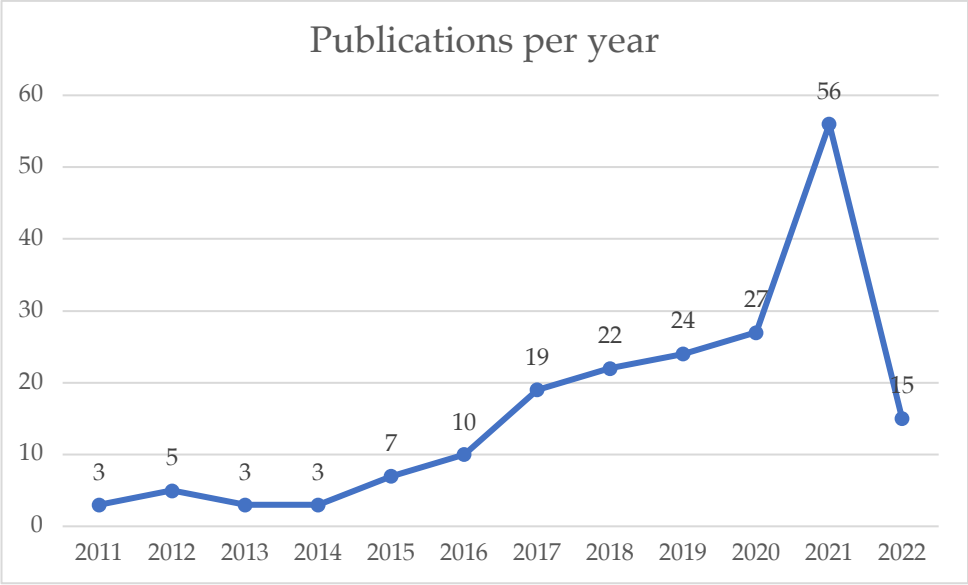


Figure 2 Publications of the sample distributed per year (n=194)

The sample shows that a wide variety of journals have published articles about the applications of crowd engagement by public institutions and nonprofit organizations (Figure 3). As it was expected, some of the journals most frequently appearing in the sample

are focused on open innovation (Journal of Open Innovation: Technology, Market, and Complexity) and public administration (International Journal of Public Sector Management, Public Administration and Information Technology). Moreover, it is interesting to notice the presence of some Journals specifically focused on sustainability (Sustainability (Switzerland)), design and planning of urban spaces (Urban Planning) and on the discussion of the possibilities, issues and challenges that societies face today regarding digitalization (eJournal of eDemocracy and Open Government). The fact that "Sustainability (Switzerland)" is the most frequently appearing journal in the sample already anticipates the fact that co-creation in the public sector is often applied to reach sustainability targets, in the context of dealing with climate change, and to promote a more inclusive urban planning, as it will emerge and be further discussed in the text mining analysis

The huge variety of journals included in the sample stands out, reaching a total of 126, with 103 of them counting for only one article each, highlighting how the knowledge of the topic is still sparse.

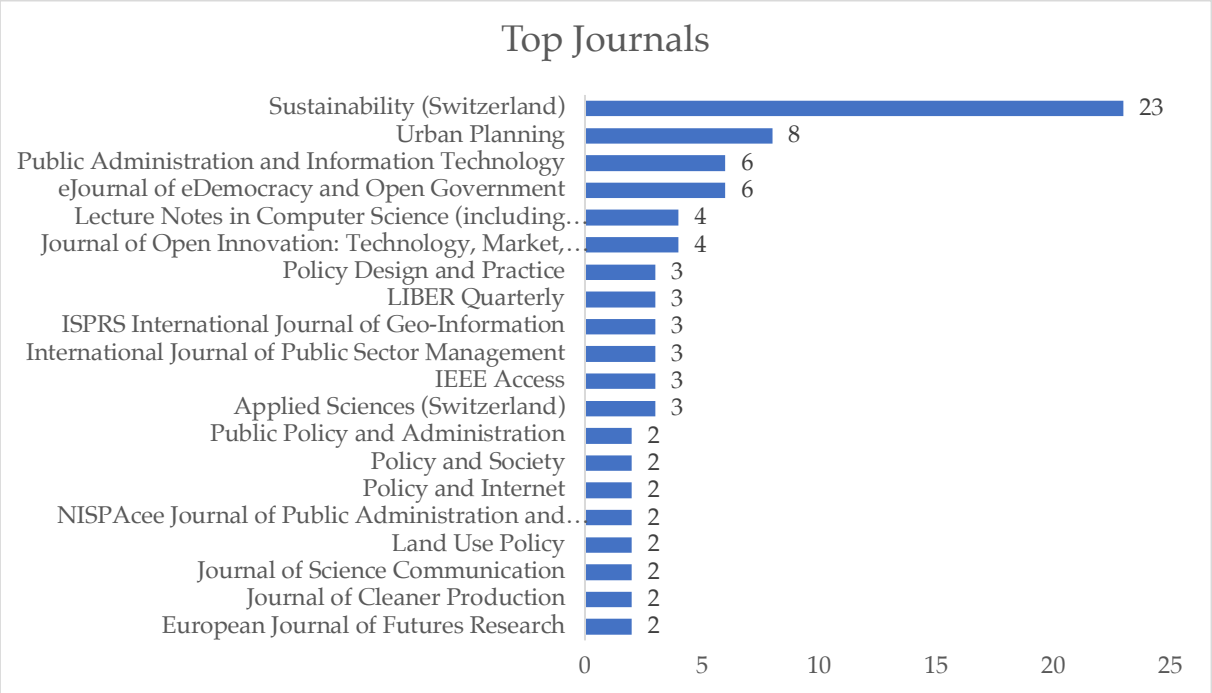


Figure 3 Top journals of the sample (n=194)

Looking at the most cited articles belonging to the sample (Table 2), it is observable that they have been published across nine different journals, some of which are related to the fields of innovation management (Industry and Innovation), environment and sustainability (Sustainability (Switzerland), Environmental Science and Policy) and administration (Administrative Science Quarterly). Among them, one of these journals is associated with two of the most cited publications: Sustainability (Switzerland). Once again, the fact that "Sustainability (Switzerland)" is the journal with the most publications belonging to the

sample while also having the highest number of the most cited papers shows how the theme of sustainability appears to be quite associated with the concept of crowd engagement.

Table 2 Most cited publications of the sample (n=193)

Authors	Title	Year	Source Title	Cited by
Bogers M., Zobel A.-K., Afuah A., Almirall E., Brunswicker S., Dahlander L., Frederiksen L., Gawer A., Gruber M., Haefliger S., Hagedoorn J., Hilgers D., Laursen K., Magnusson M.G., Majchrzak A., McCarthy I.P., Moeslein K.M., Nambisan S., Piller F.T., Radziwon A., Rossi-Lamastra C., Sims J., Ter Wal A.L.J.	The open innovation research landscape: established perspectives and emerging themes across different levels of analysis	2017	Industry and Innovation	424
Yun J.J., Liu Z.	Micro- and macro-dynamics of open innovation with a Quadruple-Helix model	2019	Sustainability (Switzerland)	144
Bell S., Upchurch P., Snavely N., Bala K.	OPENSURFACES: A richly annotated catalog of surface appearance	2013	ACM Transactions on Graphics	122
Wehn U., Rusca M., Evers J., Lanfranchi V.	Participation in flood risk management and the potential of citizen observatories: A governance analysis	2015	Environmental Science and Policy	108
Lifshitz-Assaf H.	Dismantling Knowledge Boundaries at NASA: The Critical Role of Professional Identity in Open Innovation	2018	Administrative Science Quarterly	91
Dolmaya J.M.	Analyzing the crowdsourcing model and its impact on public perceptions of translation	2012	Translator	66
Puerari E., de Koning J.I.J.C., von Wirth T., Karré P.M., Mulder I.J., Loorbach D.A.	Co-creation dynamics in Urban Living Labs	2018	Sustainability (Switzerland)	61
Falco E., Kleinhans R.	Digital participatory platforms for co-production in urban development: A systematic review	2018	International Journal of E-Planning Research	60
Van Eijk C., Steen T.	Why engage in co-production of public services? Mixing theory and empirical evidence	2016	International Review of Administrative Sciences	54
Nesti G.	Co-production for innovation: The urban living lab experience*	2018	Policy and Society	52

1.3.1.1. "Public" vs. "private" labeled publications

Once having described the main sample, it is interesting to see how it compares with the "private" labeled papers. To remind the difference between the two, the classification has been manually done at the end of the sampling funnel, by singularly looking at the abstracts

of the articles. As already explained, it was decided to use the "public" label for all those documents about crowd engagement, in which the initiator is either a governmental or public institution or a nonprofit organization (Estellés-Arolas & González-Ladrón-De-Guevara, 2012). The "private" label refers instead to the supplementary literature about processes with which the novel phenomenon shares some elements, which are instead initiated by a for-profit organization, so a company or a group of corporations (Estellés-Arolas & González-Ladrón-De-Guevara, 2012), built to be used for comparisons.

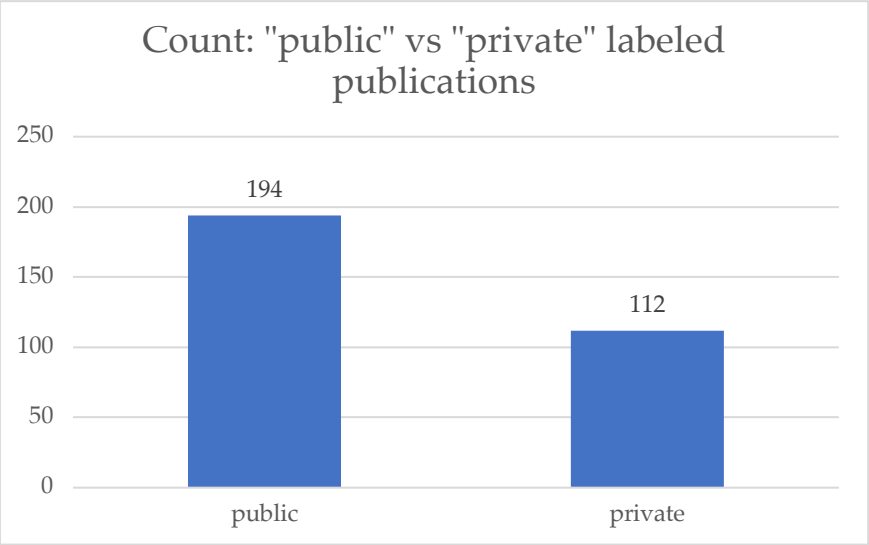
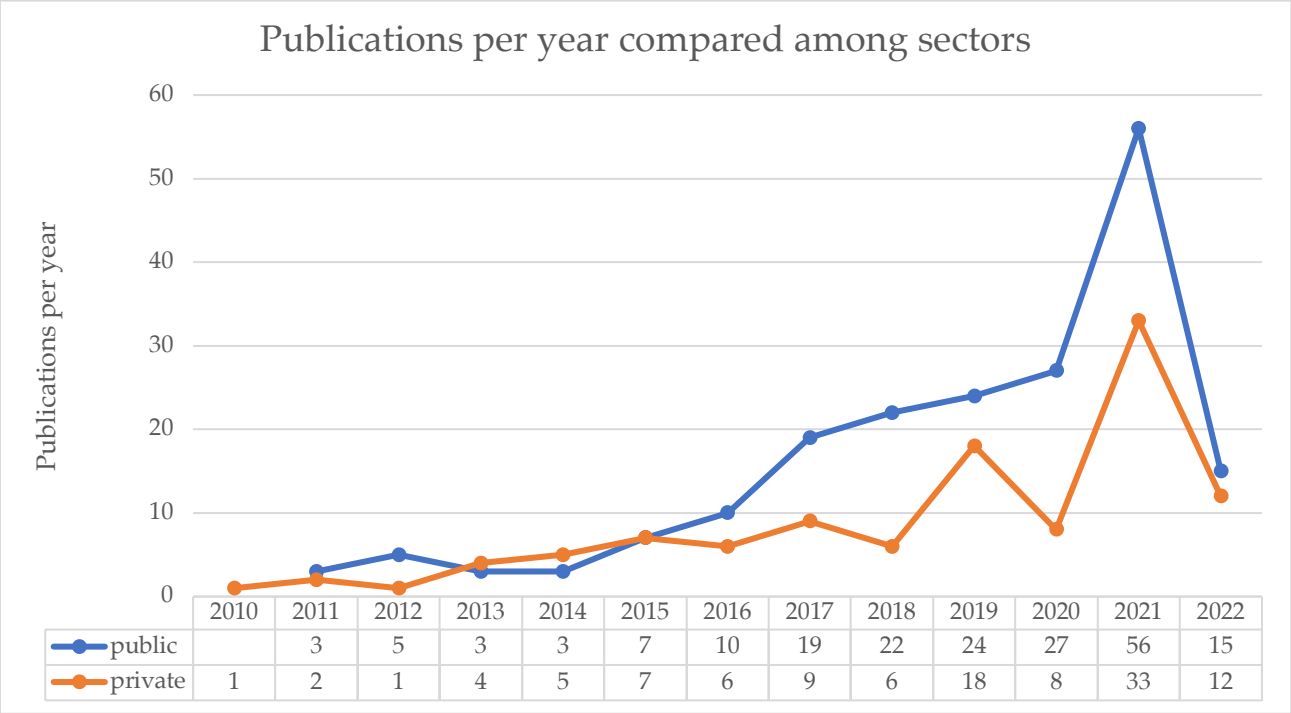


Figure 4 Private" vs. "Public" labeled publications

It stands out that how the "public" labeled publications appear to be more numerous than the private ones, counting 194 publications instead of 112 (Figure 4). This is probably related to how the articles have been selected. Indeed, publications that included case studies or surveys were preferred to those which did not. Considering the results given by the research on Scopus it was noticed how, in the case of publications referring to private initiators, there were more articles without case studies than in the case of the public labeled ones. This led, during the selection phase, to the elimination of more "private" labeled publications than it happened with the public ones, resulting in the numerical difference between the two categories.

It is interesting to make a comparison of the publications per year between the two categories (Figure 5).



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
public		3	5	3	3	7	10	19	22	24	27	56	15
private	1	2	1	4	5	7	6	9	6	18	8	33	12

Figure 5 Publication per year compared between "public" and "private" labeled publications

It can be noticed that until 2015, the publications per year of the two fields are relatively homogenous. However, from 2016 until 2022, a gap between the two appears, with the "public" labeled publications always being more numerous than their counterpart. This could be explained in the light of the fact that many of the "public" labeled articles describe the application of the crowd engagement process to tackle problems related to sustainability (Compagnucci et al. , 2021) and disaster management (Song et al., 2020), both of which are themes which are becoming increasingly important in the last years given the fact that sustainability is more and more becoming a global challenge (Hossain et al., 2019). At the same time, the Covid-19 pandemic started in 2020, triggered the experimentation by governments with crowd engagement procedures to manage the resulting crisis (Gama, 2021). It is therefore no surprise that some of the more recent publications will analyze exactly these kinds of responses by the government, as will be further discussed.

While reading both "public" and "private" labeled papers, it was noticed how some characteristics emerged which could be used to further classify the articles. First of all, most of the publications included an analysis of one or multiple case studies. This was for instance the case of a publication investigating the capacity of co-creation to transform the practices of the public sector in the context of urban development (Leino and Puumala, 2021). On the other hand, other papers drew their conclusions based on surveys, like when analyzing crowdsourcing applied with the purpose of performing translations (Dolmaya, 2012). Moreover, when considering a real-world application of crowd engagement, it stood out how in some cases, instead of leaving the participation to its challenges open to everyone, it was preferred by the initiator to control the acceptance of a certain candidate, leading to the creation of a "selected" crowd, vs. the "unselected" crowd which is formed when there are

no conditions on the inclusion of people. This was for instance the case of the datathon organized by Israel's Ministry of Health (MoH) to respond to the Covid-19 pandemic with the goal of involving the country's research community to develop data-driven models to address health policy challenges triggered by the virus. To select the participants, the candidates had to fill in some registration forms, the data of which included demographic, sector, and experience information of each participant. This facilitated the screening of participants by the MoH and professional auditors (Peleg et al., 2021). Moreover, it was noticed how the process of selecting the crowd was often coupled with the goal of making sure that the participants had specific knowledge and expertise, considered necessary to perform the required tasks, leading to the creation of a "skilled" crowd. This is generally not true in case the participation is left open to anyone, since this will lead to the inclusion of some participants who are experts in the task's field and others who are not. Indeed, in the already discussed datathon in Israel, the candidates with the best expertise in data science, epidemiology, and regulation and policy were selected. This leads, to the final distinction that can be made across articles about real-world crowd engagement applications. If in some cases the goal is to find solutions to problems that have been more or less rigidly defined through a top-down process, like in the datathon's case which was aimed at finding data-driven models, in other cases, the crowd engagement process wanted to enable the creation of bottom-up movements, leading to a collaboration between the crowd and the initiators in a decision making or agenda-setting process. This was the case with Better Reykyavic which is an online consultation website where city residents have the opportunity to put forward their ideas on issues related to services and operations of the City. The forum is open to all opinions and participation that accords with the Terms of Use (Lackaff, 2015).

1.3.2. Co citation analysis results

This sub-section is dedicated to the results of the co-citation analysis, the goal of which was to uncover the theoretical foundations of the articles of the sample. The output of Vosviewer, the software chosen to perform this task, is a graph made by a network of nods, each one representing one of the most co-cited references by the analyzed publications. The size of each element of the map is proportional to its importance, while the arcs connecting two different nodes highlight the fact that they have been cited together: the closer they are, the stronger the connection between the nodes will be (Van Eck and Waltman, 2014). It was decided to perform the co-citation analysis twice. The main one was conducted on the sample of publications regarding crowd engagement, so the "public" labeled documents, to understand and define the theoretical foundations of the process. Moreover, a supplementary analysis was performed only on the additional literature about similar methodologies applied by private companies, the "private" labeled publications, to enable a comparison to better identify what makes crowd engagement unique.

Before running each analysis, it was necessary to decide the minimum number of citations required for a reference to appear on the network. This decision has been taken considering the overall readability of the resulting graph and the insights it could so provide.

A sub-section has been dedicated to each analysis. All two of them start by describing the setting of the parameter and the resulting number of nodes in the network. They then proceed to describe the corresponding graph in terms of its elements and clusters and to comment on the results.

The main co-citation analysis was conducted on the sample of publications regarding crowd engagement to understand and define the theoretical foundations of the process. Moreover, a supplementary analysis was performed only on the additional literature about similar methodologies applied by private companies, to enable a comparison to better identify what makes crowd engagement unique.

1.3.2.1. Co-citation analysis on "private" labeled publications

Starting with the analysis conducted on the "private" labeled publications, the minimum number of citations for a certain publication was set at 7, which resulted in a graph with 27 elements. Among these, the analysis shows that the most important publications, as made clear by the size of their nodes, are: Chesbrough, 2003 a; Howe, 2006 and Von Hippel, 2005. It is also interesting to see how these papers belong to different groups of nodes. Indeed, the analysis shows how three clusters have been formed (Figure 6), which are representative of three different streams of academic knowledge in which the articles of the sample were rooted.

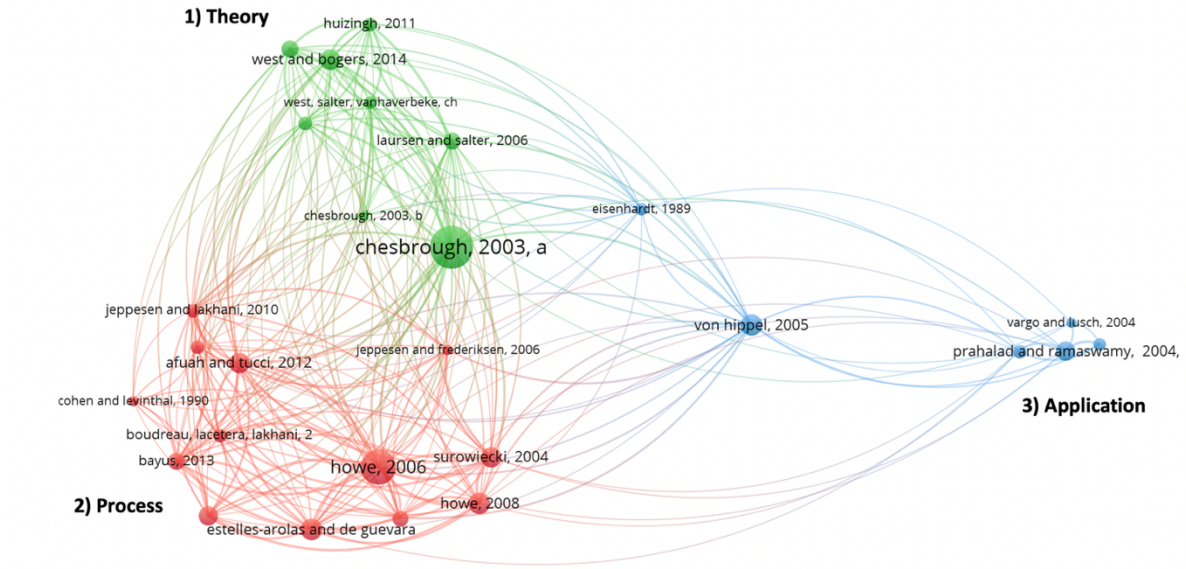


Figure 6 Graph representing the results of the co-citation analysis performed on the "private" labeled publications of the sample (n=192)

Starting with the green cluster, which was given the name "Theory", it stands out that its focus is set on the concept and theory of open innovation (OI). Indeed, all 8 articles are about open innovation: some of them focused on the conceptualization of OI (Chesbrough, 2003 a; Chesbrough 2003 b; Dahlander and Gann,2010; Enkel et al., 2009; Laursen and Salter, 2006; West and Bogers, 2014) while others exploring also its future developments (Huizingh, 2011; West et al. 2014). Amongst these, there is the most quoted publication by the articles of the sample (Chesbrough, 2003 a), which acts as one of the pivotal nodes connecting the different clusters. It appears to be the most homogenous group of all in terms of subjects explored, with all articles being about OI, with 3 of them having Chesbrough as an author.

The red cluster, which is the most numerous one, is focused on the theory and process of crowdsourcing and was given the name "process". Indeed, out of its 13 articles, 7 are directly focused on the process of crowdsourcing. These include three publications defining the process of crowdsourcing, its rise and its future impact on business (Howe, 2006; Howe, 2008; Estelles-Arolas et al. 2012), including Howe's seminal work "The rise of crowdsourcing". The remaining 4 articles describe crowdsourcing's potential for problem-solving, idea generation and distant search (Brabham, 2008; Poetz and Schreier, 2012; Afuah and Tucci, 2012; Bayus 2013). Still related to this concept, the cluster contains one publication focused on the concept of "wisdom of crowds" (Surowiecki, 2004). Finally, there are 3 articles focused on innovation contests, still within the theory of open innovation, (Terwiesch 2008; Jeppesen and Lakhani, 2010; Boudreau et al., 2011) and one describing the concept of absorptive capacity as the company's ability to recognize the value of new, external information, assimilate it, and apply it to commercial ends (Cohen and Levinthal 1990). Finally, an article appears that analyses the key personal attributes of the individuals responsible for innovation, namely the innovative users, to explain the creation of value in firm-hosted communities (Jeppesen and Frederiksen, 2006).

The last cluster, blue color, was given the name of "application" and is focused on the concept of co-creation. Indeed, among its 6 publications, 3 explore and define the concept of co-creation of value (Prahalad and Ramaswamy, 2004 a; Prahalad and Ramaswamy, 2004 b, Payne and Storbacka, 2008), redefining the relationship between company and customers, supporting a more active role of the latter. Still in this cluster and related to these articles, is Von Hippel's publication about democratizing innovation, intended as the fact that users of products and services, both firms and individual consumers, are increasingly able to innovate for themselves (Von Hippel, 2005).

Furthermore, one publication analyses how perspectives that have a revised logic focused on intangible resources, the cocreation of value, and relationships are converging to form a new dominant logic for marketing, in which service provision rather than goods is fundamental to economic exchange (Vargo and Lusch, 2004).

Finally, it contains only one publication that does not explore similar concepts while being instead focused on the process of inducting theory using case studies (Eisenhardt 1989). This

can be explained by the fact that this theory is still very young and real-world examples have been used to build it.

It is interesting to notice how the green and red clusters are overall closer to one another than to the third one, which shows a greater distance from them.

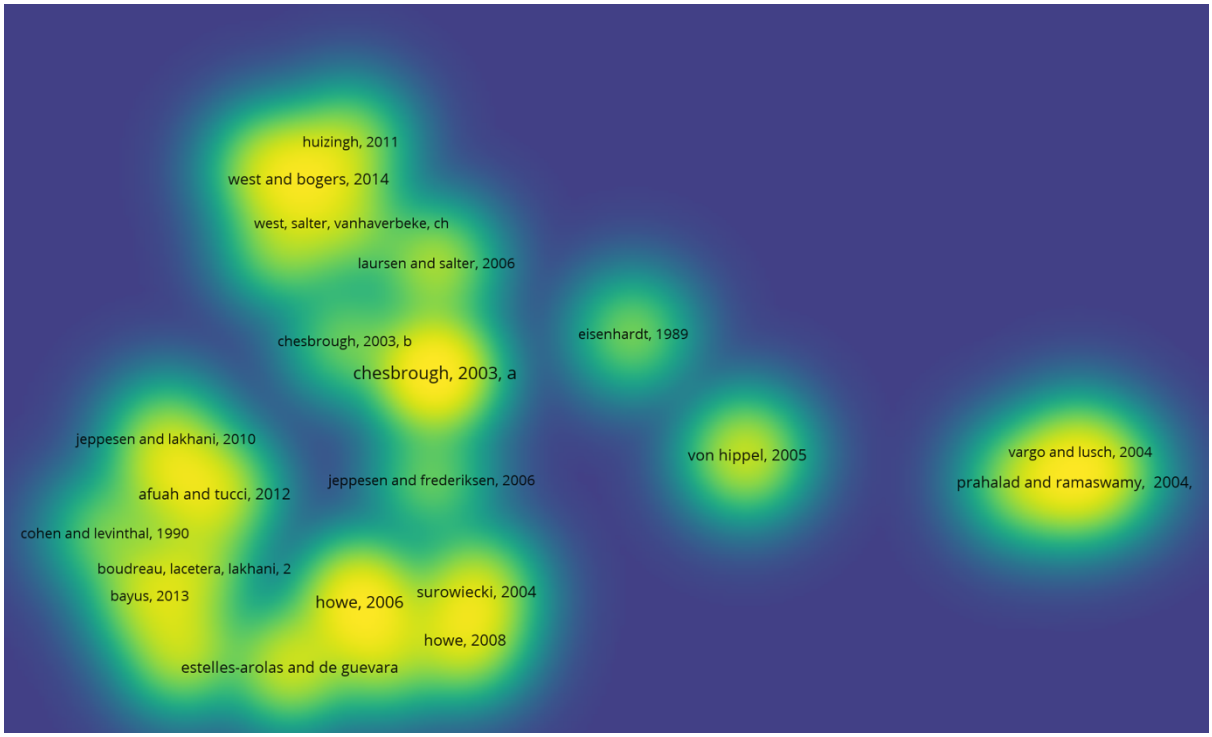


Figure 7 Density-based view of the co-citation results of the "private" labeled papers (n=192)

According to the graph, and its density visualization (Figure 7) Von Hippel 2005 acts as a focal node, connecting the knowledge streams of all three clusters one with the other. Indeed, it is the node showing the overall highest number of links.

1.3.2.2. Co-citation analysis on public labeled papers

The main co-citation analysis was performed on the sample made of the publications about crowd engagement, labeled as “public”. It was decided to set the minimum number of citations to 6, which led to a graph with 23 nodes divided into three clusters.

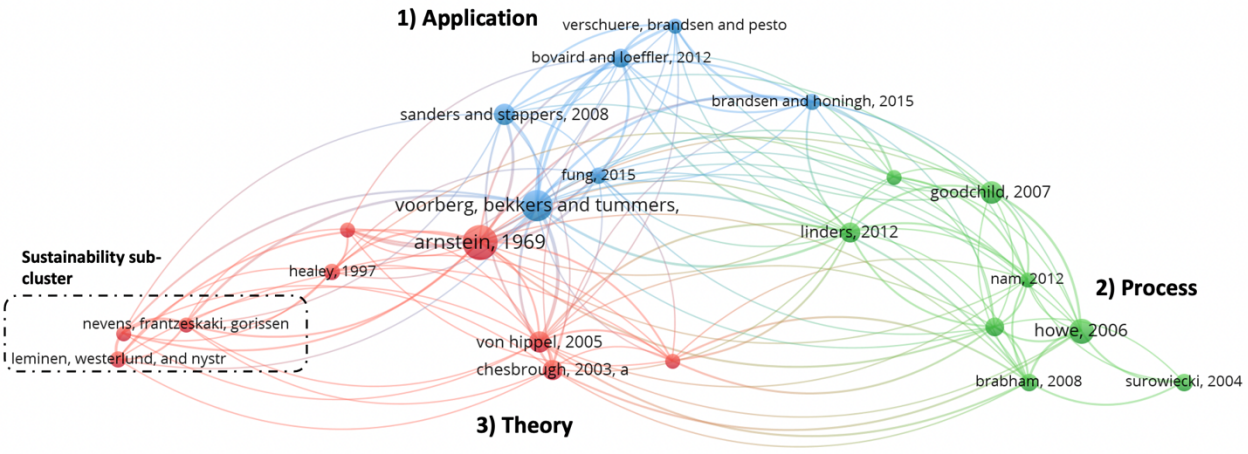


Figure 8 Graph representing the results of the co-citation analysis performed on the "public" labeled publications of the sample (n=194)

Among them (Figure 8), the red one includes significant new concepts while the other two (the green one and the blue one) are similar in content with the clusters of "methodology" and "application" already discussed in the first co-citation analysis. Indeed, it can be observed how they are still respectively focused on the themes of crowdsourcing and co-creation while exploring them from the perspective of public initiators instead of private ones as was the case in the previous analysis. The red cluster, instead, while showing some articles about open innovation, introduces what will be the most relevant difference between the two co-citation analyses.

Starting with the "application" cluster, the main theme remains the concept of co-production, now explored in the public sector, especially regarding its application for the design of public services. It includes two articles focused on co-production for public value creation (Bovaird and Loeffler, 2012; Voorberg et al., 2015). Moreover, there is one publication discussing the state of the art in research on the co-production of public services (Verschuere et al., 2012) while another one explores several different types of coproduction of public services (Brandsen and Honingh, 2016).

Finally, the last publication is about the potential of citizen participation to advance three values of democratic governance: effectiveness, legitimacy, and social justice (Fung, 2015). The last two mentioned articles were both published in the journal "public administration review".

The "process" cluster remains focused on the concept of crowdsourcing, especially when applied in the public sector. Apart from three articles that had already appeared in the

corresponding cluster of the co-citation analysis on the "private" labeled publication which focused on the theory behind crowdsourcing and the wisdom of crowds (Howe, 2006; Brabham, 2008; Surowiecki, 2004), all the other nodes more specifically refer to the public sector. Indeed, some publications discuss crowdsourcing's application to involve citizens in the urban planning process (Brabham, 2009), how citizen-sourcing can be conducted via platforms enabled by web 2.0 technologies (Nam, 2012) and the concept of volunteered geography, which is based on the use of the internet to assemble and disseminate geographic information provided voluntarily by individuals (Goodchild, 2007).

Moreover, it is interesting to notice how this cluster also includes two publications focused on the concept of co-production in the public sector, with one exploring its application for the design of public services (Bovaird, 2007), while the other tackling the theme in the context of e-governments and social media (Linders, 2012).

Finally, the red cluster**,** called "theory" is especially interesting as it includes some knowledge which was not uncovered from the previous co-citation analysis.

It explores the concepts of open innovation and democratization of innovation (Chesbrough, 2003; Von Hippel, 2005), by looking at the application of OI specifically in the public sector (Hilgers, 2010). The inclusion of Arnstein's seminal work about citizen participation "A ladder of citizen participation" (Arnstein, 1969) strengthens the focus on the public sector, which, as analyzed by another article of this cluster, is being transformed into an environment for co-creation, evolving from a situation where governments strictly respect a service provider role (Torfing et al., 2019). Furthermore, an article exploring collaboration among citizens (Healey, 1997) is included in this group.

What is interesting about this cluster, is the appearance of three articles exploring the concepts of applying open innovation and co-creation to reach sustainability, and living labs (Leminen et al., 2012; Nevens et al., 2013; Voytenko et al., 2016), which appear to go hand in hand. Indeed, living labs bring experimentation to real-life environments with the participation and co-creation of users, partners, and other parties, creating innovations that have a superior match with user needs (Leminen et al.; 2012). Moreover, the LL concept is being operationalized in contemporary urban governance for sustainability and low-carbon cities (Voytenko et al., 2016), being the settings in which real-life trajectories of sustainable development in cities are deployed and at the same time carefully observed (Nevens et al.; 2013). The cluster therefore anticipates the importance of the role played by cities to reach sustainability goals, as they are the operational units in which concrete actions can be envisaged, designed, politically facilitated and effectively rolled out (Nevens et al.; 2013).

The appearance of the concepts of living lab, sustainability and cities is not casual. Indeed, they will play a dominant role in the results of the text mining analysis.

In conclusion, by comparing the two analyses, it can be noticed how the reference literature related to the "private" labeled publications is more concentrated than the one related to the

"public" labeled papers, since the latter's graph shows fewer nodes, even though it has a lower number of minimum citations and more articles in the sample. Moreover, as can be seen from the map (Figure 8), the clusters of the second analysis appear to be closer than those from the co-citation on the private sector, and also show an overlap in terms of themes as shown by the "methodology" cluster which, beyond crowdsourcing, also deals with co-creation, which is the core concept of the "application" one. This might signal how the three knowledge streams building the theory of crowd engagement might be less clearly separated from each other than those of the private analysis, being combined to shape the identity of crowd engagement.

1.3.2.3. Overview of the results of the co-citation analysis

The main co-citation analysis was conducted on the sample of publications regarding crowd engagement, the "public" labeled documents, to understand and define the theoretical foundations of the process. Moreover, a supplementary analysis was performed only on the additional literature about similar methodologies applied by private companies, the "private" labeled publications, to enable a comparison to better identify what makes crowd engagement unique.

The results of the main analysis show how the process' theory is rooted in publications organized in three knowledge clusters focused on open innovation, crowdsourcing and both co-creation and citizen participation, with the first three concepts being discussed taking the perspective of public institutions. The results from the additional literature show the same three clusters, sharing some seminal papers with the main analysis, though adopting the point of view of private companies and excluding the concept of citizen participation. However, the presence in the main analysis of publications regarding open innovation's and co co-creation's applications to reach sustainability (Leminen et al., 2012; Nevens et al., 2013; Voytenko et al., 2016) clearly sets apart the two results. Consequently, it is shown how crowd engagement's theory is rooted in the concepts of open innovation, crowdsourcing, co-creation and citizen participation, which are combined with the one of sustainability in the creation of the unique identity defining the novel process.

1.3.3. Text mining analysis results

After having understood the theoretical foundations of the sample through the co-citation analysis, the next step of the research was to perform a text-mining analysis on the papers of the sample. The aim of such methodology is to uncover the most relevant concepts and themes of the publications, making it so possible to reach a higher level of granularity in the research. The main output of such analysis is the "concept map" in which concepts are represented as nodes, grouped in bubble-shaped clusters which define a theme. The bigger the cluster, the more nodes it contains, while the closer they are, the more related their concepts are. Some bubbles even overlap partially, signaling a strong relationship between the themes.

Starting from the map, concepts and themes have been analyzed by connecting them to the relative publications in the sample. To do so, an Excel document was created, where the concepts from the map have been grouped into clusters. Then, for each concept, the publications that had that specific concept in their keywords were found and analyzed to better understand its multiple meanings within the sample. From that it was then possible to define the meaning of a certain theme or cluster, by combining the insights coming from the in-depth analysis of each concept belonging to it.

The analysis has been performed twice: once on the sample made of the "public" labeled documents and once on the literature of "private" labeled publications. The results of the former, were deeply analyzed by considering every single concept it displayed, as stated above, while the latter was used to make comparisons with the former's results.

The first versions of the concept maps displayed a very high number of concepts, making it therefore hard to interpret them for the generation of insights. To solve this problem, concepts which shared similar meanings, for instance the singular and plural forms of the same noun or different conjugations of the same verb, were merged into single concepts, while concepts which were not relevant to the research were eliminated from the thesaurus of the software. To make the cleaning process as robust as possible, an additional thesaurus was created using Leximancer's feature which automatically merges terms considered as similar by the software. It was so possible to compare the initial thesaurus with the one generated using the above-mentioned feature to look for possible terms that could be merged in the former, supporting the cleaning process also through the software's suggestions. It was decided not to directly use this feature for the generation of the final results, while using it to make comparisons and support decisions about which concepts to merge, since Leximancer would have automatically merged together also terms which had to be kept separate because of their different meaning, which could be understood only by the researchers based of their understanding of the subject and not by the software.

Moreover, some compound concepts were generated to improve the results of the analysis. Compound concepts are concepts made of multiple single ones which are connected through logical operators. For instance, "living lab" can be expressed as a compound concept by connecting the single terms "living" and "lab" as "living AND lab". As a result, the map will show both single concepts and the compound ones.

The following two sub-sections are dedicated respectively to describing the results of the text mining analysis performed first on the "public" labeled papers and then on the private labeled ones. It will be so possible to highlight the main difference between the two sectors.

1.3.3.1. Text mining on the sample ("public" labeled publications)

The text mining analysis of the sample made of the "public" labeled papers led to a concept map made of 9 themes many of which overlap (Figure 9).

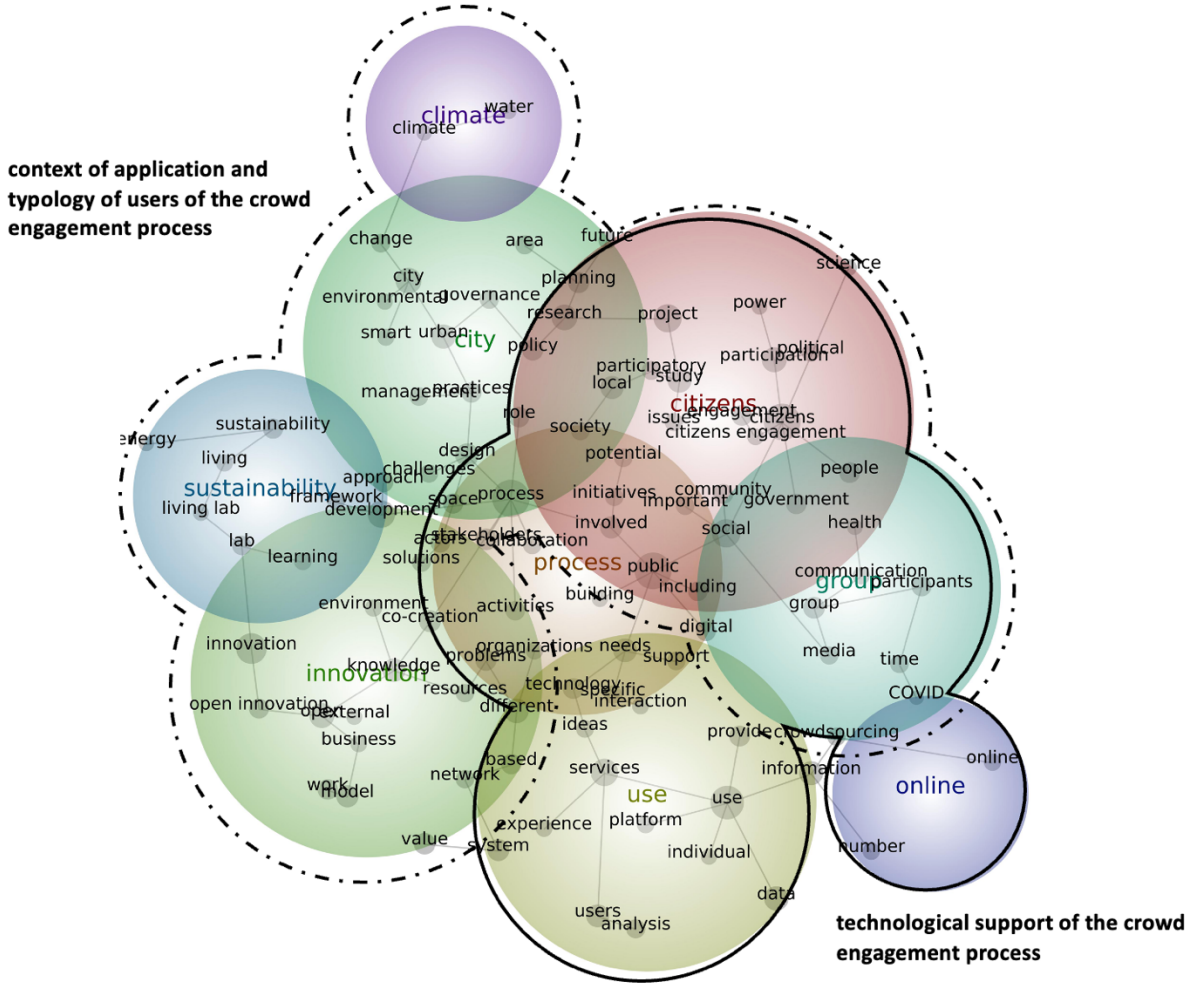


Figure 9 Concept map of the text analysis performed on the "public" labeled papers of the sample (n=194)

The final purpose of this analysis was to explore the concepts discussed in the literature about crowd engagement to analyze the process's main applications and contexts. This will support the identification of its main features, comparing it to the methodologies of "crowdsourcing", "open innovation", "citizen participation" and "co-creation", which have been defined as "proxies" used by the traditional literature for this phenomenon, as suggested by the panel of experts in the "sample selection" section. This will help to better identify the elements that crowd engagement took from each of these concepts therefore, in combination with the co-citation analysis, leading to the formulation of the final definition of the novel process.

By exploring the content of the themes, it was noticed that there were some subjects on which the papers were focused which appeared to be particularly relevant and shared by more than one theme. Consequently, two macro clusters have emerged which focus

respectively on the context of application of the crowd engagement process and on the technology that supports and enables these initiatives (Table 3).

Moreover, for the first macro-cluster, it was possible to identify two sub-clusters, still based on the homogeneity among subjects explored by the different papers included in them, as will be better explained below.

Each macro cluster will be thoroughly described and discussed in a dedicated paragraph in which all of their themes will be individually analyzed.

Table 3 Structure of the "clusterization" of the results of the text mining analysis performed on the "public" labeled papers

MACRO CLUSTER	THEMES
"*Context of application and typology of users of the crowd engagement process*"	Sub cluster 1, **"***Reshaping the role of the citizens and managing complex problems*": • Citizens • Group Subcluster 2, "*Applying crowd engagement in the urban environment and supporting sustainability*": • Innovation • Sustainability • Climate • City
"*Technological support of the crowd engagement process*"	• Online • Use • Process • Citizen • Group

First macro cluster: "Context of application and typology of users of the crowd engagement process"

The first macro cluster is called "context of application and typology of users of the crowd engagement process" and it is about crowd engagement's applications, goals and users. It includes six themes, that can be divided into two sub-clusters (Table 4) based on their most

relevant subjects, as discussed above, which focus on the context of application of the crowd engagement process and on the technology that supports and enables these initiatives.

Table 4 Composition of the first "macro-cluster": "Context of application and typology of users of the crowd engagement process"

SUB CLUSTER	THEMES
SUBCLUSTER 1: "Reshaping the role of the citizens and managing complex problems"	• Group • Citizens
SUBCLUSTER 2: "Applying crowd engagement in the urban environment and supporting sustainability"	• Innovation • Sustainability • Climate • City

First subcluster: "Reshaping the role of the citizens and managing complex problems"

The first sub-cluster explores how crowd engagement can be applied by public institutions to satisfy the citizens' request for a change in their relationship with the government that grants them a more active role. Thus, the application of the process in the public field is explored, showing how governments and public institutions have found multiple ways of exploiting and adapting it according to specific contexts and goals to be reached.

Finally, crowd engagement's potential for managing complex and transversal challenges, like the Covid-19 pandemic, is discussed

"Groups" theme

First of all, the "*Groups*" theme includes two very important concepts: government and crowdsourcing. It shows how the relationship between government and citizens is changing and how this change is demanded by the citizens who want to be more actively involved by the government. One possible implementation of such change is given by the concept of open government (Maier-Rabler and Huber, 2011) and open government data (OGD) which is related to the concept of co-creation. Indeed, OGD appears to have the potential to play a catalytic role in driving and enabling the co-creation of new public services. (McBride et al., 2019).

Other practices that are representative of the change in the citizen-government relationship are the e-government, which an increasing number of countries in the EU are experiencing (Irimie, 2015), and the one of e-democracy as shown by the Iceland constitution example where the government leveraged on ICTs to give citizens the possibility to define potential constitutional reforms (Freeman and Quirke, 2013).

In particular, in the case of e-democracy, crowd engagement emerges as the method to apply its collaborative principles, allowing governmental and non-governmental stakeholders to interact and join the debate (Toode, 2020). However, for e-democracy to be successful, it is important to highlight how governments should not limit themselves to one-way information provision and service delivery, which is generally the case of e-governments, but facilitate active civic engagement through two-way, ongoing dialogue (Freeman and Quirke, 2013).

Of pivotal importance to enable this relationship change are ICTs, which make it possible for governments to interact with citizens and to collect large amounts of data (Irimie, 2015), as will be further explored in the macro cluster "new technological support".

It stands out from this theme, how crowd engagement is often used by governmental institutions to promote citizen-government interaction (Lackaff, 2015), with the goal of dealing with very complex and uncertain situations. The most recent example is the covid 19 pandemic where governmental institutions have organized hackathons and dathathons (Gama, 2021) like in Sweden (Temiz, 2021) or Israel (Peleg et. al, 2021) to address the challenges brought by the virus.

Moreover, crowd engagement has been applied by governments and NGOs to deal with the complexity of disaster management, like with the PetaJakarta.org system, which was deployed to aggregate the locations and conditions of local flood events reported by the public via social media and to generate an open real-time map of the city's flood situation (Song, 2020).

Furthermore, the process has been applied by governments also to manage other kinds of complex issues, like urban planning (Puritat, 2019) and addressing and solving complex environmental problems (Coleman et al., 2017).

All things considered, this theme shows how when public institutions have to deal with complex problems like disaster management, pandemics and environmental challenges, they can rely on crowd engagement, which has proven itself in the past years as a valid and effective response to solve such problems (Nesti, 2018). Indeed, as it emerges from its application to manage natural disasters, from the governments' and NGOs' point of view, crowd engagement leads to the benefits of strengthening communication and coordination, optimizing emergency decision-making, and improving the ability to learn and adapt, which support and enable the solution of wicked problems. (Song, 2020),

"Citizens" theme

The second and last theme of this macro-theme is called "*citizens*" and it is directly related to the concept of "citizen participation". It includes the important concepts of "citizens", "participation", "local", "engagement", "community", "society", "political", "citizen engagement" and "science", to be intended as "citizen science". It explores the processes of citizen engagement and co-creation in the public field putting its focus on the citizens.

The related articles show how the process of crowd engagement will be one of the pillars of smart communities and smart cities. Such statement is in line with the fact that smart cities should be “citizen-centric”, meaning that when defining services, the government should try to anticipate the citizen's needs while adopting a broad and continued citizen engagement and participation process (Iqbal and Olariu, 2021). Crowd engagement will make this possible. Iqbal and Olariu even argue how this process might eventually lead to smart communities morphing into society 5.0 where the Marketplace of Services will develop into a platform for the close collaboration between citizens and their government in the co-production of services.

Going more in detail in terms of its application, it is possible to involve citizens through crowd engagement for different purposes, as will be explained in the next few lines.

Many digital participatory platforms (DPPs) have been developed to facilitate co-production between citizens and governments in the context of urban development and some of them demonstrate real potential (Falco and Kleinhans, 2018). An example of citizen engagement for urban development is “Engage Liverpool”, a large grassroots residents' initiative in Liverpool city which gave city center residents the ability to contribute to the developmental discussions for the city's strategic direction for development for the next 30 years (Speake and Pentaraki, 2017). However, it stands out how attempts to institutionalize a more active role of citizens in urban planning can still be difficult and time-consuming in some cases (Bisschops and Beunen, 2019).

Moreover, “spatial crowdsourcing” is a promising approach to promote informed citizen engagement in the context of natural resource revenue management, like with petroleum-funded projects in Ghana (Ogbe and Lujala, 2021).

Crowd engagement and citizen participation can also be applied to policymaking. An example is the involvement of non-expert citizens in EU copyright policymaking (Vetulani-Cęgiel and Meyer, 2021). Indeed, new public governance studies have increasingly sought to highlight the importance of citizen engagement in local decision-making processes as a way to identify suitable approaches to matters of public concern (Eckardt and Benneworth , 2018).

An interesting case reported by one article is the one of the Estonian citizen assembly (ECA) where crowdsourcing and deliberate mini-publics were applied to create the ECA as a response to a legitimacy crisis of Estonians political parties: Interestingly, in this case, social trust by the participants increased while their trust in the political institutions decreased (Karlsson, 2021).

Another potentially interesting and useful application of crowd engagement in the public field is “Volunteered geographic information (VGI)," which "delivered via mobile and web apps, offers new potentials for civic engagement" (Sangiambut and Sieber, 2016).

Last but not least, another possible way to exploit crowd engagement in the public sector is to facilitate communication and management between citizens and administration in reporting of issues and claims but also in submitting proposals, like in the case of Miramap. (De Filippi et al., 2016)

The potential of co-creation is based on its promise to break down hierarchies between local government, business life, universities, citizens and other stakeholders. However, since not all participants are the same it is important to know who participates and whose voices are heard (Leino and Puumala, 2021). This cluster highlights one possible challenge institutions should overcome when applying crowd engagement: failing to design the process to make sure all possible groups of people are involved. The risk is ending up with results that are not representative of the whole target population. In other words, for crowd engagement to be successful, it is of paramount importance to design the initiatives to make the involved crowd representative for society at large (Baek and Kim, 2018), and not just for the most vociferous people (May and Ross, 2018). Therefore, it should be designed to be as inclusive as possible.

For example, to tackle such problem, gamification has been experimented in multiple cases as a way to simplify the engagement process (Ampatzidou, 2018) and make it more accessible for everyone, like in the case of the city of Tirol, Brazil, where Minecraft was exploited to involve children in the process of urban planning (de Andrade et al., 2020). Moreover, play and interactive art have been used to strengthen public spaces by fostering citizen engagement and participation (de Lange, 2019).

A similar problem affects also another concept appearing in this cluster: citizen science. Indeed, it is possible to involve citizens in research projects according to the citizen science process, even with the intention of pursuing sustainability goals (Skarzauskiene and Mačiulienė, 2021). However, sometimes there is the problem of not knowing the participants of these projects well enough (Moczek et al. ,2021). It is therefore important that the process promotes inclusion and diversity.

Finally, from the politicians' point of view, orchestrating the co-creation of public value projects may strengthen their political leadership role (Torfing and Sørensen, 2019) while it has become clear that building participatory environmental governance must be considered as a long-term project for it to succeed (Fleischman and Solorzano,2018).

Second subcluster: "Applying crowd engagement in the urban environment and supporting sustainability"

If the first sub-cluster explains how crowd engagement can be successfully applied by governments to manage complex challenges, the second one, called "Applying crowd engagement in the urban environment and supporting sustainability", deep dives into one of the most urgent complex problems our society is facing nowadays: climate change. Indeed, it explores crowd engagement's potential to increase sustainability in the urban landscape and manage natural disasters, therefore also tackling climate change.

In such context, the key role of cities in the implementation of such projects emerges, which is the reason why this sub-cluster explores more in detail how crowd engagement is applied specifically in the urban setting, helping to "unlock" the potential of smart cities.

"Innovation" theme

The first theme of this macro theme is called "*innovation*" and it is focused on the application of open innovation in the public sector. Special attention is immediately given to the concept of "living lab", which will be recurring in the whole macro cluster, seen as a way to implement co-production for value creation by involving citizens (Kovács, 2016) in the context of urban living (Nesti, 2018).

Furthermore, other two very important concepts are introduced, which will be dominant throughout this macro cluster and often deeply connected to each other, which are "cities" and "sustainability". Indeed, open innovation can be applied to foster sustainable urban living (Genuchten et al., 2019), for instance by enabling collaboration through the organization of hackathons and living labs (Leminen et al., 2021). Examples are the application of citizen participation to design nature-based solutions (NBS), as will be described more in detail in the "sustainability" theme, to tackle the growing problem of climate change (Arlati et al., 2021) or crowdsourcing last mile deliveries by exploiting the network of already moving citizens to transport goods (Giret et al., 2018).

Finally, it shows how, since 2020, crowd engagement has been applied by governmental institutions to tackle the very complex problems caused by the covid pandemic through the organization of innovation contests and hackathons (Gama, 2021).

"Sustainability" theme

The "*sustainability*" theme includes two very important concepts which are also relevant for other clusters: "sustainability" and "living lab".

First of all, it is pivotal to understand that cities are becoming increasingly important in tackling climate change issues (Genuchten et al., 2019). To do so open innovation approaches are applied and the government plays a very important role in infrastructuring co-creative partnerships (Genuchten et al., 2019). Indeed, open innovation can enhance sustainable innovation ecosystems (Costa and Matias, 2020). To implement such projects, living labs (LL) can play an important role, since they represent a way to reach sustainability goals by supporting interaction between different stakeholders (Campagnucci et al., 2021). Moreover, among the different types of living labs, the concept of Collaborative Urban LL appears to be particularly effective at promoting collaborative decision-making to reach sustainability (Cerreta and Panaro, 2022).

It therefore stands out how the concepts of "sustainability" and "living lab" are strongly linked. This is motivated by the fact that co-creation appears to be the only viable solution for governments to deal with problems of growing complexity like climate change (Nesti, 2018). At the same time, living labs enable the required co-creation of value by actively engaging citizens, but also firms and business systems, in promoting innovation and sustainability (Campagnucci et al., 2021), therefore supporting a process from which the economy, society and environment will benefit (Campagnucci et al., 2021).

A particular application of LLs in response to climate change, is the planning and design of Nature-based solutions (NBS) (Ariati et al., 2021), which are, cost-effective, environmentally friendly, socially responsible, and resilient solutions that draw their inspiration and support from nature. Indeed, such process requires the co-creation and cooperation of multiple stakeholders, like it is shown by some projects that took place in the city of Hamburg (Ariati et al., 2021) where different living labs were organized for NBS: one was for example focused on the implementation of green roofs and facades and water management while another one fostered the redesign of schoolyards. It should be highlighted how for NBS a collaborative approach appears to work better than the classical top-down approach used by governments (Zingraff et al., 2020), motivating the use of the crowd engagement process for their implementation and design.

Finally, to foster sustainability in cities, the crowdsourcing approach can be used to make last-mile delivery more sustainable as well. To do so, it is possible to reduce the number of movements originated by the parcel delivery by taking advantage of the citizens' movements. In this way the citizens that move around the city, because of their own needs, become temporal deliverers. (Giret et al., 2018).

"Climate" theme

The "Climate" and "sustainability" clusters are strictly related. Indeed, it is climate change and its long-term consequences that call for increased attention toward sustainability. The former of the two, shows how citizen empowerment, engagement and co-production are ideal to deal with *climate* change, and proved themselves as a key way to drive urban change through living labs (Olson et al., 2021) and to tackle water-related issues, thanks to the exploitation of ICTs and digitalization. Indeed, this cluster is made just by two concepts: climate and water.

The related publications explore how there is a need for citizen engagement in disaster and adaptation management to deal with climate variability and extremes caused by climate change (Brink and Wamsler, 2018). An interesting concept emerging from one article in particular is the one of deliberative democracy, which appears to be very well suited as a method to deal with climate change. Indeed, the process of deliberation has the potential to expose participants to a variety of views, engaging them in conversations with views they might not share, and to make people aware of the complexity, helping them to adopt a long-term view of the problem (Torney, 2021).

This theme highlights how, as it already emerged from other themes, crowd engagement can be exploited to deal with disaster management, in particular when it comes to water-related issues. Indeed, for example, it makes it possible to collect data to improve the modeling of floods, as it was done in Dar es Salaam, Tanzania, where such process demonstrated a high potential when it was applied for community mapping and the development of an automated flood inundation model (Gebremedhin et al., 2020). Moreover, ICTs can be exploited to manage floods through citizen engagement (When et

al., 2015), which has also been applied to grant access to water where necessary, like in Ghana (Mangai and De Vries, 2018).

It is no wonder that the "water" and "climate" concepts are related since most water problems are directly related to climate change. Even though they are strictly connected, this theme is slightly different from the sustainability one. If the latter is focused on increasing and reaching sustainability through the application of crowd engagement to prevent future problems, the former is more focused on tackling climate change itself and its consequences that are already unfolding, while stating how crowd engagement should drive urban change for sustainability, as a response to climate change.

"City" theme

The "*city*" cluster is focused on the applications of crowd engagement within the specific context of cities.

It is projected that by 2050, 80% of the world's population will live in cities (Cilliers and Flowerday, 2017) which will play an important role in defining the coming decades, especially when it comes to reaching sustainability to tackle climate change.

This cluster tells us how crowd engagement, citizen participation and crowdsourcing are becoming relevant processes to shape the cities of the future, not only through the design of urban spaces and of nature-based solutions, but also by redefining the democratic processes and mechanisms that lead to policy-making and future agenda-setting.

Indeed, crowd engagement has been used on multiple occasions to manage the urban development process (Scholl and Kemp, 2016) not only by providing concrete solutions to problems, like developing a brownfield site into a new vital area (Bisschops and Beunen,2019), but also by actively supporting and taking part in the decision-making process and planning for the future. This was shown by the town of Marcoussis (France) which represents an emblematic case of participatory foresight and policy design process, through the involvement of non-expert citizens (Gouache, 2022).

A very interesting finding from the articles related to this cluster, is the fact that crowd engagement could reshape democratic processes, increasing their transparency and the trust citizens put in them. This is represented by the emblematic case of Better Reykjavik, an initiative where residents could put forward their ideas that had significant deliberative mechanisms. It stood out from the case how bottom-up, fast-moving initiatives could potentially support the typically slow democratic process (Lackaff, 2015). Also in this context of application of crowd engagement, living labs appear to be effective for the implementation of co-governance (Bifulco et al., 2017).

Central to this cluster is the concept of "smart cities", intended as instances of Cyber-Physical Systems (CPS) wherein the cyber and physical components feed, condition, and learn from each other. In other words, smart cities leverage on modern technologies to create fully connected communities, which are based on the characteristics of being “human (or citizen) centric” (Iqbal A. and Olariu, 2021). Crowdsourcing emerges as a way to exploit the new possibilities offered by smart cities, like collecting data for more efficient use of resources (Cilliers and Flowerday, 2017). Moreover, this process has proven to be an effective way to involve citizens in the co-creation process of public services (Liu, 2021). To do so, living labs appear to be effective.

Finally, cities will play a key role to tackle climate change and all its related problems and will be pivotal to implement projects to reach sustainability (Leminen et al., 2021). Here again, living labs have proven to be an effective way to plan and design nature-based solutions to tackle the climate crisis (Arlati et al., 2021). It is no wonder then, that on the concept map, the “city” cluster acts as a bridge between the “climate” and “sustainability” clusters, with both of which it overlaps.

To sum up, cities will play a role of growing importance in the future as most people will live in them and will be pivotal to face the challenges of the coming decades. In such context, crowd engagement is emerging as a potential way to tackle the problems of urban planning, public service design and provision, climate change and resource management; and to improve the dynamics of the cities for instance by enabling shared governance (Mahmoud et al., 2021) and participatory policy planning.

The following table summarizes the most important results emerged from the analysis of this macro cluster (Table 5).

Table 5 Summary of the most important results of the first "macro-cluster": "Context of application and typology of users of the crowd engagement process "

MACRO CLUSTERS	THEMES AND SUBCLUSTERS	RESULTS
"Context of application and typology of users of the crowd engagement process"	Sub cluster 1: "Reshaping the role of the citizens and managing complex problems" Themes: • "Citizens" • "Group"	Crowd engagement emerges as an answer to the citizens' request for a change in their relationship with governmental institutions that grants them a more active role (Maier-Rabler and Huber, 2011). Indeed, it makes it possible for citizens to be more actively involved for instance in the processes of strategic planning (Speake and Pentaraki, 2017) and policymaking (Eckardt and Benneworth, 2018). Moreover, crowd engagement appears to be the key enabler of both e-democracy (Toode, 2020), as it supports two-way dialogue between the two parties (Freeman and Quirke, 2013), and of "citizen-centric" cities (Iqbal and Olariu, 2021) It is furthermore highlighted how crowd engagement has the potential to manage complex problems like natural disasters (Song, 2020) or the Covid-19 pandemic (Gama, 2019). This sub-cluster also shows how crowd engagement has been applied to involve the citizens for a variety of purposes, like urban planning (Speake and Pentaraki, 2017) and policy-making (Vetulani-Cęgiel and Meyer, 2021). Finally, for crowd engagement to be successful, it is of paramount importance to design the participatory initiatives to make the involved crowd representative for society at large (Baek and Kim, 2018), and not just for the most vociferous people (May and Ross, 2018).
	Sub cluster 2: "Applying crowd engagement in the urban environment and supporting sustainability" • Themes: • "Sustainability" • "Climate" • "City" • "Innovation"	Crowd engagement is defined as a promising approach to fighting climate change and reaching sustainability in urban contexts (Nesti, 2018). To make this happen, governmental institutions play a key role in infrastracturing co-creation processes for the purpose of sustainability (Genuchten et al., 2019) with cities becoming the primary context for these initiatives to unfold and be successful (Leminen et al., 2021). In particular, living labs emerge as an effective approach to implementing participatory processes for sustainability (Campagnucci et al., 2021). Furthermore, there is a need for citizen engagement in disaster and adaptation management to deal with climate variability and extremes caused by climate change (Brink and Wamsler, 2018). Indeed, it is discussed how crowd engagement has proven successful to manage water-related issues through community mapping and improving flood modeling (Gebremedhin et al., 2020) Finally, when implemented in the urban context, the applications of crowd engagement are manifold, like urban planning (Scholl and Kemp, 2016) and public service design and provision (Liu, 2021).

Second macro cluster: "Technological support of the crowd engagement process"

The second macro cluster called "Technological support of the crowd engagement process" is about the technology used to enable and support the process of crowd engagement initiated by public institutions or nonprofit organizations. The important role of digital technologies and ICTs is explored, showing how they can be exploited to improve the crowd engagement process by simplifying its implementation and opening up new possibilities for the management of complex problems while, if correctly deployed, overcoming one possible challenge of such process already highlighted by the "citizen" macro cluster: ending up with involving a crowd that is not truly representative for all people who will be exposed to the results of the initiative. Indeed, modern technology expands the reach of crowdsourcing initiatives, making it possible to hear even the voices of marginalized people, making the process as inclusive as possible.

This macro cluster is made of five themes (Table 6) which have been selected based on the fact that they all share the focus on subjects related to the exploitation of technology to support and enable the crowd engagement process.

Table 6 Composition of the second macro cluster " Technological support of the crowd engagement process "

MACRO CLUSTER	THEMES
Technological support of the crowd engagement process	• Online • Use • Process • Citizen • Group

"Online" theme

The first theme highlights the important role played by *online* channels as tools to connect people in the implementation of crowd engagement. To do so, digital participatory platforms are often used and have shown real potential for both online and offline co-production between governments and citizens (Falco and Kleinhans, 2018). This was the case of the Estonian People's Assembly (ECA), which showed how these democratic initiatives influenced participants' social and political trust (Karlsson M. et al., 2021). Moreover, the Covid-19 pandemic has shown how online channels can be exploited to implement crowd engagement when it is required to overcome physical and national barriers to handle complex problems, as demonstrated by the many cases of governments organizing hackathons and dathathons to manage the covid pandemic with successful

results (Gama K, 2021). Indeed, the EUvsVIRUS case proved that crowd engagement, with the support of technology, can even go beyond national boundaries and connect people at an international level (Gama K, 2021). Furthermore, this theme shows the relationship between online communities and collective intelligence and some opportunities offered by artificial intelligence (AI) in the context of online engagement processes. Indeed, it stands out how online communities might be considered as sustainable collective intelligence (CI) ecosystems since they merge the four criteria for CI defined by Surowiecki: independence, diversity, decentralization and a process to aggregate information (Skarzauskiene and Mačiulienė, 2021); while in the case of online forums for municipalities, AI can be applied to widen the participation while reducing administration costs (Haqbeen et al., 2021).

"Use" theme

The second theme called "*use*" includes the important concepts of: "data", "platforms", "users" and "service". It defines open data and public platform providers as important enablers respectively of open innovation in public contexts and collaboration within open government data ecosystems (Linåker J., 2021). Indeed, the literature of the sample confirms that there is a relationship between open data and co-creation (McBride K., 2019). An example of the potential for sharing governmental data with citizens is offered by the success of the dathathon organized by Israel to manage the problems related to the COVID pandemic. Indeed, the country's Ministry of Health gave access to deidentified governmental data to Israel's research community, so that it could provide insights to solve the pandemic's policy challenges (Peleg et al., 2021).

Moreover, it further explores the applications of digital participatory platforms which emerge as enablers of e-democracy, as shown by the ECAs case already discussed (Karlsson M. et al., 2021), and of co-production between citizens and governments in the context of urban development (Linåker J., 2021), showing their important role to support collaboration, user engagement and co-creation in the public field. It is even possible to use IT systems that can use Open Government Data, visualize urban proposals in 3D models and provide automated feedback on the feasibility of the proposals as a communication platform between citizens and city administrations, providing so an integrated top-down and bottom-up urban planning and decision-making approach to smart cities (Khan et al., 2017)

Furthermore, it emerges from this cluster how crowd engagement has been applied by governments to co-create digital public services (Jarke, 2021) and public service apps (Emaldi et al., 2017). This can be achieved for instance through policy labs as shown by the northern Ireland innovation lab (Whicher and Crick, 2019).

"Process" theme

The third theme belonging to this macro cluster is called "*process*" and it strengthens the relationship between the concepts of "crowdsourcing" and "digital". It describes crowd engagement as a process that, while being able to be used to reach different goals when

applied in the public sector, is strongly enabled, supported and enhanced by digital technology and ICTs, which are of paramount importance to involve all important actors of the projects. Indeed, digital tools can be for instance used to support co-creation projects in urban spaces, involving its different stakeholders (Žlender et al., 2021). Moreover, this cluster highlights how ICTs are especially relevant enablers of E-governments, the strategic nature of which relies on the objective of simplifying communication between government, citizens and business. It is through ICTs that these three parties can be connected, facilitating processes and activities that support their connectivity (Irimie, 2015).

From the publications of the sample belonging to this cluster, it also emerged how infrastructure can be digitalized impacting the way citizens are involved in the provision of a certain service (Hoefsloot et al., 2020).

What stands out from this cluster, is how digital technologies and ICTs, if properly applied, have the potential to overcome one possible drawback of the crowd engagement process in the public sector: the exclusion of some groups of citizens. Indeed, as it emerged from the "*citizen*" cluster, there is the risk of not being able to involve all groups of people in such initiatives who will be exposed to their outcomes. By doing so, not all voices would be heard, and the obtained results would not be representative of all citizens. Digital technologies and ICTs can make the crowd engagement process as inclusive as possible, involving all relevant stakeholders, even those who are hard to reach, like marginalized youths (Jalonen et al., 2021). Indeed, it is possible to leverage such technologies to create virtual spaces of collaboration, like in the case of Firstlife (Boella et al., 2019). Furthermore, digital tools have been very important for massive participation in urban planning, also allowing to justify the costs and efforts put into a certain project (Hofmann et al., 2020).

"Citizens" theme

The "*citizen*" theme, while being also related to the other macro cluster, shows how attention has been given to using different technologies, like augmented reality, to support collaborations on platforms. Indeed, common techniques to enable communication between stakeholders for participatory engagement operate independently on various systems and tools. Due to this, creative collaboration's full potential cannot be fulfilled (Postert et al., 2022). Combining them through technology would improve the possible outcome of the citizen engagement process (Postert et al., 2022).

Finally, it emerges how leveraging software and technology for gamification can simplify the process of citizen engagement (Ampatzidou, 2018), making it more accessible, as in the case of Minecraft for urban planning (de Andrade et al., 2020), as already discussed, further improving its inclusiveness.

"Group" theme

Finally, the "**group**" theme shows how ICTs and digital technologies have been fundamental enablers in the development of e-governments (Irimie, 2015), e-democracies (Freeman and Quirke, 2013) and open governments (Maier-Rabler and Huber, 2011), the principles of which can be applied through crowd engagement (Toode, 2020), and which, as already discussed, are representative of the change in the relationship between government and citizens.

The following table summarizes the most important results that emerged from the analysis of this macro cluster (Table 7)

Table 7 Summary of the most important results of the second "macro-cluster": " Technological support of the crowd engagement process "

MACRO CLUSTERS	THEMES AND SUBCLUSTERS	RESULTS
"Technological support of the crowd engagement process"	Themes: • "Online" • "Use" • "Process" • "Citizen" • "Group"	It was demonstrated how online channels are pivotal in supporting and enabling the implementation of crowd engagement initiatives, making it possible to connect people by overcoming physical barriers and national boundaries, which proved to be essential during the Covid-19 pandemic (Gama K, 2021). To do so, digital platforms and ICTs are fundamental tools to support collaboration, user engagement and co-creation in the public field, involving its different stakeholders (Žlender et al., 2021), as shown in the context of urban development (Falco and Kleinhans, 2018). Open data and public platform providers emerge as important enablers respectively of open innovation in public contexts and collaboration within open government data ecosystems (Linåker J., 2021). Indeed, it is confirmed that there is a relationship between open data and co-creation (McBride K., 2019), with the potential of sharing governmental data with citizens being shown by the case of Israel's datathon to fight Covid-19 (Peleg et al., 2021). Moreover, ICTs and digital technologies have been fundamental enablers in the development of e-governments (Irimie, 2015), e-democracies (Freeman and Quirke, 2013) and open governments (Maier-Rabler and Huber, 2011). User engagement has been applied by governments to co-create digital public services (Jarke, 2021) and public service apps (Emaldi et al., 2017). Furthermore, digital technologies and ICTs can be exploited to make the crowd as representative as possible for society at large, making the crowd engagement process as inclusive as possible, involving all relevant stakeholders, even those who are hard to reach, like marginalized youths (Jalonen et al., 2021). For instance, gamification can simplify the process of citizen engagement (Ampatzidou, 2018), making it more accessible, as in the case of using Minecraft to involve young people in urban planning (de Andrade et al., 2020). Finally, online communities appear to be sustainable collective intelligence ecosystems (Skarzauskiene and Mačiulienė, 2021).

1.3.3.2. Public vs private

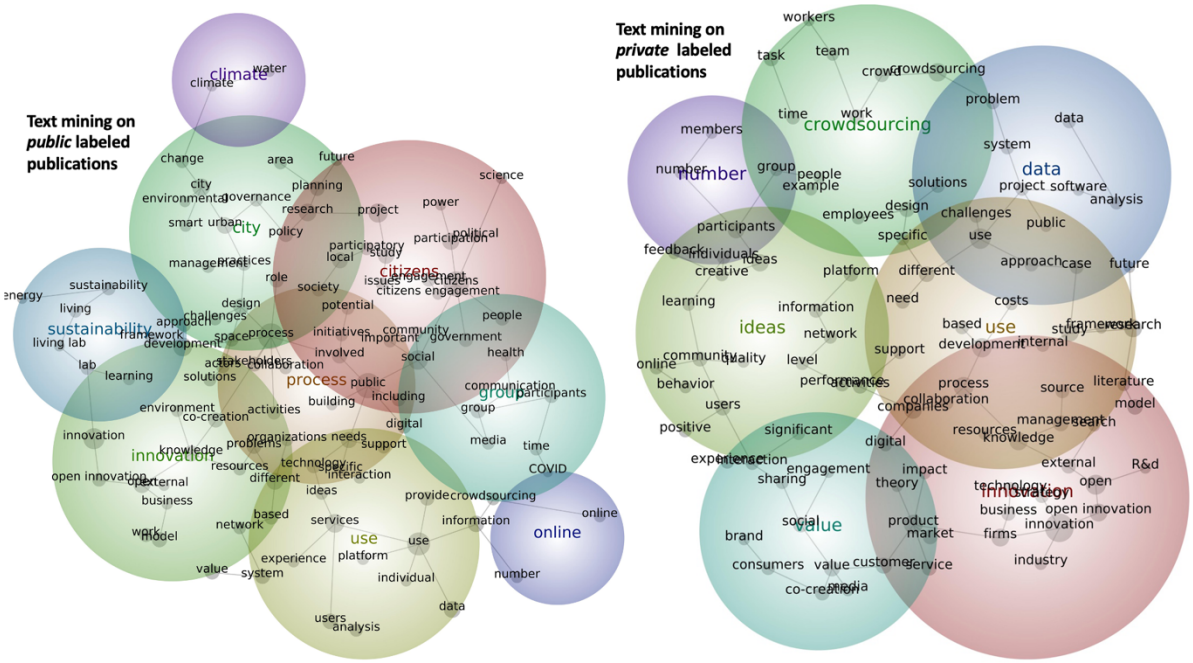


Figure 10 Comparison between the results of the text mining analysis performed on the "public" labeled papers (on the left) and on the “private” labeled papers (on the right)

The text mining analysis on Leximancer has also been performed only on the “private” labeled publications, to enable a comparison with the results originated by the previous analysis (Figure 10 Comparison between the results of the text mining analysis performed on the "public" labeled papers (on the left) and on the “private” labeled papers (on the right)). First of all, it is interesting to compare the lists of concepts generated by the software in the two cases, even before considering the overall themes of the concept maps. Indeed, if Leximancer is asked to re-cluster the nodes, the themes that are formed might change, whereas the concepts will not, as they have been generated by the software before the clustering step takes place. It is very interesting to notice which concepts are missing from each analysis, with respect to the other. The results from the “private” labeled papers do not include concepts referring to the public and urban contexts like *citizens, city, smart, building, government, policy, political, urban, society, participation*. At the same time, most of the concepts which refer to climate change, sustainability and the related problems are missing: *sustainability, lab, living, environment, environmental, climate, water* and *health*. On the other side, some

concepts appear in the private analysis which was not included in its counterpart. This is the case of many terms referring to the corporate world: *firms, companies, brand, R&D, market, product, industry, performance, costs*. At the same time new concepts appear that are used to describe the possible actors involved in the crowdsourcing process when they are external to the company: *customer, consumer* or internal: *employees, workers, teams*.

This results of course in the "clusterization" of different themes by the software. Considering the concepts which the results about the private sector are missing, it is no wonder that the corresponding concept map does not show the themes of "city" and "citizens". This is very representative of the fact that the actors involved in crowd engagement initiatives are different from those of similar processes taking place in the private sector. Public organizations and nonprofit organizations, as discussed above, put their focus on the citizens. On the other hand, when these processes are initiated by private companies, the concept of "citizen" is replaced by the ones of "customer" and "consumer", highlighting the different roles played by the crowd in such context. This is very well explained by the "value" and "innovation" theme of the private concept map.

The "**innovation**" theme explores how knowledge from the external environment is brought inside the company through open innovation.

It shows how for the purpose of generating innovation, businesses are becoming more and more reliant on external parties, and outside actors are often used as information sources (Basit, 2021). Indeed, firms frequently use innovation contests and intermediaries to get knowledge from sources that are external to their boundaries (Doppio et al., 2020).

Access to external knowledge is actually one of the benefits OI and crowdsourcing offer that motivates their rapid adoption by companies. The growing complexity organizations have to deal with, motivates the use of these processes, as seeking various knowledge is necessary for new product development in complex situations (Lee et al. 2019).

The "**value**" theme shows the pivotal role played by customers in this process. Indeed, through customer participation they are involved in value co-creation with the companies, the importance of which has been supported by research (Della Corte et al., 2015). It is by implementing co-creation that companies can seek higher organizational flexibility through the improvement of their innovation ability and the adaptation of their products and services to the consumers' needs. This might even lead to a more sustainable market position (Hurni and Grösser, 2017). Moreover, companies should encourage interaction between customers in online brand communities, as it can positively affect value co-creation (Luo & Li, 2022)

This shows how the crowd engagement process takes place in different contexts from what happens in the private sector. As discussed above, cities play a key role in crowd engagement initiatives and are becoming their main context of application. In the private sector, the context of application of similar processes like crowdsourcing is the one of firms and companies, which absorb knowledge from the outside.

Indeed, the "*crowdsourcing*" theme highlights how crowdsourcing has been more recently even applied within the boundaries of the company, with employees and workers as actors, which emerge as new possible sources of knowledge to involve in the process. It is the case of the so-called "internal crowdsourcing" which can be applied by companies to overcome information silos (Pohlisch, 2020), connecting geographically distant units and integrating new employees (Pohlisch, 2021). As shown by the application of such process by SAP, a German software company, internal crowdsourcing can be applied with various goals which range from the development of the employees' skills and competencies to the design of more sustainable business model (Pohlisch, 2020).

Finally, it is quite evident how the goals and the beneficiaries of the application of these processes are different when comparing their implementation by governments with the ones by private companies. Crowd engagement was applied for different reasons, like urban planning, public service design (Liu, 2021), policy-making and future agenda setting, with the final beneficiary being the citizen, who is also the source of knowledge. Moreover, such projects are often implemented to increase sustainability and tackle climate change, so much so that "sustainability" and "climate" were not only concepts but also themes in the public concept map.

In the private sector crowdsourcing and open innovation are generally applied to achieve higher competitive advantage in different ways by implementing an "open strategy" (Chesbrough and Appleyard, 2007), as explained by the value and innovation cluster. First of all, as shown by the banking sector, value co-creation with customers makes it possible for companies to provide personalized products without investing too much capital and time in trying to understand the clients' wishes. This results in an improved customer experience (Peña-García et al., 2021).

Moreover, more and more companies are involving their user communities in the generation of innovative ideas. The resulting new "user-designed" products are then preferred by customers to the ones of designer-driven firms, as they identify themselves more with companies using a user-driven philosophy (Dahl et al., 2015).

Furthermore, customer co-creation initiatives can increase the retention rate of the company, by positively impacting customer loyalty (Menon and Hamsavardhini, 2021).

Finally, if co-creation leads to high perceived quality, it can even affect brand advantage, therefore creating competitive advantage (Mulyana et al., 2019).

In conclusion, even if innovation contests have been more and more organized by some companies to address sustainability-related issues (Greco et al., 2021), the concept map of the private sector does not show any sustainability or climate themes, signaling how such concepts are not yet central to the application of crowdsourcing in the private sector.

1.3.3.3. Overview of the text mining results

This paragraph is intended to provide a concise overview of the results of the text mining analysis.

First, considering only the "public" labeled papers, it was shown how crowd engagement can be used by governments to satisfy the citizens' request for a change in their relationship with public institutions, reshaping their role towards more active participation (Maier-Rabler and Huber, 2011). However, while doing so, initiators must be sure to design the process to make the involved crowd representative for society at large and not only for the most vociferous people (Baek and Kim, 2018; May and Ross, 2018). Moreover, the process' potential for handling complex societal challenges was examined. This led to a more in-depth discussion about crowd engagement's application to increase sustainability in the urban context and to manage natural disasters, in response to climate change (Nesti, 2018). To do so, it was highlighted how governmental institutions play a pivotal role in infrastructuring co-creation processes (Genuchten et al., 2019).

It was then possible to define the important role of digital technologies and online channels to support and enable the crowd engagement process. It is so possible, for instance through digital platforms, to promote wide participation by overcoming geographical and physical barriers, which was for instance necessary during the covid-19 pandemic (Gama K, 2021). Finally, ICTs and online channels can be exploited to reach marginalized people, facilitating their access to crowd engagement initiatives, therefore helping to overcome the potential unrepresentativeness of the involved crowd (Jalonen et al., 2021).

In conclusion, the results of the analysis of the "private" labeled papers made it possible to make comparisons between crowd engagement and processes with which it shares some elements which are instead initiated by companies. This highlighted how moving from the private sector to the public one, the users go from being customers to citizens while the main context of application shifts from the firms to the city. Finally, while sustainability is amongst the main goal of crowd engagement when implemented by public institutions, companies only recently started to consider it as a possible target, instead focusing crowdsourcing and open innovation processes on increasing their competitive advantage (Chesbrough and Appleyard, 2007).

1.4. Conclusions

This research combined co-citation analysis and text mining on the sample about crowd engagement to provide a systematic literature review of the topic.

The co-citation analysis was performed twice, once on the sample of the "public" labeled publications and once on the literature of the "private" labeled ones. This made it possible to understand the theoretical foundations of crowd engagement, making significant comparisons with the theory shaping similar processes initiated by private companies with which it shares some elements.

Overall, the theory of crowd engagement is rooted in three streams of knowledge which explore the broad concept of open innovation (OI), how the process of crowdsourcing was defined over time in the public sector and how the concepts of co-creation and citizen participation are reshaping the relationships between citizens and governments.

When analyzing only the "private" labeled papers it stands out how the results still show three knowledge streams focused on those concepts, this time shifting their focus from the public to the private sector, therefore exploring crowdsourcing's application by companies and co-creation as a way to include customers as part of their extended enterprise (Prahalad and Ramaswamy, 2000).

However, even if the results of the two co-citation maps appear overall similar in their three clusters, some elements signal a significant difference between the two. Indeed, in the case of crowd engagement, the knowledge stream about open innovation includes also publications defining OI's and co-creation's applications to reach sustainability, especially through living labs, which do not appear in the graph

generated from the "private" labeled publications. This highlights how sustainability is central to the concept of crowd engagement, as it is explicitly contributing to building its theoretical foundations.

Consequently, this analysis highlighted how the theoretical foundations of the crowd engagement process have some elements coming from the private sector, with which it shares some knowledge, while showing features clearly setting it apart, like having citizens as main participants, instead of customers, and being intrinsically more focused on the concept of sustainability.

In conclusion, the results show how crowd engagement was born from the combination of elements belonging to the previously existing concepts of open innovation, crowdsourcing, citizen participation and co-creation with the one of sustainability, in a novel process with its own identity.

The text mining analysis was instead performed to deepen the understanding of crowd engagement's applications and contexts while comparing them to those of similar processes initiated instead by private companies. First of all, it stands out that the participants involved in the process are citizens, instead of customers of the initiator and that crowd engagement has proved itself as an effective way for governments to answer the citizens' demands for a change in their relationship with public institutions that will give them a more active role in society (Maier-Rabler and Huber, 2011). Indeed, the analysis showed that the process has been successfully applied with the goals of more deeply engaging residents in policy-making and agenda-setting.

As already anticipated by the co-citation analysis, sustainability established itself as a dominant theme in the application of crowd engagement, as it often acts as the final purpose of the initiatives. This is for instance often the case when involving citizens in urban planning projects intended to increase the city's sustainability or in the design of nature-based solutions to fight climate change (Ariati et al., 2021). Indeed, it was explained how there is a need for citizen engagement in disaster and adaptation management to deal with climate variability and extremes caused by climate change (Brink and Wamsler, 2018). In comparison, private companies have yet to make sustainability the core of their participatory processes, even though some cases of companies designing initiatives to involve external actors to increase their sustainability have already been spotted (Greco et al., 2021).

Moreover, cities emerge as the ideal environment for crowd engagement processes to unfold as they will become home to most people in the coming years and offer the infrastructure to support and enable such initiatives (in cities (Cilliers and Flowerday, 2017).

At the same time, the very important role played by technology in crowd engagement initiatives emerged from the analysis. Indeed, to fully exploit the potential of crowd engagement, digital and online technologies and ICTs play a pivotal role as they make it possible to design participation in the broadest way possible (Falco and Kleinhans, 2018) while potentially reaching even marginalized groups of people (Jalonen et al., 2021). It was thanks to the internet that it was possible to organize crowd engagement initiatives even during the covid-19 pandemic (Peleg et al., 2021), proving its potential to overcome physical barriers and enable collaboration between geographically distant people. Moreover, these technologies make it possible to overcome one of the process' main challenges: not being able to involve a crowd that is actually representative of society at large and that does not involve only the most vociferous people (Baek and Kim, 2018). Indeed, governments can exploit digital technologies to reach marginalized people, therefore ensuring a broad and diverse participation by citizens in the process.

In conclusion, the Covid-19 pandemic highlighted in particular one key aspect of crowd engagement: its potential for managing complex and multi-dimensional challenges. While humans are generally good at applying linear and logical thinking to solve complicated technical problems, the most important challenges our society has to face today appear to be decentralized in their nature and changing at a faster pace than it is humanly possible to react (Peach et al., 2019). This is exactly the case with the problems related to increasing sustainability and fighting climate change, which, as discussed, were recurring themes in this analysis. It stands out how crowd engagement emerged as a way to tackle these complex challenges by overcoming physical and geographical barriers and bringing together people, to generate solutions at a faster rate.

Based on the results of the co-citation and text mining analyzes, it is possible to identify the main features of crowd engagement while comparing it with other similar processes with which it shares some elements. This will support the final formulation of the definition of the phenomenon.

The concept of crowd engagement is very broad and gathers within its theoretical boundaries elements belonging to multiple concepts, while shaping its unique identity which differentiates it from each of them.

As seen from the co-citation analysis, crowd engagement combines the existing approaches of "open innovation", "crowdsourcing", "citizen participation" and "co-creation" with the concept of "sustainability", therefore generating a new process that has its own distinctive identity. By complementing these findings with the results of the text mining analysis, which enabled the researchers to deepen the understanding

of crowd engagement's applications and contexts, it was possible to understand which elements this process has in common with the other mentioned concepts and what sets it apart, enabling so a comparison from which the definition of crowd engagement will follow.

First of all, crowd engagement takes from open innovation the approach of integrating knowledge that is generated from external actors within the boundaries of the initiator, may it be a public institution or a non-profit organization, to overcome challenges of diverse nature (Gassman and Enkel, 2004).

Moreover, it shares with crowdsourcing the potentially very broad span of the engagement initiative enabled by the exploitation of digital technology to implement the initiative (Estellés-Arolas & González-Ladrón-De-Guevara, 2012), the importance of which has emerged multiple times. However, differently from crowdsourcing, crowd engagement events take place not only online through digital platforms but also physically, "in-person", for instance through living labs.

Furthermore, it shares with citizen participation the fact that the participants are citizens, who are generally unskilled individuals who are not selected based on their knowledge, instead of being clients of the initiator as it happens in the cases of open innovation and crowdsourcing. This consideration further separates crowd engagement from crowdsourcing, which instead often relies on skilled participants to solve potentially very specific problems (Estellés-Arolas & González-Ladrón-De-Guevara, 2012).

Moreover, as it is true for citizen participation, also this novel process involves participants in the decision-making process (Seltzer and Mahmoudi, 2013), which takes place based on the approach of co-creation, with citizens and initiators collaborating to reach the final goal (Voorberg et al., 2014), instead of asking the individuals to directly generate the final solution, as it happens instead with crowdsourcing (Estellés-Arolas & González-Ladrón-De-Guevara, 2012).

The goals of this decision-making process are often those of agenda-setting and policy-making. This highlights another specific feature of crowd engagement: most of the problems that are tackled by this kind of initiative are very complex and impact society at large, instead of being micro tasks solvable by single individuals affecting mainly the initiator, like in the case of crowdsourcing (Estellés-Arolas & González-Ladrón-De-Guevara, 2012). This shows that crowd engagement shares with collective intelligence the purpose of solving complex societal problems (Peach et al., 2019; Ryan et al., 2020).

Crowd engagement, therefore, gathers within elements belonging to different processes its conceptual boundaries, shaping so a novel identity that sets it apart from them.

1.4.1.1. Definition of "crowd engagement"

In light of the conclusions drawn from the co-citation and text mining analyses and the comparison made with the other concepts building its theoretical foundations, it is possible to define crowd engagement.

The term "crowd engagement" refers to the involvement of citizens in collaboration with decision-makers that goes beyond the basic adoption of collaborative governance methods (Brabham 2015). In the case of crowd engagement, participatory processes move towards service co-creation in which providers and users collaborate to take advantage of value co-creation opportunities. This is made possible by involving citizens both in top-down and bottom-up approaches (Alves 2013; Uppström 2014),

According to the literature, crowd engagement can be defined by the following two elements:

- an *open call*, meaning there is generally the absence of a selection process whereby potential participants are accepted based on their skills and knowledge, according to some pre-determined rules.
- a *crowd* (Burger, Helmchen and Penin, 2010), that, as a result of the open call, will be very diverse in terms of knowledge, skills, competencies and geographical background

Consequently, one of the main traits of crowd engagement is that the crowd will be composed mainly of self-selected, unskilled citizens.

In terms of the engagement methodologies applied, the process goes beyond the involvement of citizens only through online channels, typical of crowdsourcing, and takes also place through "in-person" physical events, for instance through living labs (Voytenko et al., 2016).

As far as the initiators of the events are concerned, crowd engagement initiatives are organized by public institutions or nonprofit organizations. Moreover, it is interesting to highlight how in such participatory processes the collaboration between initiators and participants tends to take place on equal terms (Schenk and Guittard, 2011).

Crowd engagement is targeted at supporting decision making, having the potential to be used for planning, policy-making and for the design of public service (Liu, 2021). This is well aligned with the nature of the problems faced through this process, which show superior complexity to those tackled on average through crowdsourcing. Indeed, it must be highlighted how crowd engagement is applied to manage macro-tasks instead of the micro-tasks directly accomplishable by individual crowd members, usually solved through other participatory processes like crowdsourcing

(Estellés-Arolas & González-Ladrón-De-Guevara, 2012). This is exemplarily shown by the complex and multidimensional nature of some challenges managed through crowd engagement in recent years like the Covid-19 pandemic (Peleg et al., 2021) and natural disasters like floods (When et al., 2015). Therefore, instead of asking the participants to directly provide solutions to compensate for a lack of competencies by the initiators, crowd engagement is focused on engaging citizens according to a co-creation approach to support initiators in the processes of decision-making, defining problems and solving macro-tasks.

This brings to the final distinctive feature of the problems generally managed through crowd engagement: the process is often applied to manage challenges which, given their transversal nature, impact society at large including all its potential actors like citizens, companies and public institutions, therefore potentially making it a multi-stakeholder process. To provide a quick overview of the discussed process, its main features are summarized in the following table (Table 8).

In conclusion, it is now possible to provide the following definition of "crowd engagement":

"Crowd engagement is the process by which public institutions or nonprofit organizations engage an often self-selected and unskilled crowd of citizens, both in online and offline initiatives, to manage and solve, through the co-creation of partial solutions or problem definitions, very complex challenges related to sustainability and affecting society at large"

Table 8 Summary of the distinctive features of "crowd engagement"

Elements defining the crowd engagement process	Distinctive features
Solver(s)	A crowd of generally self-selected, unskilled citizens, sometimes mixed with firms, experts and specialized communities in the logic of multi-stakeholder, problem-solving ecosystems
Engagement methodology	Both "in-person" and virtual events promoting co-creation between the initiator and the participants
Initiator(s)	Governmental institutions or nonprofit organizations
Input(s)	Challenges to be solved that are complex and transversal (i.e. societal challenges)
Output(s)	Aimed at supporting initiators in the processes of decision-making, defining problems and solving macro-tasks

1.4.2. Theoretical implications

From a theoretical perspective, this systematic review adds to the existing literature a definition of crowd engagement, showing how it has combined elements from the already established processes of "open innovation", "crowdsourcing", "citizen participation" and "co-creation" with the concept of sustainability to shape its novel identity.

In particular, it was interestingly found out that sustainability is a defining aspect of the phenomenon. Indeed, it first appears in the co-citation analysis in some publications building the theoretical foundations of the process, where it was discussed how sustainability can be reached in open innovation and co-creation contexts, especially focusing on the implementation of living labs (Leminen et al., 2012; Nevens et al., 2013; Voytenko et al., 2016). Moreover, it was then explored more in detail in the analysis of the text mining results how crowd engagement is often applied with the purpose of increasing sustainability, for instance through the design of nature-based solutions or urban planning, while also helping to fight climate change, enabling water management and natural disaster management (When et al., 2015).

Furthermore, another aspect that was added to the literature that defines the crowd engagement process is its characteristic of being applied for the solution of macro-tasks. Indeed, this research has highlighted how this process is generally implemented by governmental and non-profit organizations to manage problems that are more complex than those tackled by private companies through crowdsourcing (Estellés-Arolas & González-Ladrón-De-Guevara, 2012). Indeed, instead of focusing on micro-tasks like it often happens in the corporate world, where participants are asked to provide solutions to very specific issues for instance through a "call for ideas" related to product innovation or crowdsourcing contests for specific micro-tasks as logos design, crowd engagement has emerged as a process applied to handle complicated multi-dimensional problems. This is made possible by the process' distinctive trait of enabling rapid transversal knowledge access and coordination and by its potentially wide pool of participants reachable by governmental institutions.

Finally, this systematic review shows how technology, especially ICTs and online channels, (Falco and Kleinhans, 2018) must be considered as an integral part of the design of a crowd engagement initiative, given their pivotal role in supporting and enabling broad and diverse participation.

1.4.3. Practical implications

From a practical perspective, this systematic literature review provides some useful insights that could be exploited by public institutions to better organize and structure crowd engagement initiatives.

First, it highlights how crowd engagement should be applied to solve the most urgent and complex challenges our society faces today. Indeed, it was successfully implemented to manage the covid-19 pandemic (Peleg et al., 2021) and natural disasters like floods (When et al., 2015) and is a key enabler in reaching sustainability targets in urban contexts (Campagnucci et al., 2021).

Moreover, solving complex problems often requires wide participation, which can be reached through digital technology. Indeed, it was shown how using digital tools like platforms (Falco and Kleinhans, 2018) could positively impact participatory processes, supporting and enabling a truly broad involvement of citizens. However, when selecting online channels, initiators should be aware of the risk of marginalizing people with low technological knowledge and skills, enhancing one of the process's main limitations: the unrepresentativeness of the involved crowd (Baek and Kim, 2018). This is made worse by the self-selecting bias typical of voluntary participation initiatives, leading to a crowd engagement process that gives voice to those who are already interested in similar initiatives while excluding already marginalized people, therefore seriously putting into discussion the legitimacy of the results of the process, as they will not be representative of society at large. Public institutions should be aware of these challenges and implement crowd engagement initiatives in a way that overcomes them.

1.4.4. Future research agenda

Crowd engagement has grown in application in the past years and will probably continue to do so in the coming future. This can be motivated by its qualities which make the crowd engagement process especially suitable to handle complex problems like climate change management and reaching sustainability goals. Moreover, it emerges as an appropriate way to satisfy the citizens' demands for a more active role, changing their relationship with governments.

Given that the theory behind crowd engagement is still being developed, there is still much that needs to be explored by academics. This section is aimed at defining a path for future research based on the findings of the systematic literature review.

The following research agenda has been built with its related questions, taking inspiration from the previous analyses conducted ("text mining on the public sample").

As shown by various clusters of the concept map resulting from the text mining performed on the "public" labeled papers, technology plays a key role in supporting and enabling the crowd engagement process. This finding has even led to the definition of a macro-cluster specifically about the empowerment of the engagement process through modern technology. In particular, it stood out the very important role played by the online world and digital technology in such a context. Indeed, they have been true enablers of crowd engagement projects, as shown by the many initiatives launched by governments to fight the Coronavirus, like in Israel's case (Peleg et al., 2021), in a time when meeting physically was simply not possible. Digital technologies make it possible to bring down physical and geographical barriers, enabling the broad participation of the public. However, it must be remembered that unfortunately not everyone possesses the digital skills and tools to connect to the internet. This could become a significant problem when it is fundamental for the crowd engagement process to include all possible actors to work properly, like in the case of urban planning or policy making. Indeed, basing the participation on digital tools could lead to the marginalization and exclusion of some potential users, like the elderly or underprivileged people, basically causing the opposite effect it was intended for. The question then becomes:

"*Under which circumstances is digital technology improving the inclusiveness of the crowd engagement process and how can it be applied without marginalizing some groups of users*?"

The "climate" cluster is focused on how crowd engagement can be implemented to deal with climate change, in particular looking at the impact it is having on water management and the related problems it is causing. It explores how such process can be applied to deal with water-related natural disasters like floods (Gebremedhin et al., 2020) and to manage the access to clean water where necessary (Mangai and De Vries, 2018). It could be interesting to expand the research to other scarce resources, to understand whether their management could be improved through crowd engagement, as an answer to climate change:

"*How could the crowd engagement process be applied to improve the management of scarce resources as an answer to climate change*?"

It stood out from the "group" theme how it is pivotal that the governments promote two-way dialogue with citizens, instead of limiting themselves to one-way

information provision (Freeman and Quirke, 2013). However, even when citizens are actively involved there is the risk of "participation theatre" which happens when technology is used in a way to prohibit real participation, while promoting a "bogus" one (Grönlund, 2011).

"*What are the factors/mechanisms that guarantee that the participation process designed by governments cannot be instrumentalized by them, in order to overcome participation theatre*?"

Cities will play a role of growing importance in the coming years, given the fact that they will be home to 80% of the world's population by 2050 (Cilliers and Flowerday, 2017). Therefore, cities will become the context in which crowd engagement processes will be applied to reach different goals. In particular, they will be pivotal to support and enable the long path to reach sustainability goals to fight climate change. However, whether it is for sustainability, for policy making or for all the other goals for which crowd engagement can be applied, the ideas and solutions generated by the citizens must be implemented by the public institutions for them to make a relevant impact. Unfortunately, sometimes there is a gap between knowledge creation and implementation (Lackaff, 2015), meaning the initiators end up not applying what was generated by the participatory processes, significantly limiting their benefits.

"*How can the crowd engagement process be designed to reduce the gap between knowledge creation and application?"*

"What signals can be given to the participants to convince them that their efforts will be implemented and make a difference, avoiding their demotivation?"

In the "use" theme the importance of open government data, which is enabler of co-creation in the context of open governments (McBride K., 2019) is stated. However, as shown by Israel's datathon, sharing data with the public is a process that comes with some hurdles (Peleg et al., 2021). Much of the information held by public institutions is confidential and providing it to citizens could violate the privacy of many. One way to manage this challenge without having to make the participant sign a confidential agreement is to elaborate the data to cover what must not be leaked. This could however limit the full exploitation of the shared data.

"*How is it possible to manage privacy concerns in the case of open governmental data without significantly limiting its potential/keeping all of its potential?*"

The "citizens" cluster highlighted how reaching "real" inclusiveness should not be taken for granted when designing the crowd engagement process. Indeed, even if

initiatives are designed to enable the broadest of participation, some groups might not be represented by the final results. This can be for instance related to the fact that they lack the confidence (Lackaff, 2015) to speak up or that the process is organized in a way that does not motivate them enough to take part in it. Thus, there should be further research as far as the relationship between citizens and initiators and the former's motivation to participate in such process change.

"How can the crowd engagement process be designed to make sure all relevant stakeholders are included in it, so that its results are not representing just the voices of few?"

"Why do people decide, even if they have the opportunity, not to participate in the crowd engagement process?"

"What kind of monitoring systems can be applied to understand which groups of people are not participating or speaking up without violating their privacy?"

"What are the best ways to motivate citizens to participate in such projects?"

"How does the motivation to participate in the solution of complex problems change for the users, compared to solving micro-tasks through crowdsourcing?"

"How does the relationship between participant and initiators change in contexts of crowd engagement with respect to the processes of crowdsourcing and open innovation?"

As it stood out from the sample, crowd engagement is applied to tackle very complex and multi-dimensional challenges like pandemics, as shown by the many engagement processes organized to manage the effects of Covid-19 (Gama K., 2021), natural disasters, like floods (Gebremedhin et al., 2020), and fighting climate change (Brink and Wamsler, 2018) by supporting and enabling the path towards greater sustainability. Such applications of crowd engagement, show how the process goes beyond the solution of micro-tasks, as it was mainly the case for crowdsourcing (Estellés-Arolas & González-Ladrón-De-Guevara, 2012), entering the real of macro-tasks. However, with this shift a new problem might arise which is related to the fact that such tasks, because of their complexity and transversal nature, might not be fully understood in all their intricacy by the participants, leading to their contributions not effectively helping to solve the tackled problem. Thus, the question arises:

"How can the crowd engagement initiative be designed to make sure that the participants are led to effectively contribute to accomplishing macro tasks of which they might lack the overall understanding?"

The "sustainability" theme has repeatedly highlighted how living labs are an effective way to engage citizens for sustainability-related purposes (Campagnucci et al., 2021). This might suggest that such kind of initiatives might have the potential to solve other complex issues (Komatsu et al., 2021), leading to the question:

"What is the future role of living labs in engaging the crowd in problem-solving processes related to complex issues?"

Finally, as far as the "innovation" cluster is concerned, its focus on open innovation and the presence of the concept of business suggests the possibility to explore the possibility of public institutions partnering with private companies to organize crowd engagement initiatives, posing so the question:

"What could be the role of crowd engagement initiatives that go beyond the phenomenon analyzed in this research, taking into account possible collaborations with external private businesses as initiators?"

All formulated research questions have been summarized in the following table (Table 9) and can be visualized on the concept map at the end of the paragraph (Figure 11)

Table 9 Potential questions to help define the path for future research on the topic of crowd engagement in the public sector

Cluster	Research Question	Reference number
Online	*Under which circumstances is digital technology improving the inclusiveness of the crowd engagement process and how can it be applied without marginalizing some groups of users*?	1
Climate	*How could the crowd engagement process be applied to improve the management of scarce resources as an answer to climate change*	2
Groups	*What are the factors/mechanisms that guarantee that the participation process designed by governments cannot be instrumentalized by them, in order to overcome the phenomenon of participation theatre*?	3
Cities	How can the crowd engagement process be designed to reduce the gap between knowledge creation and application? What signals can be given to the participants to convince them that their efforts will be implemented and make a difference, avoiding their demotivation?	4
Use	*How is it possible to manage privacy concerns in the case of open governmental data without significantly limiting its potential/keeping all of its potential?*	5
Citizens	*How can the crowd engagement process be designed to make sure all relevant stakeholders are included in it, so that its results are not representing just the voices of few?* *Why do people decide, even if they have the opportunity, not to partake in the crowd engagement process?* *What kind of monitoring systems can be applied to understand which groups of people are not participating or speaking up without violating their privacy?* *What are the best ways to motivate citizens to participate in such projects?* How does the motivation to participate in the solution of complex problems change for the users, compared to solving micro-tasks through crowdsourcing?" "How does the relationship between participant and initiators change in contexts of crowd engagement with respect to the processes of crowdsourcing and open innovation?"	6
Process	How can the crowd engagement initiative be designed to make sure that the participants are led to effectively contribute to accomplishing macro tasks of which they might lack the overall understanding?	7
Sustainability	*What is the future role of living labs in engaging the crowd in problem-solving processes related to complex issues?*	8
Innovation	*What could be the role of crowd engagement initiatives that go beyond the phenomenon analyzed in this research, taking into account possible collaborations with external private businesses as initiators?"*	9

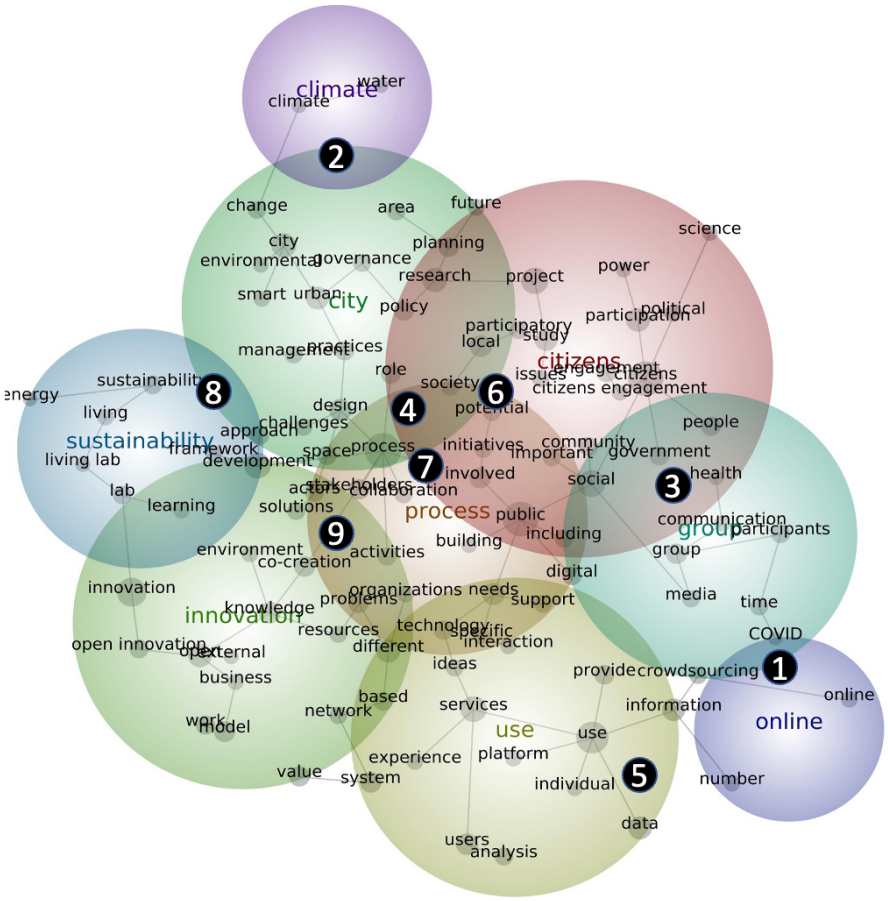
Going beyond the text mining performed only on the public labeled papers and referring to the sub-section "comparison between the text mining results of the private and public labeled papers", other possible research paths emerge.

While comparing the results of the text mining performed on the "public" labeled publications with the "private" labeled ones, it stood out how sustainability played a way less important role in the latter of the two. Even if there are some publications discussing how sustainability is addressed in crowd engagement cases by the private sector (Greco et al., 2021), the text mining on the "public" labeled publication not only shows that sustainability has its own theme in the map but that it is recurringly explored by most of the other themes. "Why is sustainability still not playing a pivotal role among the reasons why companies should implement crowd engagement?". "How can companies reach sustainability through crowd engagement?"

In conclusion, the conclusions of the systematic literature review discussed how crowd engagement combines specific elements from open innovation, crowdsourcing, citizen participation and co-creation with the concept of sustainability, shaping so its distinctive identity. This puts crowd engagement in a unique position with respect to the other mentioned concepts. Consequently, it is reasonable to expect that crowd engagement's defining challenges and benefits will show some differences and peculiarities with respect to those of the other processes.

"What are the challenges and benefits of crowd engagement?"

Figure 11 Potential questions to help defining the path for future research on the topic of crowd engagement in the public sector



1.4.5. Limitations

This sub-section is aimed at discussing some limitations of the conducted research.

The main limitation of this study is given by the fact that, as a result of the novelty of crowd engagement, the literature to be analyzed had to be selected using some "proxies" for the phenomenon as keywords. Indeed, given its very recent nature, it was expected that it had not been explored by the literature under the new name of "crowd engagement", leading to the selection of terms referring to other processes with which the novel phenomenon shared some elements, that could have helped to provide the final definition of crowd engagement. However, to make such selection as robust as possible, all keywords have been approved, with some of them being even directly suggested, by a panel of academics and experts in open innovation, crowdsourcing and citizen participation, who considered them as valid proxies for crowd engagement.

Referring to the "sample selection" sub-section, after the final selection for the research string to use on Scopus, the resulting publications had to be filtered to reach the final sample on which to base the following analysis of the research. To perform such filtering, first the abstracts and then the texts have been screened to understand whether to discard the documents or not. The results of the final selection have been discussed among the researchers involved in this analysis to make them as robust as possible. However, it is difficult to exclude with absolute certainty the impact of personal bias in such selection, meaning that other researchers might have taken different decisions about the inclusion of certain publications, leading to a different final sample.

In the "Text mining analysis results" sub-section it was discussed how the initial concept maps generated by Leximancer, both when considering only the "public" labeled publications and when considering only the "private" labeled ones, displayed too many concepts and were therefore too complex to interpret. It was therefore necessary to reduce the number of terms by looking for ones that shared similar meanings and could therefore be merged into just one concept and for those which could be considered irrelevant and therefore completely excluded from the map. Personal bias might have had an impact on this process, meaning that different people may have performed it in a way that would have led to different final concept maps in terms of concepts, themes and clusters. However, the fact that this cleaning process was performed based on criteria shared by the researchers, provides robustness to the final selection of concepts to be represented by the software on the map. Finally, the inductive nature of the research might make it difficult to statistically generalize some of its results (Yin, 2013).

2 Qualitative research

The systematic literature review conducted in the first chapter of the dissertation led to the definition of crowd engagement. It was so shown how these initiatives are organized by public institutions or nonprofit organizations to solve problems that are generally of a complex nature by involving citizens in a co-creation process. The research agenda closing the systematic literature review discussed how there are still many aspects of crowd engagement on which future exploration should be focused on. In particular, it highlighted how research needs to be conducted to identify the challenges and benefits of the newly defined process. To do so, there is the need to conduct empirical research on these subjects, therefore going beyond what can be derived from the literature through bibliometric analysis. Indeed, as discussed in the conclusions of the systematic literature review, crowd engagement's theory is influenced by that of the processes of "citizen participation", "crowdsourcing" and "open innovation", sharing some features with each of them while having its own identity, clearly differentiating it from all of them. Consequently, given the novelty of crowd engagement, there is the need to go beyond bibliometric analysis and conduct qualitative research to identify its challenges and benefits.

The second chapter of this dissertation is therefore focused on the analysis of a sample of nine international case studies, chosen according to the specific purpose of finding out about crowd engagement's challenges and benefits. To do so, a total of ten semi-structured interviews were conducted with representatives of the different cases. The goal was not only to identify crowd engagement' challenges and benefits but also to understand their impact and reach with respect to two particular variables used to describe the cases: the initiative's intensity and its span.

The former refers to the level of involvement of the participants in the process. Initiatives with a high level of intensity engage the citizens very intensively by giving them the opportunity to provide suggestions and ideas or even take part in the implementation of the results (Torfing et al., 2019). This is for instance what happens when the public is actively involved in urban planning (Brabham, 2009) like it was

done by the city of Helsinki. As will be discussed more in detail in the following paragraphs, the Finnish capital involved its citizens in a crowd engagement initiative called "City Plan", the aim of which was to define the long-term direction of the city's urban development.

"Span" instead refers to the number of people involved in the process, which can be higher or lower according to its goal. It is interesting to notice how initiatives with a high span tend to compromise on intensity (Torfing et al., 2019), therefore involving more participants less actively. The opposite is also true, with most high-intensity initiatives usually showing a low span.

Exploring whether the challenges and benefits of crowd engagement can be related to the initiatives' span and intensity, is especially interesting. Indeed, it enables one to better predict the insurgence of a certain challenge, given the span and intensity of the considered initiative, while also providing guidelines to better design it to be able to leverage a desired benefit of the process.

The first section of the qualitative research is focused on providing an overview of the benefits and challenges of the crowd engagement process discussed in the literature. This part will exploit the sample of publications created for the systematic literature review of the first chapter to analyze what is already known about the benefits and challenges of these initiatives.

In the second section the research methodology will be discussed in all of its detail. It will start by providing a description of the sample of the cases that have been chosen for this research and then explain how the data has been collected for the following analysis. Finally, the steps carried out to analyze the gathered information will be explained.

The third section is instead dedicated to discussing the results of the previous data collection and analysis phase. A coding tree representing the results of the coding phase will be defined. Moreover, the benefits and challenges of the crowd engagement process that have emerged from the interviews will be thoroughly described and supported by relevant text segments selected from the interviews' transcripts.

The fourth and final section provides the conclusions drawn from the previous analysis. Moreover, two sub-sections are dedicated to exploring first the managerial and then the practical implications of the research. Finally, the research agenda and limitations sub-section builds solid foundations for potential research objectives while discussing the main limitations of the performed research.

2.1. Literature review

The systematic literature review of the first chapter of this dissertation made it possible to gain a clearer understanding of the defining characteristics of the crowd engagement process when applied by public institutions or non-profit organizations. While doing so, some of its challenges and benefits emerged, as they were discussed by some papers of the sample. However, the related conclusions have generally been based on single case studies, or on groups of them that shared very similar characteristics, which were analyzed by the authors and often presented as findings the researchers came across while pursuing their primary research goal (e.g Peleg et al., 2021). In other words, there seems to be a lack of publications specifically targeted at providing a general definition of the challenges and benefits of crowd engagement's applications which generally emerge as marginal considerations and from a narrow perspective. This is of course also related to the still young nature of the crowd engagement process. Consequently, the knowledge about these subjects appears to be very sparse and still to be explored. It is the aim of this empirical research to solve this problem by providing an analysis of the process's challenges and benefits, based on a diverse sample of cases.

The two following sub-sections are dedicated to discussing some of the main challenges and benefits of the crowd engagement process that emerged from the publications of the sample of the previous systematic literature review.

2.1.1. Challenges of crowd engagement

Starting with the challenges of crowd engagement, the biggest one, as reported in multiple papers, is designing the crowd engagement initiative so that in the end it is not truly inclusive. This means that, instead of promoting wide participation, it ends up being used only by some people because other relevant stakeholders are not or do not feel encouraged enough to speak up. This risk must not be confused with the fact that sometimes the targeted crowd is selected based on competencies and expertise, instead of the process being left accessible by anyone who wishes to do so. Indeed, the mentioned challenge must be interpreted as the fact that within the potential crowd that has been selected by the initiating institution for its crowd engagement initiative, not all possible actors are involved. As a result, the initiative might become just a channel for the most vociferous people or those who were already engaged (May and Ross, 2018).

Such problem also depends on the participants' different social worlds, knowledge and resources. Indeed, accessibility to the initiative becomes a problem for participation, especially if co-creative processes aim to include people who are in vulnerable, disadvantaged, or underprivileged social situations (Leino and Puumala, 2021), while the participants' potential contribution will be impacted by their personal knowledge, culture and skills (Ampatzidou et al., 2018)

The missed inclusiveness of the crowd engagement initiative limits the potential generation of ideas and solutions. Moreover, by just considering only the voices of some of the targeted people, there is the risk of the final results of the initiatives not being truly representative of the overall crowd that will be exposed to all consequences unfolding from them (Baek and Kim, 2018).

Another possible challenge, limiting the representativeness of the final results, is called "groupthink". Political scientists use the word "groupthink" to describe when members of a deliberative group feel pressured to suppress their own opinions in favor of group consensus. It may take the form of "cascading effects" in the case of crowd engagement applied in the policy field. Informational cascades happen when people ignore their own knowledge and imitate the actions of people who came before them (Lackaff, 2015).

This is also linked to the fact that sometimes participants lack the confidence to contribute to the process (Roche et al., 2020), even though they have the knowledge and competencies to make a difference.

Furthermore, a concept that emerged as a challenge in the implementation of crowd engagement is the one of "participation theatre" (Lackaff, 2015). Grönlund (2011) argues that technology is a malleable medium that may support a variety of participation kinds, including fake types that are intended to prevent true participation. This happened for instance in the Obama administration in 2009 with "online town halls" where citizens were encouraged to ask questions through online platforms but, in the absence of criteria to understand the most important inquiries by the participants, staffers selected the questions themselves, resulting in a process that was less spontaneous than the corresponding physical one it wanted to replace (Lackaff, 2015).

The last consideration is connected to another important challenge that needs to be discussed which is the fact that there might be a gap between knowledge creation and knowledge use. In other words, once ideas have been generated by the participants through the crowd engagement procedure, they must be implemented, which should not be taken for granted. Indeed, even if sometimes the results are different from the initiator's expectations, they need to show the intention to discuss and implement them (Leino and Puumala, 2021). Indeed, if participants perceive that the institution

is not really interested in their contribution, the final result could be an increase in the levels of dissatisfaction (Lackaff, 2015). Moreover, the goals of the participants sometimes do not align with those of the initiators, which might be perceived as unclear (Roche et al., 2020).

Another challenge hindering the correct implementation of crowd engagement is the fact that such projects can be very context specific. Being so context-dependent, it is difficult and time consuming to define such co-creation process in a way that allows for its full potential to be exploited (Leino and Puumala, 2021).

Moreover, as shown by some citizen science projects, too little flexibility in resource allocation and time management will also limit the outcomes of these initiatives (Roche et al., 2020).

Furthermore, there is the risk of citizens abusing the opportunity to participate in these projects by deliberately showing inappropriate behaviors, for instance by making racist comments, therefore providing useless and potentially detrimental contributions to the initiative's success (Lackaff, 2015).

Another possible challenge that needs to be overcome to make crowd engagement work properly is the language barrier, which might prevent people with different cultural backgrounds to communicate and interact effectively (Lackaff, 2015). It is interesting to point out how ICTs have the potential to make it possible to overcome such problems, enabling so higher levels of participation (Zammit et al., 2019).

Last but not least, there is the problem of privacy when sharing governmental data which might contain confidential information about citizens. This is especially true in the case of datathons, as discussed for the one organized in Israel to manage the covid pandemic. To overcome such problmes, it is possible to make the participants sign confidential agreements, provide only part of the data or elaborate it to cover what must not be leaked. However, by doing so, there is the risk of not exploiting the full potential of data (Peleg et al., 2021).

2.1.2. Benefits of crowd engagement

Applying the crowd engagement process comes with many benefits as well. First of all, it gives governmental institutions a way to answer to the citizens' demand for a change in the citizen-government relationship, which gives them a more active role (Maier-Rabler and Huber, 2011). Indeed, as it emerged from the text mining analysis, it is possible to involve the public in co-creation process with public institutions for different purposes, which range from urban planning to policy making and future agenda setting.

Moreover, as highlighted by many articles of the sample, the probably main benefit offered by crowd engagement is the fact that it can be used as a way to encourage participation while at the same time increasing its breath (Lackaff, 2015), making it possible to include very diverse people, therefore enhancing democratic processes (May and Ross, 2018). This offers the benefit of leveraging on transdisciplinary by including people with different backgrounds and knowledge (Roche et al., 2020) while also making it possible to reach otherwise marginalized people (Jalonen et al., 2021)

Indeed, inclusiveness appears to be something that must be considered carefully while designing the crowd engagement initiative. Indeed, according to how the process will be implemented, inclusiveness could become just "fake", as discussed above, and limit the potential of the initiative.

Pivotal to make the participation as broad as possible will be the exploitation of technology as enabler of the process, which will make it possible for citizens to participate in a democratic society more actively (May and Ross, 2018).

Moreover, crowd engagement has the potential of restoring and increasing public trust in democratic institutions (Lackaff, 2015), as shown by the Reykjavik case. Indeed, as explained by Baek and Kim in their article about participatory public service design by Gov 3.0 (2018), trust in governments has been decreasing in the past years worldwide because of their "insular" structure. In other words, governments define policies and public services to increase their operational efficiency, adopting a supplier organization perspective instead of a citizen-centric one. Supplier-centric services do not allow citizens to validate the fact they are intended for public good, resulting in a delivery gap between citizens and governments. To solve it, it is necessary to pass to citizen-centric governments. Crowd engagement offers the benefit of enabling this change and close the gap between citizens and politicians (Baek and Kim, 2018), eventually contributing to the restoration of trust.

Crowd engagement, as discussed in some articles of the sample, can be also applied to support decision-making. From this perspective, it enables the improvement of the decision-making process in very complex situations by facilitating the management of different actors interacting in complex environments (Song et al., 2020). This is also the result of the process' strength of enabling the quick integration and generation of information (Song et al., 2020) which is supported by crowd engagement's feature of allowing to access distributed knowledge coming from different sectors (Peleg et. al, 2021), showing how open innovation builds its theoretical foundations, as discussed at the end of the systematic literature review.

Moreover, multiple articles in the sample showed how the engagement of citizens by public institutions, for instance through e-governance promotes communication

between the two parties, therefore offering the benefit of increasing transparency (e.g. Szarek-Iwaniuk & Senetra, 2020).

Another benefit offered by the crowd engagement process applied in the public field is the fact that it can have an educational effect on citizens, helping them in understanding the big picture of city governance (Lackaff, 2015).

Furthermore, given its bottom-up, fast-moving nature, crowd engagement can support the traditionally slower process of governance (Lackaff, 2015) which is especially beneficial in complex situations requiring a fast response like natural disasters (Song et al., 2020).

Finally, as discussed in the text mining analysis, it became clear from the sample how crowd engagement offers a way for governments to handle very complex situations like disaster management, sustainability projects or pandemics. Indeed, the Covid-19 pandemic showed how crowd engagement, if supported by digital technologies, can be applied to manage very complex situations while overcoming physical barriers.

The following table (Table 10) provides a quick overview of the challenges and benefits of crowd engagement provided by the literature.

Table 10 Challenges and benefits of crowd engagement discussed in the literature (n=193)

CHALLENGES	BENEFITS
Abusive behaviors by participants (Lackaff, 2015)	Access distributed knowledge (Peleg et al., 2021)
Context Specificity (Leino and Puumala, 2021)	Answer to the citizens' demand for more active involvement by the government (Maier-Rabler and Huber, 2011)
Gap between knowledge creation and knowledge use (Leino and Puumala, 2021)	Close the gap between citizens and politicians (Baek and Kim, 2018)
Groupthink (Lackaff, 2015)	Educational effect on citizens (Lackaff, 2015)
Lack of confidence (Roche et al., 2020)	Engage a broad and diverse crowd (Lackaff, 2015)
Language barrier (Lackaff, 2015)	Enhancing democratic processes (May and Ross, 2018)
Misalignment of goals (Roche et al., 2020)	Increase transparency (Szarek-Iwaniuk & Senetra, 2020).
Missing flexibility in resource allocation (Roche et al., 2020)	Integration and generation of information (Song et al., 2020)
Not truly inclusive process (May and Ross, 2018)	Reach marginalized people (Jalonen et al., 2021)
Not truly representative of overall crowd (Baek and Kim, 2018)	Restoring and increasing public trust (Lackaff, 2015)
Participants' different social worlds and resources (Leino and Puumala, 2021; Ampatzidou et al., 2018)	Solve very complex problems (Peleg et al., 2021)
Participation theatre (Lackaff, 2015)	Support decision-making (Song et al., 2020)
Privacy (Peleg et al., 2021)	Support slower processes of governance, enabling a fast response (Lackaff, 2015; Song et al., 2020)

2.2. Research objective

Considering the overall results of the systematic literature review performed in the first chapter of this dissertation, it stands out that most of the publications regarding crowd engagement in the public domain are focused on its practical unfolding rather than on its theoretical foundations. Consequently, there is still much room for research to be done, as discussed in the research agenda sub-section at the end of the first chapter.

In particular, it has been noticed how, while many papers have discussed the challenges and benefits of the crowd engagement process that had emerged from a specific case study that was analyzed, generally discussing them as marginal considerations, publications aimed at providing a general definition of the challenges and benefits of crowd engagement's applications are still missing. Consequently, the knowledge about these subjects appears to be very sparse and still to be explored.

Indeed, as previously discussed in the initial literature review section of this chapter, some challenges and benefits of this process have been derived by putting together the results of some selected papers of the sample. This was for instance the case of Lackaff (2015), where the main criticalities and strength of the "Better Reykjavik" participatory process have been discussed, leading to very important considerations about the concept of "participation theatre" and the educational effect such initiatives had on citizens, to name a few. The same is true for the more recent article by Peleg et. al (2021), where the privacy issue related to sharing governmental data emerged in the context of a datathon organized to manage the covid-19 pandemic. However, while very effective at highlighting some specific challenges and benefits that have emerged from specific cases, these papers maintain quite a narrow view and are unable to define these subjects for crowd engagement from a general perspective.

This is of course related to the fact that the theory related to crowd engagement is still very young and much remains to be discovered about it. In particular, even though it has some features in common with crowdsourcing, open innovation and citizen engagement, it has its own distinctive identity. Indeed, crowd engagement is applied by governmental institutions or nonprofit organizations to solve complex societal issues by involving citizens in a co-creation process. These features, give the process a position that is not shared with most initiatives belonging to open innovation, crowdsourcing or citizen participation. That is why it can be expected that crowd engagement will show some differences and peculiarities in terms of its challenges and benefits, if compared to those of the above-mentioned processes.

This suggests the fact that there is still a gap in the theorization of the challenges and benefits defining crowd engagement that should be filled, motivating the effort to go beyond the analysis of existing literature and conduct qualitative research on a sample of case studies.

This leads to the objective of this second chapter of the dissertation, which is, through the analysis of a diverse sample of cases of crowd engagement initiatives, to identify the challenges and benefits of the crowd engagement process, providing so an organized overview of them.

The research will be therefore aimed at finding an answer to the following research questions:

RQ 1: *"What are the challenges of the crowd engagement process?"*

RQ 2: *"What are the benefits of the crowd engagement process?"*

2.3. Research methodology

In this section, the design of the research procedure is described. It starts by motivating the choice of using a case-study approach and the steps followed to define the challenges and benefits of the crowd engagement process. It then defines the process that led to the final sample of case studies and provides a brief description of each of its cases. The design of the interview process and of the data collection phase is then explained. In conclusion to the section, the data analysis process applied in this research is described.

2.3.1. Qualitative analysis approach: case study methodology

Given the explorative nature of the research, it was decided to follow the case-study approach (Eisenhardt, 1989). This choice was also supported by the fact that such methodology leads to a deep comprehension of the subject's nature and complexity, enabling the building of theory (Voss, Tsikriktsis and Frohlich, 2002), as it is the goal of this chapter of the dissertation.

The case study methodology is based on the combination of multiple sources of information to analyze real-life, contemporary cases (Yin, 2009). Given the intricacy of

the themes under inquiry, however, it was necessary to use a flexible tool that could be adapted according to the requirements of each case study. Consequently, the semi-structured interview has been chosen as the main data collection methodology for this research (DiCicco-Bloom and Crabtree, 2006).

To get deep, qualitative insights for a thorough study from many angles, nine case studies were chosen.

2.3.2. Data analysis methodology: inductive vs. deductive approach

When carrying out qualitative content analysis, two possible approaches can be followed: the deductive one and the inductive one. The former starts with an established theory, which acts as its foundation, and tries to analyze whether it applies to specific cases (Haverty et al., 2000). The latter is instead focused on deriving and summarizing new concepts by analyzing the raw data collected during the research (Thomas, 2006), letting the categories emerge from them instead of testing pre-defined ones like in the deductive approach.

This research combines the two methods (Hemkhaus, 2016). Indeed, it started by defining in the literature review some challenges and benefits of the crowd engagement process that have initially emerged from the "public" labeled papers of the sample used in the first chapter of the dissertation, therefore following a deductive approach. Then, to validate and expand these results, an inductive methodology has been applied to let new codes emerge from the empirical sample, by performing "in vivo" coding on the transcripts of the interviews.

The steps followed in this research exploit both deductive and inductive approaches were based on the work of M. Hemkhaus (2016) and will be briefly described in the following lines (Figure 12). It starts with a literature review of the "public" labeled papers of the sample built in the first chapter of the dissertation. Then, based on this literature analysis, challenges and benefits are defined using a deductive approach. These steps are then followed by an "in-vivo" coding performed on the transcripts of the interviews of the empirical cases chosen by the researchers. In this phase, which will be described more in detail in the data analysis section, challenges and benefits emerge inductively from the collected data. The results from the coding phase are then compared with those of the literature review. This phase is aimed at exploring which challenges and benefits empirically found were also discussed in the literature while identifying those which were not, which will therefore represent a novel contribution to the theory of crowd engagement.

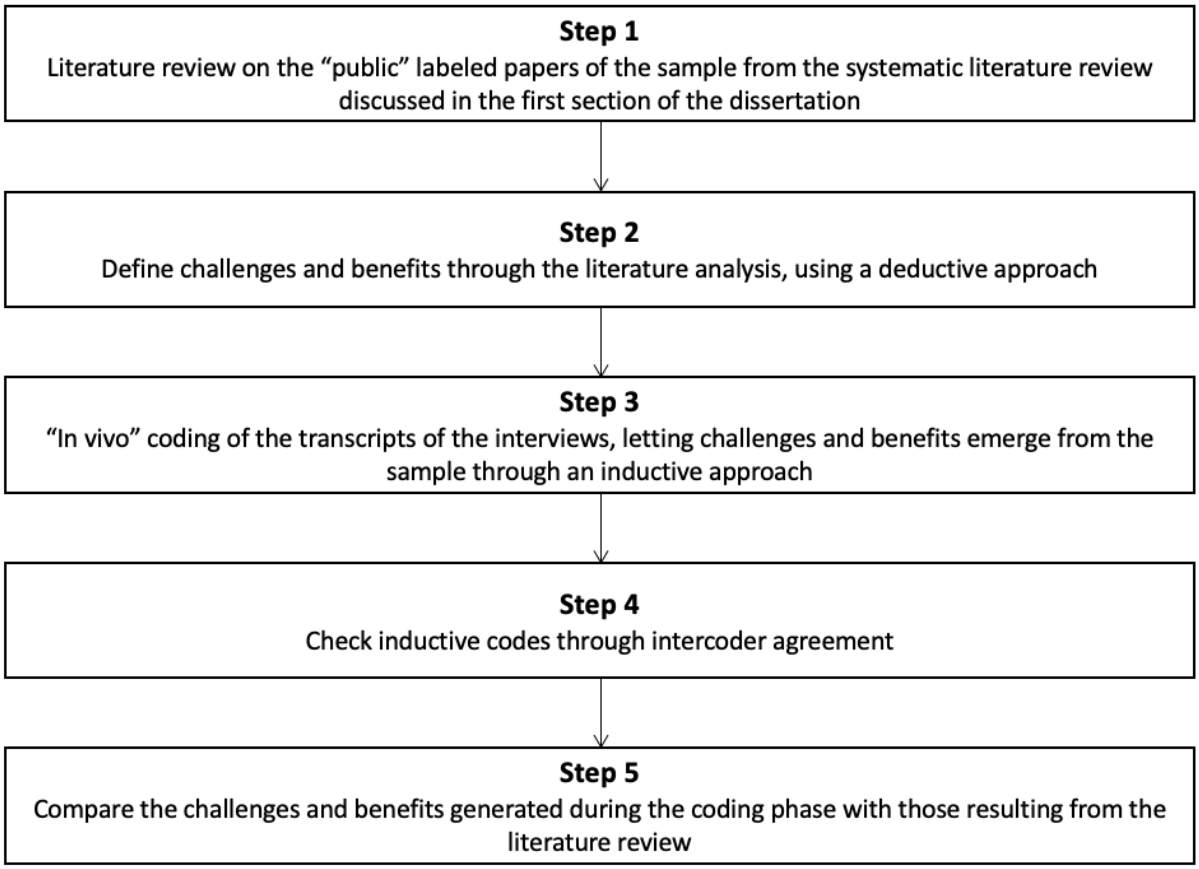


Figure 12 Process followed to define the challenges and benefits, combining both deductive and inductive approaches

2.3.3. Sample description

The sample to be studied for the identification of challenges and benefits of crowd engagement is made of 9 cases, highlighting different possible applications of the process.

It was chosen to put the focus on the initiative organized by the public institution or non-profit organization and on the initiator itself. This decision was taken for multiple reasons. First of all, adopting the perspective of the initiator allows for a deeper and more exhaustive comprehension of the implemented processes, which is pivotal to assessing its challenges and benefits. It was so possible to better assess the connection between some findings and the decisions and dynamics that led to their manifestation,

improving the understanding of the causes of each challenge and benefit. Moreover, only the initiators could provide a detailed description and explanation for all the steps and building blocks of the initiatives, going beyond considering only those in which the participants are directly involved, which would have allowed only a partial evaluation of the case. It was important to consider everything that happened beyond the direct involvement of the participants as well, like the phase of management and assessment of the results developed by the citizens.

Indeed, interviewing directly the participants would have led to narrower and more subjective evaluations of the subjects of research, as it would have been very difficult for them to generalize and relate perceived challenges and benefits to the design of the initiative, of which they could have had only partial knowledge and understanding. Moreover, they would have been able to comment only on the phases in which they were directly involved, while it was in the research's interest to explore all the steps and dynamics of the process, to develop more comprehensive results.

Moreover, the interviewed people, who were representing their organizations, had often been directly in touch with the participants during the initiatives and were so able to provide the participants' points of view as well, adding so some important information about the process.

The different cases were selected making sure that they would bring different perspectives on the research questions, according to the principles of purposive sampling (Schreier, 2018). Moreover, each one of them had to respect some selection criteria to be accepted. According to the provided description of crowd engagement, the cases had to be focused on the solution of complex problems affecting most of society, like natural disasters, climate change or sustainability. Secondly, the initiator had to be either a public institution or a nonprofit organization. Finally, citizens had to be involved, sometimes at an international scale, in the solution of the problem.

Most of the cases were identified based on some prior research on collective intelligence by Nesta, the UK's innovation agency for social good. Indeed, Nesta's focus was put on cases initiated either by public institutions or nonprofit organizations which tried to harness the potential of citizens and data to solve problems of a global nature, therefore fulfilling the required criteria to be included in the sample. It was so possible to define the initial sample of 6 cases to be analyzed (Cases A, D, F, G, H, I). Moreover, some interviewees, based on their experience, suggested other relevant projects to expand the research for which they provided contacts. This triggered a "snowball" effect leading to the inclusion of three new cases (cases B, C and E), bringing their final count to nine.

The sample of cases shows a variety of applications and contexts of the crowd engagement process in terms of the initiatives' span and intensity. This diversity was

reached on purpose, to obtain results that could be representative of crowd engagement in general, and not for just one of its implementations. Indeed, the sample includes both cases in which the initiator was a non-profit company and some in which it was a governmental institution. Moreover, they show different final purposes and methods to engage the citizens, with the high-intensity cases involving them in a more active way than the low-intensity ones.

Finally, the interviewees were all people who directly participated in the initiative's design and/or implementation as part of the initiator's team or founders. Moreover, some of them had experience in more crowd engagement initiatives than the ones they were representing. This was exploited by the semi-structured interviews' flexibility, by designing the questions to give the interviewees the possibility to expand the discussion, also including other experiences which were relevant to answer the research questions.

As far as the number of interviews to be conducted for each case is concerned, it was initially decided to fix the minimum threshold at three and to adjust the actual number during the research (Francis et al., 2010; Patton, 2015, module 40). However, talking with people who were representing the perspective of the initiator of the crowd engagement processes led to interviews that were so rich in insights that information saturation was quickly reached (Schreier, 2018). Indeed, there was only one instance in which it was necessary to have more than one interviewee, as in all other cases, the additional data provided by a second interview was not enough for it to be considered of value.

The next paragraphs are dedicated to briefly describing the analyzed cases.

2.3.3.1. Case A: Carbon neutral helsinki 2035

Carbon neutral Helsinki 2035 is a project published by Helsinki's Mayor's office in 2018 with the purpose of identifying measures and actions enabling and supporting the city's path towards carbon neutrality by the year 2035 (Ryan et al., 2020). Given the complexity of this goal, it was necessary to involve as many stakeholders as possible in the process of both defining and implementing the project. That's why the plan itself was collaboratively drafted in an open way, engaging researchers and experts, civil society organizations and other stakeholders like the city's energy company. This process led to the definition of 147 actions which would have led to carbon neutrality (Ryan et al., 2020). Moreover, to ensure their implementation and fine-tune the plan, a collaborative monitoring system was created. Through the Climate Watch page it is possible to track the progress of each of the actions, for each of which multiple measures are shared like the expected time before completion, whether it is on

schedule or not and what tasks still must be performed. The goal of this website was to guarantee transparency and public accountability, while giving the citizens' the opportunity to give real-time feedback on the plan and its progress (Ryan et al., 2020).

2.3.3.2. Case B: Conference on the future of Europe

The conference on the future of Europe (in short CoFoE)was a deliberative democracy initiative that went beyond the national boundaries, on a transnational European scale, with the goal of giving European citizens the opportunity to debate about reforms that should be made to the politics and institutions of the European Union, to shape its future in the medium to long term. The idea for this project was first launched by French President Emmanuel Macron in 2019 and then implemented under the President of the European Commission Ursula von der Leyen in 2021, after some delays caused by the Covid-19 Pandemic. The initiative was intended as a way to promote a transparent and inclusive debate on a very broad spectrum of topics involving the citizens in decision-making and giving them an agenda-setting role as well. Recommendations were generated by European citizen panels composed of people selected in order to make them as representative as possible in terms of geographic origin, gender, age and other variables or through a multilingual digital platform on which every European citizen could share their opinions, without having to go through a process of selection. The final outcome will be then analyzed by the three leading institutions of the conference namely the President of the European Parliament, the President of the Council and the President of the European Commission to understand what will be the follow-up.

2.3.3.3. Case C: EUvsVIRUS hackathon and matachathon

The EUvsVIRUS Hackathon took place in April 2020 and was sponsored by the European Commission, led by the European Innovation Council with the patronage of the Commissioner for Research and Innovation, and Culture, Education and Youth Mariya Gabriel. The event brought together civil society, innovators, partners and investors from across Europe with the purpose of developing innovative solutions to challenges related to COVID-19 in an effort to show that the European Community was truly united in their response and management of the pandemic. During the hackathon over 30.000 people from the EU and beyond participated in the design of solutions which belonged to six thematic areas: health and life, business continuity, social and political cohesion, remote working and education, digital finance and other topics.

The matchathon, which took place in the month of May, was instead focused on matching the best 120 teams from the hackathon with partners from the private and public sectors, building 2235 new cross-European partnerships. EUvsVIRUS involved people from 40 different countries and proved to be extremely efficient in the fight against Covid-19, showing world record numbers in terms of countries involved (40), new partnerships (2235), curated meetings (1500), partners (500+) and projects (120).

2.3.3.4. Case D: Global fishing watch

Global Fishing Watch was founded in 2016 by three organizations which are Google, Oceana and Sky truth with the goal of advancing ocean government and sustainability by increasing the transparency of human activity at sea through a remote tracking system of vessels (Peach et al., 2019). The data collected from the automatic tracking systems (AIS) of the boats is combined with governmental data on commercial fishing to create publicly shared maps for the visualization and analysis of vessel-based human activity at sea. This makes it possible to increase the transparency on human activity at sea, making it common knowledge, to enable fair and sustainable use of the ocean and to protect the global fish population (Peach et al., 2019).

2.3.3.5. Case E: City plan Helsinki

Helsinki's "City Plan" is a long-term strategic land-use plan aimed at guiding the future development of the city's urban structure until 2050. Key themes of the project are the densification of the Finnish capital and the expansion of its center to create homes for the approximately 860.000 forecasted residents, the conversion of some motorways into boulevards and the birth of new districts. To reach such an ambitious goal, citizens and businesses were involved in the planning process to include their views and improve their understanding of what was going on, understanding whether they agreed with it or not. To enable their participation, different kinds of initiatives were launched like a map survey which was organized early on in the process which enabled citizens to pin on a map the locations they considered as appropriate for construction, important green areas and much more. Digital tools were complemented by physical events, which the participants could physically attend to discuss and learn about the plan. Finally, given the long-term nature of this project, much attention was also given to the inclusion of young people in the process, who were engaged with specific events like workshops aimed at giving students the opportunity to think about the city's future and its urban planning challenges.

2.3.3.6. Case F: Public lab

Public lab is a non-profit organization and community with the goal of democratizing science to overcome environmental challenges. It was founded in the aftermath of the BP oil spill in 2010, when activists, locals and social scientists came together and used DIY "community satellites", basically balloons or kites with cameras on them, to create an accurate image of the oil spread by putting together all pictures taken (Peach et al., 2019). The collected data could then be used to assess the extent of the environmental damage. Public lab has since then grown into a global community with the purpose of supporting environmental research, sharing tools, methods and resources to enable anyone to investigate their environment. Examples of its application are the "sand sentinel program", the goal of which is to ease the filing of reports on suspected permit violations by frac sand mining companies, and the "The mountains and mines monitoring project" which is intended for monitoring active mine sites in West Virginia to document violations of environmental law.

2.3.3.7. Case G: Safecast

Safecast is an internationally operating nonprofit organization whose goal is to create useful, accessible and granular environmental data thanks to the work of volunteers (Ryan et al., 2020). It was born after the Fukushima Dai-ichi nuclear disaster in 2011 as a crowdsourcing project building both hardware and software solutions for environmental monitoring of radiation levels. After the earthquake and its impact on the nuclear reactors, data made available by the Japanese government regarding radiation were not precise enough. They were based on large average numbers of huge areas in which the radiation levels could instead vary considerably. This, combined with an evacuation plan that was largely based on a voluntary decision, made it difficult for people to understand whether to leave their homes. Safecast was born as a process based on crowdsourcing mechanisms to collect and generate more precise data about the radiation levels in order for the residents to make informed decisions as far as the evacuation was concerned (Ryan et al., 2020). To collect the data, volunteers can get a kit and build a tool following instructions given by Safecast which they will bring with them while moving around the country. Radiation levels are so measured and then uploaded, building what has now become, as stated by the organization's co-founder and global director Sean Bonner: "the largest data set of radiation data that has ever been assembled". Safecast has grown globally, being used across the U.S.A, Australia and Western Europe, like in France where an entire system was built around the organization's data, and also expanded its work to collecting other data types like air pollution, maintaining its status as a facilitator of the public release of environmental data.

2.3.3.8. Case H: Belgian sortition model, The Ostbelgien Model

The parliament of the German-speaking Ostebelgien region gave birth in 2019 to a process for applying deliberative democracy based on sortition, the random selection of citizens who participate in the assemblies (Ryan et al., 2020). After the success of a similar project focused on the topic of childcare in 2017, it was decided to permanently create a process for deliberative democracy which would engage citizens to restore their confidence in politics. Through this process, it is possible for members of the German-speaking community to formulate suggestions about certain topics, taking so part in the decision-making process for the region. Two bodies were created: the citizen council and the citizen assembly. The first one is made by former members of the citizen assembly and is in charge of the selection of the topics to be discussed in a process that involves the whole region's population by asking for recommendations. The selected topics are then discussed by the citizen assemblies, the members of which are randomly selected among all citizens of the German-speaking community aged 16 years or older. The goal of the citizen assembly is to formulate a set of policy recommendations which are then presented to members of the parliament. The MPs will then determine whether they will implement them and, if not, provide sufficient motivation to the assembly for their refusal (Ryan et al., 2020). This process is permanent as it was legislatively established to keep the citizens' dialogue and the assemblies are now starting to discuss the 4th topic (digital skills), after having seen many recommendations being implemented. The purpose of this process is to restore the citizens' confidence in politics by increasing their understanding of it and including them in the decision-making process, closing the gap between voters and politicians.

2.3.3.9. Case I: Ushahidi

Ushahidi is an online platform for crowdsourcing data in support of human rights advocacy, emergency and humanitarian response in crisis situations (e.g natural disasters like fires or earthquakes, situations of violence, etc.) and transparency and accountability campaigns for good governance (Ryan et al., 2020). The non-profit organization was born in 2007 after the riots following the Kenyan elections, as a platform to collect, validate and share data about the spread and location of violence, enabling citizens to map what was happening around them. Since then, the goal of Ushahidi ("testimony" in Swahili) has always been to give a voice to marginalized people, who in moments of crisis are often the most affected ones and the last to be considered. To do so, the "crowd mapping" (crowdsourcing geographic data for the

creation of maps) platform provides communities in need and organization tools for data collection, data management, data analysis and visualization and response. Data can be collected through many channels, both online like email and offline like SMS, to ensure communication even in the worst situations and the platform itself is open source, meaning it can be customized and used according to the purpose of the users (Ryan et al., 2020). Since its first deployment in 2007, the platform has grown considerably and has been deployed in more than 160 countries providing situational awareness and enabling better decision-making when delivering disaster relief. Among many deployments, Ushahidi was used to monitor Kenya's constitutional referendum in 2010, collect information about people needing help in the Haiti 2010 earthquake and prevent forest fires in Italy. More recently, the platform was used more than 2500 times to meet the response and emergency needs of communities during the Covid-19 pandemic.

2.3.4. Design of the interview process

Since the objective of this research was to deepen the understanding of crowd engagement's challenges and benefits in the public sector, it was chosen to apply the methodology of semi-structured interviews (DiCicco-Bloom and Crabtree, 2006). This type of interview process is structured according to a protocol made by a sequence of open-ended questions that have been thoughtfully chosen based on the topics the researcher wants to study. As a result, there will be room for interaction from both sides, even though the themes of the research are predefined (Roulston and Myungweon, 2018). For instance, if a topic of interest arises during the interview and the researchers want to delve more into it, they can ask follow-up questions that were not originally planned or they can push the interviewee to elaborate on the response (Roulston and Myungweon, 2018). Given the complex nature of crowd engagement projects, this method appeared ideal for the research's purpose as it allows to explore predetermined themes, namely challenges and benefits of the participatory process, while giving the interviewees enough freedom to make sure they can leverage their experience and knowledge while answering to the questions (DiCicco-Bloom and Crabtree, 2006). To match this design method feature, the semi-structured interview has been chosen as the primary data source (DiCicco-Bloom and Crabtree, 2006).

2.3.5. Data collection

The data analyzed to define the challenges and benefits of crowd engagement was obtained from different sources to enable their triangulation (Table 11), taking different perspectives to make the cognitive process more robust (Flick, 2018).

Table 11 Data sources for each case study

CASE STUDY	SOURCES USED TO TRIANGULATE THE DATA
A	Sources: interview, emails, secondary data
B	Sources. interview, emails, secondary data
C	Sources: interviews, emails, secondary data
D	Sources: interview, emails, secondary data
E	Sources: interview, emails, secondary data
F	Source: interview, emails, secondary data
G	Sources: interview, emails, secondary data
H	Sources: interview, emails, secondary data
H	Sources: interview, emails, secondary data

To do so, data was collected from the interviews and email correspondences with the interviewees and from secondary sources, like webpages and previous studies about the cases. In particular, the latter was used in the phase preceding the interviews to better understand the single cases and whether they were truly relevant to our research, enabling an informed selection of the sample. Moreover, secondary sources provided information that supported the definition of the protocol used for the primary research which was conducted in the form of semi-structured interviews. Therefore, while the main themes of the interview process had been fixed, the use of open-ended questions meant that some freedom was left to the interviewees to enable them to elaborate on some topics (DiCicco-Bloom and Crabtree, 2006). As a result, the protocol served as a guide while the prepared questions were not used as a strict and immutable structure but were adapted as the interviews went along, with some of them being reformulated or skipped based on the previous answers (Roulston and Myungweon, 2018). Moreover, sometimes additional questions were asked to deepen the discussion about some topics that emerged from the interviewees and that were valuable for the research.

The protocol itself was structured in five main sections (Table 12) and the questions were designed to make sure to exploit the interviewee's personal experience of the field while giving them the freedom to spontaneously expand the conversation by raising topics relevant to them.

The first section was aimed at getting a general overview of the case and the interviewee's role.

The second section was defined to obtain more specific information on some aspects of the crowd engagement initiative which could be relevant when trying to make sense of the emerged challenges and benefits, namely the project's purpose, problem to be solved, users involved, the contribution of the users, and steps of the engagement process.

The goal of the questions in the third section was to understand whether the project went as planned, leading to a discussion about the main criticalities that had to be managed and the main reasons for the success of the project.

Finally, the fourth and fifth sections were both focused on directly asking about the challenges and benefits of the crowd engagement process with the former being aimed at defining them for the specific case that has been analyzed during the interview. The latter instead asked the interviewee to talk about challenges and benefits drawing on their whole experience and going beyond the single initiative that had been analyzed. Indeed, some of the people that have been interviewed had managed multiple projects of crowd engagement and could therefore expand the discussion beyond the boundaries of the case.

The questions were provided to the interviewees in advance and the interviews were recorded and transcribed (Jenks, 2018) to enable the following step of coding the results, in accordance with the consent of all participants.

Finally, when necessary, some follow-up questions have been asked to the interviewees via email, while the secondary resources exploited to complement the interviews' information were: i) previous interviews about the cases; ii) the projects' and organizations' official webpages; iii) documents kindly shared by the interviewees (e.g., PowerPoint presentations); iv) other webpages analyzing the cases.

Table 12 Interview protocol for the semi-structured interviews. "Ushahidi" was used as an example of the case's name. According to the case, some questions were adjusted.

Obtaining a general overview of the case and the role of the interviewed person
Can you tell me a little about Ushahidi?
What is your role in it?
Defining the crowd engagement process of the case
What is the goal/purpose of the process?
Could you tell us which problem or challenge you want to solve?
What contribution do users give?
Who are the users engaged in the process?
What are the steps of the process to engage the users?
Success of the initiative
Does it work?
Would you say it met the expectations and goals?
Defining the main challenges and benefits of the crowd engagement process with respect to the case
Given the context, why did you decide to apply crowd engagement?
So, what would you say are the main benefits offered by crowd engagement when tackling this problem?
What are the main challenges of this approach which you have to overcome to make it work?
Defining the main challenges and benefits of the crowd engagement process in general, going beyond the case
Based on your experience what do you think are the main benefits of crowd engagement in general, going beyond your specific case?
What are instead the main challenges faced while implementing crowd engagement in general?

2.3.6. Data analysis

To analyze the collected data, a coding process was conducted. As discussed in the "data analysis methodology: inductive vs. deductive approach" paragraph, the coding process of the interviews followed an inductive approach. The results of the literature review were therefore not used to build a framework to be used in the analysis phase but have been used to make comparisons with the coding results. It was so possible to support the sense-making of the results of the analysis and assess their validity while combining them with the previous findings. The coding process of the interviews was based on the procedure for the inductive analysis of qualitative data described by Thomas (2006) and can be described by the following steps.

The first phase was data cleaning, in which all raw data was formatted in a common format. By recording the interviews with Microsoft teams, it was possible to exploit the software's feature that automatically generates a transcript of the call, providing so the initial raw data that needed to be elaborated. These first versions of the interview's text were then cleaned and corrected by rewatching the recordings (Jenks, C. J. 2018). Moreover, the names of the participants were highlighted using a color scheme common to all transcripts.

Then, once the texts were prepared, they were closely read to get a general understanding of the results.

The next step was aimed at selecting segments of text that were considered to be relevant for the analysis, based on the objective of the research. This was directly performed on the cleaned transcripts of the interviews by highlighting the relevant phrases. While doing so, a first dichotomic categorization of the segments into potential challenges and benefits was executed to facilitate the following steps.

These text segments were then used in the following phase to generate the codes that eventually built the coding tree. First, a within-case analysis was performed to understand the typologies of challenges and benefits that emerged in every single initiative of the sample. This led to a preliminary generation of codes for each case (Thomas, 2006). The coding was performed manually with the help of an excel sheet on which all the various text segments that had been identified were pasted and organized. By doing so it was possible to consider only the relevant phrases, allowing for a better comparison among them and consequently simplifying their classification and the generation of codes representing the main challenges and benefits that emerged from the interview. The excel sheet was then also used to perform the inter-reliability coding which will be discussed in a few lines. Once some preliminary codes had emerged by singularly considering every interview, a cross-case analysis made it possible to compare them with the purpose of eliminating redundancy among the

codes (Thomas, 2006), by highlighting the differences and commonalities between them. This led to a more robust categorization of the codes which represented the crowd engagement process' challenges and benefits for the entire sample.

The final model was then compared with the results of the literature review, to assess which of its findings had also been discussed in the literature and which appeared instead to be novel contributions to the theory of crowd engagement.

2.3.6.1. Intercoder reliability

Intercoder reliability (ICR) numerically measures the level of agreement reached by different coders when analyzing the same data set (O'Connor and Joffe, 2020). In the context of coding, reliability means that a certain coding scheme can be consistently applied multiple times replicating the same results (Geisler, 2019). While the main objective of ICR is to guarantee the robustness of the results, it should also be applied to foster discussion among the researchers, making them reflect on the defined codes (O'Connor and Joffe, 2020). Consequently, this process is not only intended for validation but also to develop the analysis (Geisler, 2019) and should therefore be exploited to adjust the coding frame while improving the accuracy of the analysis (Joffe & Yardley, 2003).

To conduct ICR, it was decided to follow the procedure proposed by O'Connor and Joffe (2020). First of all, some preliminary decisions were taken. As suggested by the authors it was decided to start with two coders and then include a third one to increase the accuracy of the results. To achieve a high level of precision, it was chosen to consider single lines or a small group of successive sentences, when it was needed to achieve a clearer understanding of what the interviewee was saying, as units to be coded. Moreover, simple agreement and Cohen's Kappa (k) were identified as the reliability measures to be calculated. In particular, the former was chosen because it is the most common one (Kolbe & Burnett, 1991) and computed as the ratio between the number of agreements and the total number of analyzed segments. Even though this measure provides a quick way to assess the agreement level of the coders, it does not take into account the fact that sometimes they might agree just by chance (Hallgren, 2012). As a result, it may provide a more "optimistic" assessment of the results than what happens to be true. Therefore, Cohen's kappa, which is a statistical test rather than a percentage agreement measure, was also computed, as it compensates for the probability that coders might agree by chance (O'Connor and Joffe, 2020). The closer this measure is to 1, the more reliable the final results are.

After these preliminary decisions had been taken, the first coder, who was the most familiar with the cases, started by segmenting the interviews, identifying the most

relevant lines, and applying codes, as suggested by O'Connor and Joffe (2020). The transcripts were then passed to the second coder, with the relevant sentences to be coded visible, who had to define the codes on their own without knowing the colleague's previous results. The outcomes were then compared, with the single agreement being computed as 91,54%. Since the results were considered not robust enough, this first iteration of the coding phase spurred a critical dialogue between the coders in which the differences were discussed and the coding frame was refined (O'Connor and Joffe, 2020). It was decided that, beyond being meaningful for the analysis, a single code had to appear in at least two separate cases for it to be kept. Consequently, the codes went from being 35 in total, showing 20 challenges and 15 benefits, to 27, with 14 challenges and 13 benefits, going therefore under the 30 codes upper limit suggested by MacQueen et.al (1998), without compromising on their comprehensiveness for the sake of ICR.

It was then proceeded to conduct a second round of coding at the end of which the simple agreement was computed as 97%. Moreover, to take into account the possibility that coders might agree by change, Cohen's Kappa was calculated as 0,9685. Moreover, to check whether the results showed some bias, the marginals of the two coders, meaning the number of times each code was attributed by a coder independently from the other, were compared. Since they showed only minimal differences, the results were considered unbiased (Geisler, 2019)

As anticipated above, after having reached this result, which was considered satisfying in terms of coding framework, a third coder was introduced to increase the robustness of the analysis of the segments. Consequently, the simple agreement was computed as the ratio between the total number of agreements between all three coders and the overall amount of analyzed segments. Its final value was therefore calculated as 96,98%. Moreover, Cohen's Kappa has been computed for the coder 1 and coder 3 combination as well as for coder 2 and coder 3, leading respectively to 0,9895 and 0,9738. As discussed above, in both cases the marginals were checked and showed no bias.

Since the coding frame was considered robust enough and comprehensive of all relevant findings from the interviews, ICR came to its end and the so obtained results were classified as final.

2.4. Results discussion

This section starts by providing the final results of the coding process, which have been generated from the interviews' transcripts. To do so, the two final coding trees, one for crowd engagement's challenges and one for its benefits, will be represented and all their elements discussed, while the most relevant quotes from the interviewees will be reported in dedicated tables. The so emerged challenges and benefits of the crowd engagement process will be then compared to those found in the literature review, identifying those who had been already discussed and those who might instead provide a novel contribution to the theory related to these initiatives. Finally, cases, challenges and benefits will be mapped on three different diagrams to better compare them and assess their impact based on two variables of the crowd engagement initiatives: intensity and span.

2.4.1. Challenges

As can be recognized from the multiple levels of the coding tree representing the challenges of the crowd engagement process in the public sector (Figure 13), the final results, highlighted by the black rectangles, have been organized in different "clusters". The following lines are dedicated to explaining the meaning behind each of them, deep diving into all of the emerged challenges.

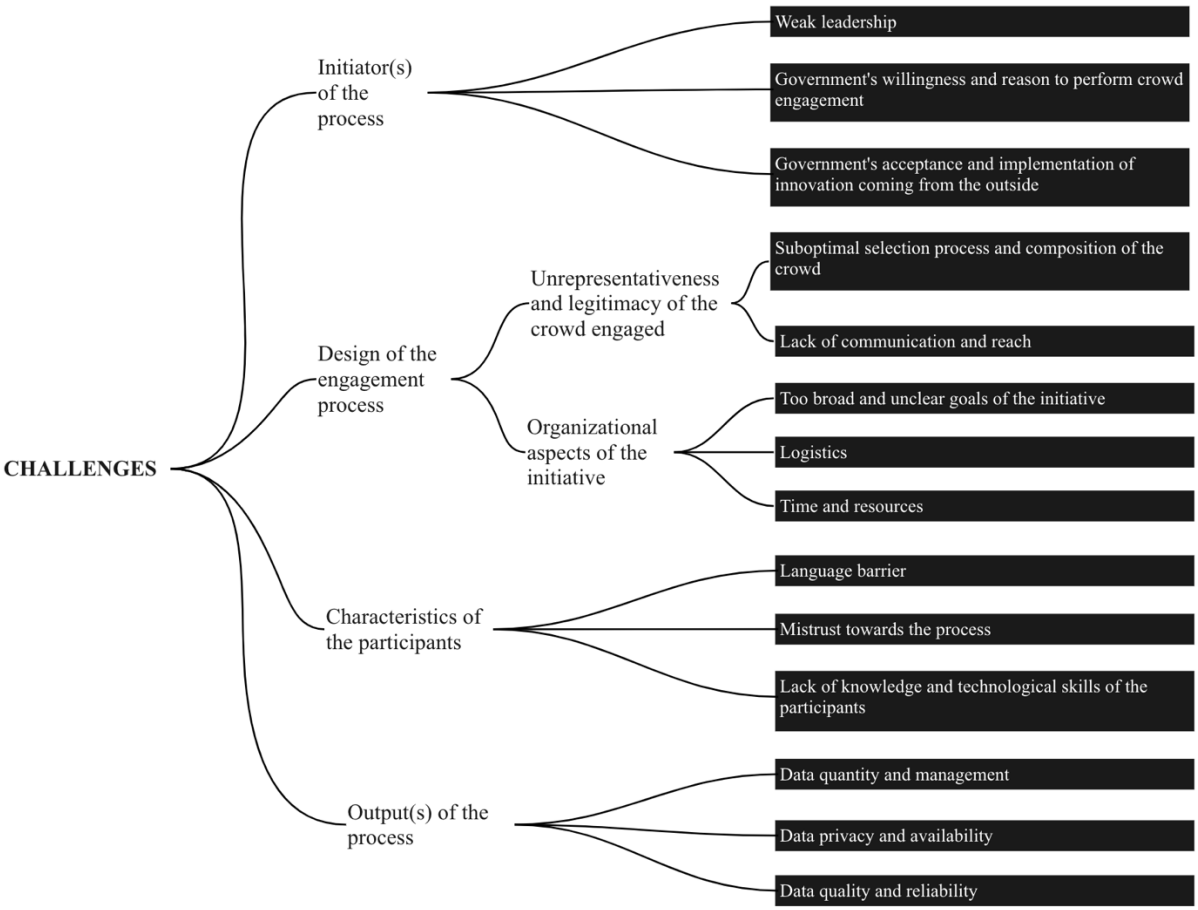


Figure 13 Coding tree of the challenges of crowd engagement

2.4.1.1. Design of the engagement process

The challenges belonging to this cluster all share the fact that they originated from the way in which the crowd engagement process was designed. In other words, they exist because of poor organizational choices by the initiators. As explained by the interviewees of cases A and E, the not effective design of the process might derive from a lack of experience of the initiator. Therefore, after a successful learning process, if needed, a well-thought design of the crowd engagement process should make it possible to overcome these challenges.

The findings have been further grouped into two sub-clusters: "unrepresentativeness and legitimacy of the crowd engaged" and "organizational aspects of the initiative". In total, this cluster counts for 39,60% (Table 15) of all phrases marked as challenges, being, numerically speaking, the most relevant group of the analyzed coding tree.

The first sub-cluster includes all challenges that cause the sample of participants of the crowd engagement process to be unrepresentative of society at large, therefore limiting the legitimacy of its results.

It starts with the "suboptimal selection process and composition of the crowd" challenge, which refers to the way in which the crowd is composed. This was particularly relevant for deliberative democracy cases (B and H), where the participants were selected to make sure that citizens of all social and economic backgrounds would be represented in the assemblies.

As discussed in case B, for the successful implementation of crowd engagement initiatives it is fundamental to connect it to a broader societal and Democratic dialogue, so that there is truly popular support behind its outcomes. To do so, initiators must make sure to reach representativeness for all society and to avoid a selection process that reproduces power structures, biases and political cleavages by only having those participate that have the political education and the interest in these subjects, while also having the economic resources and the time to participate. In other words, not only those whose voices are already heard should be included and those who might struggle to participate, because either they cannot afford it or cannot find the time, should be supported by the process.

The second and last challenge belonging to this sub-cluster is called "lack of communication and reach" and it refers to the fact that if the communication of the crowd engagement process is not properly carried out, many potential participants will not take part in the event merely because they were not informed about its existence in the first place. As highlighted by case A, this might lead to the inclusion only of people who were already interested in similar initiatives, therefore significantly reducing the reach of the crowd engagement process, constraining the representativeness of the involved crowd and consequently limiting its potential outcome and impact. The fact that this was the challenge that was reported by the highest number of cases among all, should make it clear, that communication is very significant for the success of crowd engagement initiatives and that it should not be treated lightly when designing the process.

The "organizational aspects of the initiative" sub-cluster includes all the challenges that originated from the organization of the crowd engagement initiative and, instead of impacting the representativeness and legitimacy of the crowd, limit the effectiveness of the process itself.

The first challenge to be considered from this perspective is caused by having "too broad or unclear goals of the initiative". This was highlighted by cases A, B and E

where the scope of the initiative was too broad, leading to the generation of ideas by participants which were not very high in quality and difficult to implement, therefore connecting this challenge to the "data quality and reliability" one above discussed. Consequently, the initiators appeared to be unable to formulate the tasks in a way that enabled them to steer the crowd in a direction that led to an effective solution generation by the participants. It is very interesting to notice how this is the challenge mentioned the highest number of times across the interviews (Table 15), 10,89%, together with "Government's acceptance and implementation of innovation coming from the outside". This might significantly show how, with the theory behind the process being still young, there might be still the need for the initiators to focus on the learning process to gain enough experience to overcome this and all the others challenges of this cluster.

Moving on to the next challenge, cases B and C discussed how ineffective management of the initiative's logistics will limit its effectiveness. It must be noted how the interviewees used the term "logistics" in a very broad sense, including all activities supporting the complex task of organizing the phases of the process, with particular attention given to those actually involving the participants, like managing online and "in presence" meetings all over Europe, including the technical aspects of their implementation.

The last challenge of this sub-group is called "time and resources" and it refers to the fact that to organize crowd engagement processes, which might be very complex, broad and long, financial resources will be very important to support the operations. This is especially true for non-profit organizations, for which funding, as discussed in case G, will significantly limit their reach and success. Indeed, governmental institutions' cases were more focused on the importance of managing resources in a proper way rather than collecting them in the first place. Going beyond money, as shown by cases A and B, time plays also a very important role as a resource for crowd engagement processes, with its allocation and management significantly impacting their effectiveness.

2.4.1.2. Initiator(s) of the process

"Initiator(s) of the process" refers to all challenges that are intrinsically related to the organization designing the events. In other words, these challenges are not caused by the way the process was defined, by the solutions it generated or by its participants, but directly stem from the initiators' culture, members and their mentality.

This cluster is made of three challenges. While the first one is true for both non-profit and governmental organizations, the last two only apply to the latter, as shown by the cases analyzed in this research.

The first challenge of this cluster is called "weak leadership" and it refers to the fact that not having strong and motivated leaders with the right mindset will prevent the crowd engagement process to unfold successfully. Indeed, as mentioned in case C, given the complexity of organizing these events, it is pivotal to have a well-established organizational structure with the right leadership philosophy, to make everyone feel valued and keep the morale high to make everything work. Moreover, citing a very relevant quote from case F by Liz Barry: "The method cannot be put into a bottle". What is meant by this is that it should not be taken for granted that the process behind a crowd engagement initiative can be institutionalized and mechanically applied as many times as needed. Indeed, the role played by the projects' leaders, who are passionate about the initiatives' purpose, should not be underestimated. In other words, it should not be taken for granted that a successful crowd engagement methodology automatically self-perpetuates in its effectiveness after a leadership change following the exit of the passionate founders of the projects.

The following two challenges have in common the fact that they are caused directly by the culture of the governmental institution that initiated and organized the crowd engagement event. Consequently, the next findings apply only to the cases in which the initiator belongs to mentioned category and is not true, at least from what emerged from the sample of this research, for non-profit organizations.

First of all, "Government's willingness and reason to perform crowd engagement" refers to the fact that government institutions might still be hesitant to perform this kind of participatory process and might do it for the "wrong" reasons. In other words, as discussed in case A, professionals working in the public domain, which often are experts in their sector, might not be willing to hand part of their decisional power to a less skilled crowd of citizens. Consequently, crowd engagement initiatives might be organized not because of the process' values and potential but only because it is required by law or, as discussed in case B, as a sort of "window dressing", instrumentalizing the process just to increase the perceived democratic legitimacy of a government.

"Government's acceptance and implementation of innovation from the outside" is strictly related to the previous challenge but is instead focused on the fact that, once the crowd engagement process has been completed, public institutions might show a

lot of resistance in accepting ideas that were not internally developed. In other words, it might be difficult for these organizations to embrace innovation that comes from the outside, for instance because of problems related to who gets credit for it, which might be important for the politician's career path. Moreover, as introduced in the previous challenge, it might be difficult for experts to open up to the crowd and accept ideas that were co-created with citizens. This challenge includes the "knowledge creation vs. knowledge implementation" concept discussed in the literature review section. Indeed, as it stood out from case B, in the absence of commitment by the governmental institution, there is no certainty that the generated ideas, if accepted, will also be implemented. This will of course significantly limit the potential impact of the crowd engagement process as, if solutions are not put into practice, no real difference can be made by the process. It is interesting to notice how this code shows the highest appearance percentage of all challenges (Table 15), 10,89%, tied with "too broad and unclear goals of the initiative".

Finally, it must be highlighted how in the interview of case H it was discussed how the last two mentioned challenges can be overcome by designing the process in a way that will guarantee, even by law, that the generated ideas are considered and reviewed by the initiators and that, if not put into practice, an explanation is provided directly from the politicians to the citizens to meaningfully motivate their decision, therefore reinforcing their implementation.

2.4.1.3. Characteristics of the participants

The "characteristics of the participants" cluster brings together all challenges that specifically refer to some characteristics that were intrinsic to the participants. From the interviewees, it could be understood how these were all aspects over which the initiator often lacked control, and therefore had to try to compensate for or limit their impact.

The first challenge included in this cluster is the "language barrier". This refers to the fact that when the crowd engagement initiative is broad enough to be conducted on an international level, the participants could struggle to communicate with each other because they do not speak the same language since they come from different countries. This was reported in cases B and C where the participants came from all over the EU. There were some cases of people who did not speak English, meaning they could not exploit such common language to effectively communicate with others. To solve this problem, case B successfully implemented a multi-lingual translation platform which made it possible to effectively overcome the mentioned problem.

The next challenge belonging to this cluster is called "mistrust towards the process" and, as its name says, it refers to the fact that sometimes the participants do not fully trust the crowd engagement process. This can be for instance related to the use of technology in these initiatives which are not familiar to them, as it emerged from case I. Indeed, there have been situations where some marginalized communities showed what was called by the interviewee as "technology phobia". In other words, they were reluctant to use new and unfamiliar digital tools like online platforms and needed therefore reassurance to develop trust and accept the usage of such channels. Moreover, citizens often are concerned about the way in which the data they have submitted, will be used by the initiators. This aspect is related to the "privacy" issue discussed in the "output(s) of the process" cluster and causes a lack of trust in the crowd engagement process, preventing some people from participating and therefore limiting the breath and the success of the initiative.

Finally, "lack of knowledge and technological skills of the participants" is related to the fact that sometimes there is a misalignment between the knowledge and competencies of the initiators and the participants, leading to the submission of solutions that are not feasible or in scope for the former. This happened for instance in the case A, where the participants sometimes lacked the required knowledge to tackle the complex problem of reaching carbon neutrality and therefore formulated suggestions which were not successful. Moreover, in some cases, the lack of technological skills might prevent certain people to participate in the initiative even if they want to, for instance in the case of an entirely digital event and elderly people not having a computer.

2.4.1.4. Output(s) of the process

This cluster was formed by grouping all challenges that were directly related to the data and contributions provided by the participants to the initiators through the crowd engagement process.

To start with, there was a total of four cases (A, E, F and H) that reported the challenge which was defined as "data quantity and management". What stood out is how the crowd involved in the analyzed initiatives, given their wide breath, often generated huge quantities of contributions or data for the initiators, making it very hard for them to analyze all of them. While this might not be a problem in the case of standardized data, like with Global Fishing Watch, when the submissions are more articulate in nature, like citizen-generated suggestions, the situation becomes very challenging. In other words, as stated by Liz Barry in case F, there is an information processing challenge when initiators have to manage the contributions generated by the

participants which are sometimes articulated in a noisy and unorganized way. As reported in case A, this might even happen in some minor planning processes and makes it very difficult to identify the most relevant things in all the collected information.

"Data quality and reliability" refers instead to whether the submitted solutions are actually of value for the initiators. In other words, the single submission could not be implementable for various reasons (e.g., regulations) or simply not good enough to be applied. This can be related, among other things, to the participants' personal knowledge of the subjects on which the initiatives are focused. However, the fault does not lie only in the hands of the participants. Indeed, as discussed in case A, this problem might be connected to the type of solution the crowd is asked to generate. Indeed, when this is more about free imagination, it seems more likely that participants will generate ideas that are not in line with the targets.

Going beyond quality issues, initiators might even have to deal with problems regarding the reliability of the collected data. This was highlighted by case I, where "infodemics" of "fake news" have more than once hindered the platform's effectiveness.

The last challenge included in this cluster is "data privacy and availability" and is related to the fact that some of the provided information might be difficult to handle because of problems related to privacy, which makes it hard to share and combine data coming from different sources. Sometimes, as shown by case D, the required data is not made available at all because of privacy concerns and thus cannot be incorporated into the crowd engagement process, limiting so its potential effectiveness.

The following table (Table 13) shows some of the most relevant text segments from the transcripts of the interviews that led to defining the discussed coding tree.

REFERENCE LETTER	SEGMENT	CLAUSE	CODE
F	16	So essentially like how can long-term agency staff be open to hearing innovation that came from outside the agency? Because there's a problem with who gets credit and there's a, you know, there's a problem for people in those career paths.	Government's acceptance and implementation of innovation coming from the outside
B	23	[…] the institutions did not commit to a binding follow up and this intern situational disagreement that I've been talking about will most probably keep, prevent the most kind of radical reforms and recommendations that came out of the process [...] whether the recommendations are really going to have large practical impact, that is very doubtful at the moment but it's also a bit too early to assess I would say	Government's acceptance and implementation of innovation coming from the outside
B	31	I think the main challenge is the commitment of those in power to the outcome and to take the results and the outcomes of these processes seriously	Government's acceptance and implementation of innovation coming from the outside
A	30	So, opening the questions up to the crowd, I think it's still slightly difficult thing to accept for some part of the public domain this kind of a Co-creation idea	Government's acceptance and implementation of innovation coming from the outside
B	24	[…] the conference on the future of Europe, not many people have heard about it, it was not communicated, especially in national media almost at all. It wasn't also the digital platform was not very visible. It was very limited engagement as I said with the digital platform and I think there's a lot of ways to potential in terms of communication outreach and giving this literally first deliberative democracy experiment of transnational nature, which is, it's a major thing to give it the visibility and with that the potential impact that it could or should have had	Lack of communication and reach
H	15	It's really important to do good communication around it	Lack of communication and reach
A	12	But then as we analyze the process later on so after this participation in the crowdsourcing phase, it became clear that it was still kind of very biased towards the people who were already working with similar topics. So, although the idea maybe at first was to make as wide participation as possible, then it was operationalized through that kind of means that mostly invited in the ones who were all already kind part of similar networks and so on. So, we didn't maybe reach as wide participation as was expected, but it was more targeted towards the already existing networks and contacts	Lack of communication and reach
B	28	Then the language barrier. Obviously, because many citizens only spoke their native language	Language barrier
F	10	But it's not like self-perpetuating so when the people who were committed to being there, being in the culture, when people started to, you know, have their life hit different phases and be less involved, it didn't auto like…It's not a model that automatically self-perpetuates.	Weak leadership
F	11	[…] attempt to institutionalize the methods more, after some of the people who put their whole lives into building the community and moved on, and I would say it is not working as well. So, the main, the first main criticality is: the method cannot be put into a bottle. You can't put it in a bottle and ship it and just do it again	Weak leadership

C2	11	I would say it's more setting up a good organizational structure. What's the leadership philosophy? How did they treat others? How did they treat people on the team? So, they feel included and equal, they feel valued as a person, as a team from each country	Weak leadership
C2	12	So, I would say a lot of it comes down to having the right mindset, the morality, you know, the philosophy, the leadership.	Weak leadership
B	26	[…] logistical challenges of organizing like this participatory democracy and event on a transnational level with citizens from all member states	Logistics
D	10	[…] it can be sometimes sensitive information, or it can be information that people prefer not to be shared	Data privacy and availability
D	11	[…] and in Europe for example, that is more of an issue because this data is attached really to privacy like it's linked to privacy legislations and it's quite complicated to access data	Data privacy and availability
A	21	So, when it is more about this free kind of imagination and so on. So then in the end, it's most likely that the ideas are not in line with the actual target	Data quality and reliability
I	21	I think the first one is that we are in an era where there are “infodemics” of fake news and fake reports. So, this definitely affects the quality of information that is being reported in some instances and it's something that we are actively trying to see how we could improve our technology to be able to detect	Data quality and reliability
F	17	so essentially these are the two things to the government to try to sensitize to is that problems are being articulated to them by the general public in a noisy, unorganized manner.	Data quantity and management
A	31	I have seen that even in some minor planning processes in Helsinki, the amount of information coming in from the participatory processes is huge	Data quantity and management
A	32	So, kind of the planners and the other experts who are then utilizing somehow those ideas are kind of crowning under all of the knowledge that comes in and are kind of unable to somehow feel trade and identify the main things *(OR THEMES?)* in all of that information	Data quantity and management
B	30	Then the time the timing this really tight time frame and schedule of only one year and of only these three meetings for the developing the recommendations really constrained the discussions and the depth in which the discussions could go	Time and resources
G	16	Funding was always the problem	Time and resources
A	27	[…] the main barrier from now on will be time	Time and resources
B	33	The visibility of those processes and their connection to a broader societal dialogue. I think is a big challenge because ultimately the Democratic value also depends on, not a handful of citizens basically deliberating behind closed doors and then coming up with something that can automatically be considered representative of what all citizens want but connecting it to a broader societal and Democratic dialogue. So that there's really popular support behind the outcome of some of the crowd engagement	Suboptimal selection process and composition of the crowd
B	37	If there's no A financial compensation and B, some kind of other support structures for instance, for single parents let's say or for also people with disabilities	Suboptimal selection process and composition of the crowd

B	38	[…] because especially when it comes to public sector engagement you want representativeness right, you want representativeness for all society and you don't want to reproduce power structures and domination structures and biases basically by only having those participate that a have the political education may be or in general, education level to be interested in these things to begin with, and can afford time and money wise because those will be those whose voices are already generally speaking louder than the public debate already and that shouldn't then be reproduced and be the same for deliberative mini-publics	Suboptimal selection process and composition of the crowd
H	17	It's a barrier. Not everyone has a computer, not everyone can use a computer. I don't think that we can think that everyone is digitally reachable	Lack of knowledge and technological skills of the participants
A	16	[…] expect that the residents can kind of understand the whole institutional context and the regulation and so on to identify what could be the actual and actions that should be taken	Lack of knowledge and technological skills of the participants
I	24	I think those two are significant challenges. Maybe something that I can mention is the sort of like "technology phobia" amongst some communities which are vulnerable. So, the moment you mentioned that you can use this technology platform or tool to share your views, usually we need more hand-holding or more reassurance to build trust with some communities to allow them to actually fully share information	Mistrust towards the process
E	19	So there needs to be trust.	Mistrust towards the process
B	22	the scope was too broad, so the recommendations are not of such a high quality	Too broad and unclear goals of the initiative
A	20	And then we were not completely able to formulate maybe the questions in a way that they would have directed or somehow told to the participants of what we are actually looking for	Too broad and unclear goals of the initiative
A	22	I would say that their strengths were then minimal, mostly because of our own inability to steer the participation process towards a direction which would have led to more effective outcomes	Too broad and unclear goals of the initiative
B	32	[…] be wary not to have participatory democracy or crowd engagement instrumentalized as a way of window dressing and just increasing perceived Democratic legitimacy of a certain government	Government's willingness and reason to perform crowd engagement
A	25	[…] many of these participation efforts are still aligned with the "law says" that we need to engage humans. So, we do the minimum possible to kind of fit what's stated in the law	Government's willingness and reason to perform crowd engagement
A	29	So, I think there is still the bit of this hesitation from the expert sides to expose kind of their expertise for the crowd intelligence and so on. So, kind of giving away some of what they think that they now hold the power of their own expertise	Government's willingness and reason to perform crowd engagement

Table 13 Relevant quotes about crowd engagement's challenges

2.4.2. Benefits

As for the challenges, also the benefits offered by the crowd engagement process in the public sector, represented by the black rectangles in the corresponding coding tree (Figure 14), have been organized in different clusters. The following lines are dedicated to explaining the meaning behind each of them, deep diving into all of the emerged benefits.

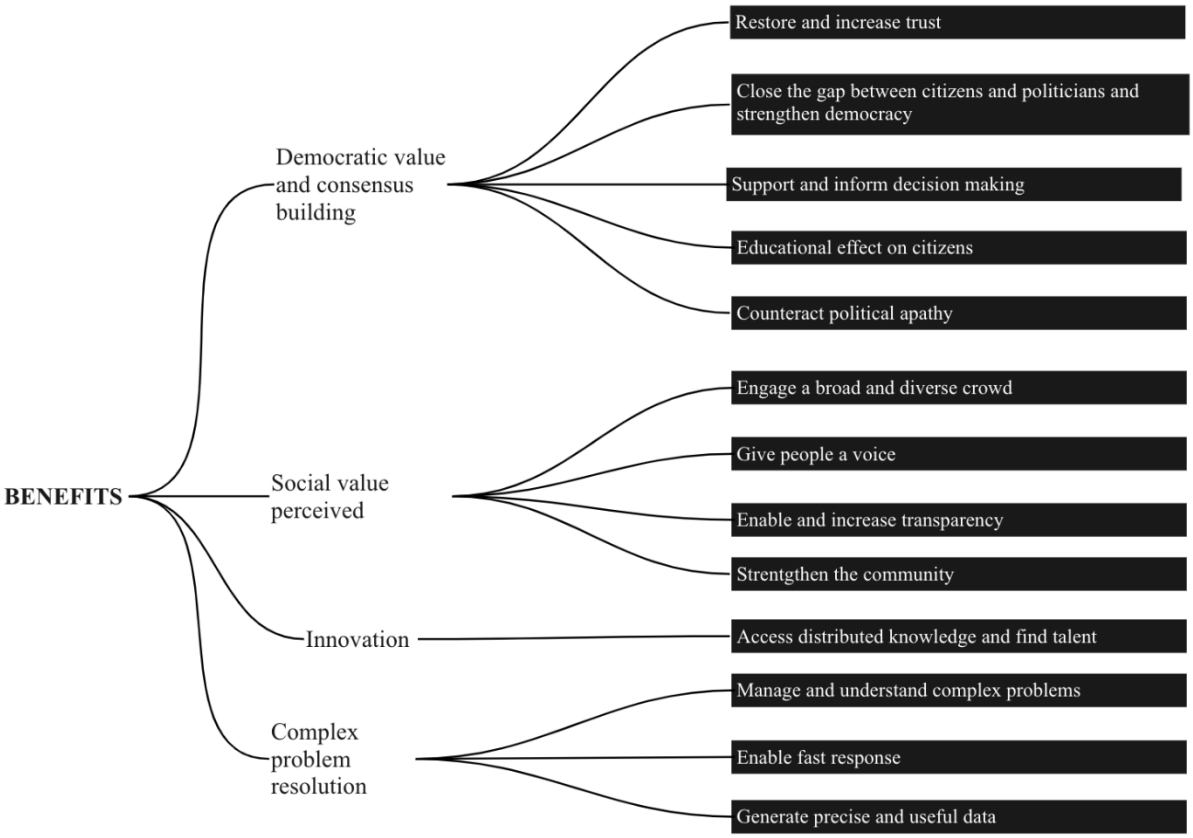


Figure 14 Coding tree of the benefits of crowd engagement

2.4.2.1. Democratic value and consensus building

The "democratic value and consensus building" cluster includes all benefits which shared the common characteristic of having a positive effect on democratic processes, for instance by improving the public decision-making process or improving the citizens' understanding of political dynamics. It highlights the benefits that originated

especially from using crowd engagement to apply the principles of deliberative democracy, as is true for cases B and H.

The first benefit included in the cluster, "restore and increase trust", refers to the fact that crowd engagement can help rebuild the citizens' confidence in political processes. This is especially true when it is used to implement the principles of deliberative democracy like in the cases B and H. The latter in particular is about an initiative that was founded with the purpose of restoring the trust in public decision-making by involving citizens in the discussion and development of solutions to selected themes of public concern. Both cases show how confidence in politicians and their decisions can be restored through crowd engagement.

Moreover, "educational effect" refers to the benefit offered by crowd engagement of helping the citizens to better understand how political processes unfold and how decisions are taken. Consequently, as shown by case G, participatory processes can be exploited to increase the public's comprehension of politics.

Crowd engagement also offers the benefit of "closing the gap between citizens and politicians", which means that the two parties, which often appear to be very distant, can be brought together thanks to this process. Indeed, as shown by cases B and H, the initiatives helped to reduce the gap between the citizens and respectively the EU and the Parliament of east Belgium. Consequently, not only will participants feel more involved in the decision-making process, but also the politicians will gain a clearer comprehension of the problems that really need to be solved, leading to a win-win situation for both parties. Indeed, that is exactly what happened in case B where the involvement of citizens sparked some fundamental discussion on the EU level. It is very significant that this benefit counts for the highest percentage (15,22%) among all the codes of the tree (Table 15), highlighting the potential this process has in bringing citizens and politicians closer together.

Another way in which crowd engagement helps public institutions is by "supporting and informing the decision-making" process. Indeed, as shown by cases D, H and I, it can be applied to effectively support governance by providing accurate information. Indeed, by including the population in decision-making processes, it is possible to support the institutions for more effective outcomes. To do so, crowd engagement adds to the information used by politicians in their discussions, a layer of actual citizen-generated data and opinions while at the same time also eliminating some existing inefficiencies, therefore improving the final decisions and the process leading to them.

Finally, as reported in cases B and H, crowd engagement can be used to "counteract political apathy", meaning that it can motivate people, who are normally not interested in political matters, to become more active and take part in the related discussions.

What stood out from case H was how this positive effect was not limited to the initiative itself but went beyond, as participants showed the will and interest to do more for their community even after their participation in the initiative had ended, therefore improving the final decisions and the process leading to them.

In conclusion, this cluster shows how the correct implementation of the crowd engagement process can have a very significant and positive impact on democratic processes as it offers the possibility to bring citizens and politicians closer together, improving the latter's comprehension of significant issues and the former's understanding of political processes, support decision-making, spurring discussion about critical themes, and increase the citizens' active participation in their community. As a result, trust in politics can be restored and increased.

2.4.2.2. Social value perceived

The cluster called "social value perceived", refers instead to all challenges offered by the crowd engagement process from which society might benefit, going beyond those that are strictly related to political and democratic processes. Indeed, as will be explained, crowd engagement might even be exploited to give a voice to people when democratic processes fail to consider them and are therefore ineffective to solve problems.

One benefit offered by crowd engagement is, as already anticipated by its name, its ability to "engage a broad and diverse crowd". Indeed, as shown by cases A, B, H and E, the process enabled the inclusion of a wide pool of participants which was, especially in case B, extremely heterogenous as the participants not only came from different social and economical backgrounds but also from entirely different countries all over the European Union. Moreover, crowd engagement, makes it possible to involve groups of people who normally would be marginalized by normal processes. This was shown by cases E and H where young people were actively involved, thanks to crowd engagement, in processes where they would have normally participated less than other groups of people. As stated by case A, crowd engagement makes it possible to engage all relevant stakeholders to imagine together possible actions to solve the challenges tackled by the corresponding initiative, therefore leading to outcomes which represent society at large.

The next benefit is very related to the one that was just explained and has been defined as "giving people a voice". Crowd engagement can be used as a tool to make sure people whose voice is generally ignored are heard. As stated in case I, in crisis situations like natural disasters, the citizens who are the most affected by them are usually the last to be considered in the decision-making processes that will directly

impact them. Crowd engagement can be exploited to reverse this dynamic and give marginalized people a voice. While "engage a broad and diverse crowd" was referring to the process' potential of involving a very numerous and heterogeneous pool of participants to lead to more representative outcomes, "giving people a voice" is about helping specific communities which are asking for help but are not considered by the public institutions. As stated by Liz Barry in case F there is "a long trajectory of desperate […] problem owners" who if they "spoke using their voices of what they're being affected by, they were not getting action by regulatory agencies". Crowd engagement can therefore be exploited by governments and non-profit organizations to allow communities who are affected by a problem to aggregate their views, communicate them and get help, in other words giving them a voice. This can be especially important, as derived from the case I, for human rights activism and therefore in contexts where traditional democratic processes appear to be not ineffective in providing a solution to the matter.

Crowd engagement also offers the benefit of "strengthening the community" in the sense that by applying the process, it is possible to bring people together and show unity in response to a problem. This is what happened in case C where crowd engagement was used to enable a collective reaction of the EU to the covid-19 pandemic. Moreover, as shown by cases B and C, these processes might increase the participants' sense of belonging to their community, as it happened for some participants of case B who felt more European at the end of the event.

Finally, the last benefit belonging to this cluster is called "enable and increase transparency" and refers to the fact that crowd engagement makes it possible to increase transparency on many levels, by collecting and disclosing information coming from different sources. Indeed, as stated in cases D and G, the process can be used to generate unbiased results, in the sense that they are not related to any political opinion but just provide the facts from an impartial point of view. Moreover, crowd engagement allows for more transparent governance and innovation processes as discussed respectively in cases I, where it was used to voice the demands of marginalized people to politicians, and C, where it allowed for everyone to see what was happening in the event.

As a concluding remark for this cluster, it is interesting to notice how it shows the highest percentage among the clusters of this tree, 35,87% (Table 15). This highlights the potential crowd engagement has in enhancing and strengthening democratic values and processes.

2.4.2.3. Innovation

The "innovation" cluster is instead focused on how crowd engagement can support the development of new ideas and solutions. It includes only one challenge offered by the process which is called "access distributed knowledge and find talent". It refers to the fact that crowd engagement makes it possible to find different pieces of knowledge distributed among a wide pool of individuals and combine them to generate innovative solutions, as explained by the theory of open innovation (Gassman and Enkel, 2004). Indeed, as stated by Liz Barry in case F, "many different people around the world have parts of the information" and "it is obvious that if we could be better connected […], if we could work collectively on projects […], that that would matter". Moreover, case C shows how crowd engagement has the potential of finding talent quickly to solve very complex problems.

2.4.2.4. Complex problems resolution

The "complex problems resolution" cluster includes all benefits offered by the crowd engagement process which motivate its application to solve complex problems. In the first chapter of the dissertation, the systematic literature review, it was concluded that crowd engagement can and should be applied in response to multi-dimensional, societal challenges like climate change (Nesti, 2018) and natural disasters (Gebremedhin et al., 2020). The following lines will show, based on real-world cases, what are the benefits offered by this process that make it so effective in handling this kind of problem, supporting the conclusions reached in the systematic literature review.

First of all, crowd engagement, given its wide reach, offers the challenge to have a process that enables the "management and better understanding of complex problems". As stated by case D, by integrating a large set of information, which might even come from different sources, crowd engagement helps to get a deeper understanding of complex situations. Moreover, since these challenges are multi-dimensional, they influence society at large. Crowd engagement offers the challenge to involve all relevant stakeholders in a common effort to solve these problems, enabling so a more effective management of the situation. Indeed, as stated by case C, crowd engagement acts as a force multiplier, meaning the final result will be greater than the sum of the single contributions, therefore allowing for a more effective management of complex situations.

Secondly, crowd engagement "enables fast response" to very critical situations. This has been shown in cases G and I, where the process was applied to solve situations which needed an immediate answer by authorities like the aftermath of the Fukushima

Dai-ichi nuclear disaster in 2011 or the riots following the 2007 presidential elections in Kenya. As stated in case G, it is possible to collect large quantities of data very quickly through crowd engagement. This is the result of the process being very effective in establishing coordination mechanisms between the different stakeholders, enabling problems to be solved before they grow into even more challenging issues.

Finally, crowd engagement not only enables fast response, but it also makes it possible to "generate very precise and useful information". Indeed, by combining data collected from different resources, it is possible to exploit different perspectives to create the most robust and accurate data possible, while also providing a very broad overview of the situation, as shown by case G, where through crowd engagement it was possible to generate more precise and useful data than what had been provided elsewhere in the world.

It is the combination of an effective management of all stakeholders, a deeper understating of the problem and a fast and potentially very precise response that makes crowd engagement so effective for the resolution of very complex problems.

The following table (Table 14) shows some of the most relevant text segments from the transcripts of the interviews that led to defining the discussed coding tree.

REFERENCE LETTER	SEGMENT	CLAUSE	CODE
B	14	[…] counteracting kind of political apathy	Counteract political apathy
H	6	[…] participants said "We want perhaps to do something more, to engage more"	Counteract political apathy
B	6	That one of my working groups said she's now a converted European she was quite skeptical towards the European Union before, but just through the engagement also with her fellow citizens of different countries different languages, which she would never have met otherwise and that kind of made her feel more European and more connected with like this transnational community of which she's apart automatically	Strengthen the community
C2	4	[…] was something that really brought everyone together in I think	Strengthen the community
D	3	I think having a better understanding and being less limited on only some information	Manage and understand complex problems
A	5	And I think that overall, this kind of participation and digitalization and collective intelligence are very much discussed and also appreciated at the city. So it was maybe this kind of a natural solution to be utilized in such a plan, which does then have a quite huge influences on the everyday life of all of the residents	Manage and understand complex problems
C2	6	[…] the collective intelligence but also, it becomes a force multiplier. Because you're not just doing something you believe in, you're doing it with others that believe in the same thing	Manage and understand complex problems
I	11	The next is emergency and humanitarian response. USHAHIDI has been that tool of choice for very many communities from a forest fire to, you know, an earthquake, too even portholes on a road	Manage and understand complex problems
H	3	[…] we want to strengthen the support of the public decisions by including the population in the decision-making process	Support and inform decision making
I	12	The last one is good governance. Yeah, so good governance may be plan election and people are trying to map places where, you know, there may be disorder or voting irregularities and this has been used right from Kenya	Support and inform decision making
B	4	[...] to enhance the Democratic profile also of the European Union, to enhance its Democratic legitimacy by involving citizens directly which is something that had never happened before on the EU level	Close the gap between citizens and politicians and strengthen democracy
B	9	For me, it's the intrinsic value of experiencing democracy	Close the gap between citizens and politicians and strengthen democracy
H		[…] help the population to better understand how political processes are done, and how decisions are taken. We want to increase the comprehension about politics, about the processes	Educational effect on citizens
A	1	Then, in order to kind of get wider opinions about or maybe together and imagine the possible actions which could lead to carbon neutrality in this target year	Engage a broad and diverse crowd

A	2	[…] the crowdsourcing actually became a value in itself	Engage a broad and diverse crowd
H	7	Strength is also that politicians see in the topics or understand what the real problems of the people are	Close the gap between citizens and politicians and strengthen democracy
H	9	[…] closing the gap between politicians and citizens	Close the gap between citizens and politicians and strengthen democracy
F	5	I'm saying there's a long trajectory of desperate, urgent problem owners starting to make their own knowledge and in the age of the Internet, it was just so obvious that if we could be better connected around the world, if we could work collectively on local projects, if there could be a way that we could help each other, that that would matter. And so that's why we set out to apply these what are now being called collective intelligence methods to these problem	Access distributed knowledge and cheap way to find talent
C1	3	[…] a HACKATHON, it's a cheap form of finding talent and finding solutions to complex problems	Access distributed knowledge and cheap way to find talent
G	1	[…] but it grew globally after that when it sort of became clear that the data that we were collecting and publishing was more precise and useful than data that had been made available elsewhere in the world, or in many cases there was no data available elsewhere in the world	Generate precise and useful data
G	6	[…] we were trying to answer a question immediately the fastest way possible that would provide useful information	Enable fast response
G	9	[…] large group of people can collect a lot of data very quickly	Enable fast response
G	5	Our motive was to collect and publish data, period. We were not making arguments for or against nuclear power or energy or weapons or anything along that. It was just to create the data, and this seems to have been a first in that field. And I think that was largely or you know something that led to the success and adoption of the project because previously any data set that was released was funded by or created by a group with a very strong position one way or the other in relation to nuclear energy or nuclear power, which then meant that the other side of the argument would disregard that data entirely as biased and whatever	Enable and increase transparency
H	1	[…] we wanted to increase the trust in politics again. You know the tendency in the society for the moment is that we lose confidence in politician decision-making. Politics is something that's seen really critically by people	Restore and increase trust
I	4	One thing that has been core to the work that we do is to be able to help communities quickly collect and share information that enables them to raise their own voices, inform decisions about them and influence change. This is all […] from an understanding that in almost any crisis situation or each like humanitarian situation that may pop up, the people who are most affected usually are the last to be considered or heard in the decisions that pertain them and Ushahidi tries to reverse that	Give people a voice

Table 14 Most relevant quotes about crowd engagement's benefits

2.4.3. Summary of the findings

The following table (Table 15) summarizes the results of all challenges and benefits defined in the coding phase. It shows for each code, the total number of text segments that were associated with it (*count*) and the relative percentage computed first with respect to the cluster of belonging of the considered code *(% within cluster*), and then with respect to all challenges or all benefits *(% within category*). Moreover, it is possible to see for each code all the cases in which they appeared (*cases*).

Table 15 Summary of all challenges and benefits that emerged from the nine cases

	COUNT	% WITHIN CLUSTER	% WITHIN CATEGORY	CASES
CHALLENGES	101			
CHARACTERISTICS OF THE PARTICIPANTS	15		14,85%	
Language barrier	2	13,33%	0,13%	B, C
Lack of knowledge and technological skills of the participants	6	40,00%	0,40%	A, C, H, I
Mistrust towards the process	7	46,67%	6,93%	D, E, I
DESIGN OF THE ENGAGEMENT PROCESS	40		39,60%	
ORGANIZATIONAL ASPECTS OF THE INITIATIVE	23	57,50%		
Logistics	4	10,00%	3,96%	B, C
Time and resources	8	20,00%	7,92%	A, B, G
Too broad and unclear goals of the initiative	11	27,50%	10,89%	A, B, E
UNREPRESENTATIVENESS AND LEGITIMACY OF THE CROWD ENGAGED	17	42,50%		
Lack of communication and reach	10	25,00%	9,90%	A, B, E, G, H, I
Suboptimal selection process and composition of the crowd	7	17,50%	6,93%	B, H
INITIATOR(S) OF THE PROCESS	24		23,76%	
Government's acceptance and implementation of innovation coming from the outside	11	45,83%	10,89%	A, B, F

	Weak leadership	6	25,00%	5,94%	C, F
	Government's willingness and reason to perform crowd engagement	7	29,17%	6,93%	A, B, C
OUTPUT(S) OF THE PROCESS		22		21,78%	
	Data privacy and availability	7	31,82%	6,93%	D, E, G
	Data quality and reliability	7	31,82%	6,93%	A, I
	Data quantity and management	8	36,36%	7,92%	A, E, F, H
BENEFITS		92			
SOCIAL VALUE PERCEIVED		26		28,26%	
	Strengthen the community	8	30,77%	8,70%	B, C
	Engage a broad and diverse crowd	6	23,08%	6,52%	A, B, E, H
	Enable and increase transparency	5	19,23%	5,43%	C, D, G, I
	Give people a voice	7	26,92%	7,61%	F, I
INNOVATION		9		9,78%	
	Access distributed knowledge and cheap way to find talent	9	100,00%	9,78%	C, F
COMPLEX PROBLEM RESOLUTION		24		26,09%	
	Manage and understand complex problems	12	50,00%	13,04%	A, C, D, F, I
	Generate precise and useful data	5	20,83%	5,43%	D, G
	Enable fast response	7	29,17%	7,61%	G, I
DEMOCRATIC VALUE AND CONSENSUS BUILDING		33		35,87%	
	Counteract political apathy	3	9,09%	3,26%	B, H
	Support and inform decision making	8	24,24%	8,70%	D, H, I
	Educational effect on citizens	4	12,12%	4,35%	B, H
	Close the gap between citizens and politicians and strengthen democracy	14	42,42%	15,22%	B, E, H
	Restore and increase trust	4	12,12%	4,35%	B, H
	GRAND TOTAL	193			

2.4.4. Comparison between the inductive and deductive results

This sub-section is dedicated to the comparisons between the results of the coding phase and those of the literature review.

Table 16 Comparison between the challenges and benefits of crowd engagement emerged from the interviews and those discussed by the literature

CODES FROM THE INTERVIEWS	DISCUSSED IN THE LITERATURE	CHALLENGES AND BENEFITS FROM THE LITERATURE
CHALLENGES		
CHARACTERISTICS OF THE PARTICIPANTS		
Language barrier	YES	Language barrier (Lackaff, 2015)
Lack of knowledge and technological skills of the participants	YES	Participants' different social worlds and resources (Leino and Puumala, 2021; Ampatzidou et al., 2018)
Mistrust towards the process	NO	
DESIGN OF THE ENGAGEMENT PROCESS		
ORGANIZATIONAL ASPECTS OF THE INITIATIVE		
Logistics	NO	
Time and resources	YES	Missing flexibility in resource allocation (Roche et al., 2020)
Too broad and unclear goals of the initiative	YES	Misalignment of goals (Roche et al., 2020)
UNREPRESENTATIVENESS AND LEGITIMACY OF THE CROWD ENGAGED		
Lack of communication and reach	YES	Not truly inclusive process (May and Ross, 2018)
Suboptimal selection process and composition of the crowd	YES	Not truly representative of the overall crowd (Baek and Kim, 2018); participants' different social worlds and resources (Leino and Puumala, 2021; Ampatzidou et al., 2018)
INITIATOR(S) OF THE PROCESS		
Government's acceptance and implementation of innovation coming from the outside	YES	Gap between knowledge creation and knowledge use (Leino and Puumala, 2021)
Weak leadership	NO	
Government's willingness and reason to perform crowd engagement	YES	Participation theatre (Lackaff, 2015)
OUTPUT(S) OF THE PROCESS		
Data privacy and availability	YES	Privacy (Peleg et al., 2021)

Data quality and reliability	YES	Abusive behaviors by participants (Lackaff, 2015)
Data quantity and management	NO	
BENEFITS		
SOCIAL VALUE PERCEIVED		
Strengthen the community	NO	
Engage a broad and diverse crowd	YES	Engage a broad and diverse crowd (Lackaff, 2015)
Enable and increase transparency	YES	Increase transparency (Szarek-Iwaniuk & Senetra, 2020).
Give people a voice	YES	Reach marginalized people (Jalonen et al., 2021)
INNOVATION		
Access distributed knowledge and cheap way to find talent	YES	Access distributed knowledge and cheap way to find talent (Peleg et al., 2021)
COMPLEX PROBLEM RESOLUTION		
Manage and understand complex problems	YES	Handle very complex situations (Peleg et al., 2021)
Generate precise and useful data	YES	Integration and generation of information (Song et al., 2020)
Enable fast response	YES	Support slower processes of governance, enabling a fast response (Lackaff, 2015; Song et al., 2020)
DEMOCRATIC VALUE AND CONSENSUS BUILDING		
Counteract political apathy	NO	
Support and inform decision making	YES	Support decision-making (Song et al., 2020)
Educational effect on citizens	YES	Educational effect on citizens (Lackaff, 2015)
Close the gap between citizens and politicians and strengthen democracy	YES	Answer to the citizens' demand for more active involvement by the government (Maier-Rabler and Huber, 2011)
Restore and increase trust	YES	Restoring and increasing public trust (Lackaff, 2015)

The table (Table 16) highlights how 23 out of the 29 empirically defined challenges and benefits find direct support in the literature of the sample in which they had already been explored, as discussed in the "literature review" section. However, it is very interesting to notice how 6 codes appear to be telling something novel with respect to what had already been explored by other researchers. Indeed, the challenges defined as "*mistrust towards the process*", "*logistics*", "*weak leadership*" and "*data quantity and management*" and the benefits described as "*show unity, bring people together and*

strengthen the community" and "*counteract political apathy*", appear to have not been thoroughly discussed by the publications of the sample. To verify the validity of such hypothesis, additional research was conducted on the sample to check whether such subjects had been indeed not yet explored, leveraging on the Adobe Acrobat software that allowed to find single phrases related to some keywords. The so obtained results highlighted how for most codes, if anything at all, only isolated phrases which were weakly referring to them and lacked broader context were found within the sample, with two of them actually not leading to any results within the texts of the publications.

This confirmed the initial impression of the novelty of the findings, as will be discussed in the following lines.

As far as the importance of leadership in managing crowd engagement initiatives is concerned, some papers do provide some considerations. It is for instance said how it proves to be pivotal to maintain network interactions (Rakšnys et al., 2020) or how in critical situations, leaders play an important role in setting the directions to be taken (Garavaglia et al., 2021). It was also briefly mentioned how they might take the process through difficult moments (Rădulescu et al., 2020).) and how continuous leadership changes limit the success of the process (McGann et al., 2021). However, these considerations appeared to be marginal and often isolated, and were not discussed in a broader context about the potential challenges that might arise from ineffective leaders when implementing crowd engagement. The novelty introduced by this research is highlighting the importance of the human side of leadership, more than its organizational values, as the individual impact passionate people have on the process they initiated cannot be merely replicated or substituted by a well-designed methodology and other people.

Moreover, the challenge given by the often overwhelming quantity of the submissions generated by the crowd engagement initiatives was only apparently briefly referred to by one publication of the sample, which stated how among the many of them, only a handful are considered which are generally those of the most renown experts of the initiative's subjects (Bruns & Swift, 2011). Again, it stands out how our research led to far more relevant conclusions than isolated phrases. Indeed, it highlighted how the quantity of the submissions collected from participants, especially in contexts where they had been given freedom in terms of the contribution they could provide, makes it significantly difficult for initiators to extract the most relevant themes from the process, as discussed for example in case A.

"*Counteracting political apathy*" appears to be briefly mentioned by just one single publication of the sample as one of the benefits of e-democracy, by describing its potential to increase the political participation of the youth, through the exploitation of ICTs (Freeman and Quirke, 2013). The conducted research on nine case studies, goes beyond such isolated and specific statement, arguing how in crowd engagement's nature lies the benefit to reduce the political apathy of the participants, especially when actively involving them in decision-making processes (cases B and H).

As for the previous three codes, also "*mistrust towards the process*" is not thoroughly discussed as a challenge of crowd engagement by any of the publications of the sample, with the research highlighting only isolated phrases connected to such concept (e.g Ampatzidou et al., 2018; Leino and Puumala, 2021). Indeed, no article discusses the possible lack of trust of participants towards the technology used by initiators, especially relevant in less technologically skilled communities as shown by case I, and data handling concerns as a challenge that will limit the success of crowd engagement.

Finally, it stood out how "*logistics*" and "*show unity, bring people together and strengthen the community*" had not been discussed, not even marginally, as challenge or benefit of the crowd engagement by publications of the sample. This confirms the novelty of these considerations which highlight how also logistical aspects, if not implemented well, will, especially in the contexts of geographically extended processes, limit their outcome, while underlying how crowd engagement can be exploited to foster a united response to critical situations and strengthen the sense of belonging to a community.

In conclusion, the fact that some of the challenges and benefits of crowd engagement which emerged from the interviews had been discussed in the literature of the sample, does not imply that the performed research did not add any new knowledge. Indeed, in most cases, the findings led to expanding the understanding of the subject. This was for instance the case of the code "give people a voice" which was discussed in the literature by highlighting how crowd engagement process can be exploited to reach otherwise neglected people (Jalonen et al., 2021). However, while the publications of the sample focus on situations where participation is prevented mainly because of social or demographical characteristics like age, the interviews expanded this concept showing how crowd engagement enables people who have been marginalized as a result of crisis situations like natural disasters, to speak up (case I). This appears to be true also for the "data quality and reliability" challenge which expanded the discussion about the abusive behaviors of participants by considering the impact of

fake news and, going beyond reliability, the consequences of the low quality of the submissions.

2.4.5. Mapping cases, challenges and benefits

After having defined the challenges and benefits of the crow engagement process in the public sector through empirical research on nine case studies, the analysis proceeded by exploring how these findings were connected to the different cases according to some relevant features characterizing the various initiatives. It was decided to consider as variables for such analysis the span and the intensity of a crowd engagement process. While the former refers to how many participants can be reached and involved in the initiative, the second refers to how actively each of them is engaged in it (Torfing et al., 2019), as described in the introduction. Information about each initiative's span and intensity can be found in the appendix, in the table summarizing the most relevant information about the cases.

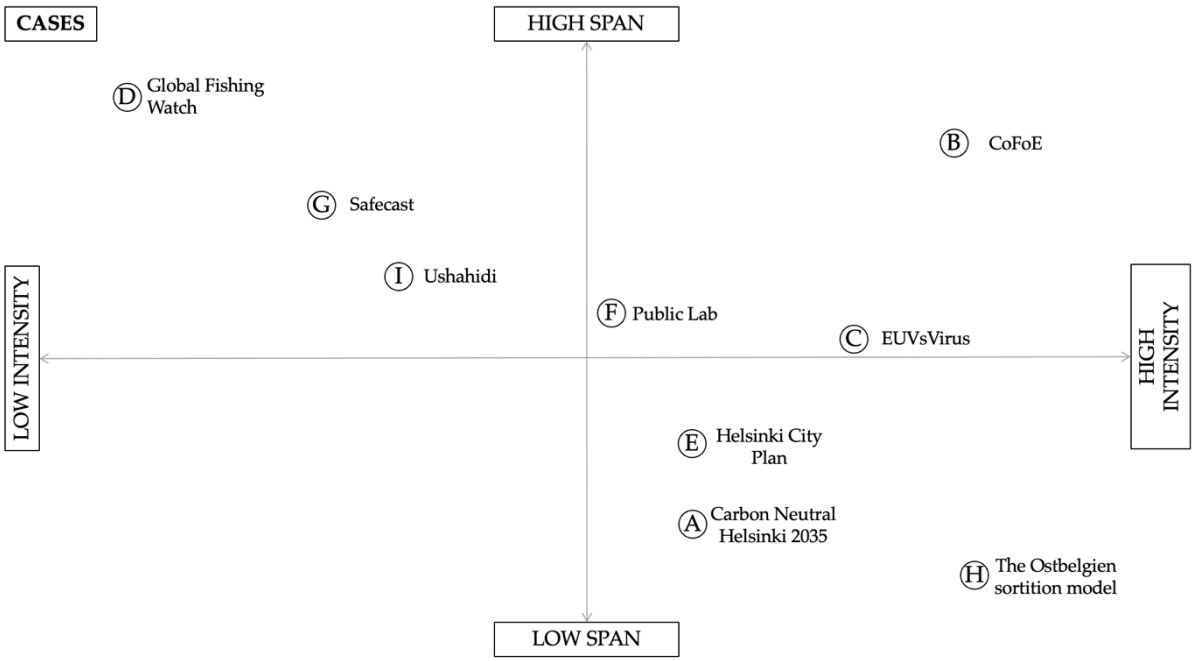


Figure 15 Mapping the nine cases based on their span and intensity

As can be noticed from the map (Figure 15), most of the cases are placed on the diagonal going from the top left corner to the bottom right one. This shows how an increase in the initiative's intensity is generally coupled with a decrease in its span,

with those having a very high intensity compromising on their span and vice-versa (Torfing et al., 2019). This is perfectly highlighted by cases D and H which are at the opposite extremes of the diagonal.

Nevertheless, there are some cases that do not follow this pattern. Indeed, both cases B and C show both very high intensity and medium to high span as they both engaged the participants in a very active way while also having an international reach, involving citizens from all over the European Union.

Starting with the challenges (Figure 16), it can be clearly seen from the graph how "*lack of communication and reach*" appears in most cases, independently of their span or intensity. This can be explained by the fact that any crowd engagement effort needs to engage participants to work properly. If the communication of the initiatives is not handled effectively, many potential participants will not be able to know about their existence and take part in them, limiting their success. Similar considerations appear to be true for the "*lack of knowledge and technological skills of the participants*" and "*time and resources*" challenges which do not appear to be significantly influenced by any of the two variables.

It is also very interesting to notice how "*data quantity and management*" seems to become more relevant as a challenge, the higher the intensity of the initiative gets. This can be explained by considering how the kind of submission participants are asked to deliver changes across the cases. As we move to the right of the graph, the initiatives show a more active involvement of the participants, who are given more freedom in terms of the contribution they can provide. This leads to less structured and standardized submissions, with respect to the cases on the left of the graph, where participants are more limited and guided in the kind of data they can share. Consequently, the submissions collected by the cases on the right-hand side of the chart will show a higher diversity and will therefore require much more effort when analyzed by the initiator with respect to those on the left. Quantity will thus make the management of the results even harder. This will be less of an issue for the cases on the left, showing less intensity and higher span, as working on data with a higher degree of "standardization" allows for a more effective optimization of the data analysis phase, as explained by case D in which increasing data quantity is actually beneficial for the results' robustness.

It should be no wonder then that "*too broad and unclear goals of the initiative*" manifests a similar pattern to that of "data quantity and management". Indeed, the more actively involved the participants are, meaning the more freedom is given to them in terms of the contribution they can provide, the more important it will be to ensure alignment between the initiators' and the citizens' goals. Consequently, clearly stating the targets

of the initiative, while limiting their scope, can help steer the participants' contribution to make it as effective as possible, while failing to do so will increase the variability of the results, making it harder for the initiators to analyze them and reducing their average quality and applicability. As a result, when designing a crowd engagement initiative based on very active involvement of the participants it will be very important, regardless of its span, to clearly state its goals while limiting its scope and not underestimate the effort required in analyzing the submission, ideally implementing and correctly sizing the data management mechanisms, to make the process as successful as possible.

Moreover, as highlighted by cases B and H which are applications of the concept of deliberative democracy, the more intense the project, the more important it is to make sure the involved crowd is representative of society at large, therefore legitimizing its contribution to the decision-making process. Consequently, a suboptimal selection of the participants will significantly reduce the success of the initiative.

Finally, it stands out how "*government's willingness and reason to perform crowd engagement*", "*government's acceptance and implementation of innovation coming from the outside*" and "*suboptimal selection process and composition of the crowd*" are challenges which appear only on the right-hand side of the graph. This signals that such challenges become more relevant as the intensity of the initiatives increases, while not showing a significant connection to their span. This can be motivated by considering that the cases showing the highest intensity are directly related to the implementation of democratic processes. Indeed, they offer citizens the challenge to contribute to the decision-making process of public institutions by providing their suggestions and opinions on the initiatives' subjects. However, for this process to be successful, the initiator must be willing to organize the initiative in the first place, and then to accept and actually implement its outcomes.

Shifting the focus on interesting findings concerning the distribution of the benefits of crowd engagement on the map (Figure 17), it stands out how "*manage and understand complex problems*" appears to be scattered all over it. This seems to imply that the process can be adapted in terms of span and intensity to best fit the requirements to manage a certain complex situation. The same appears to be true for the process's potential to "*support and inform decision-making*". Indeed, the graph shows how crowd engagement can be effectively used for such purpose even when the intensity of the initiative is lower. As explained by cases D and I, the collection of more standardized data instead of more articulated suggestions provided by participants, can be effectively used for better governance.

Moreover, it is interesting to notice how "*enabling fast response*" appears only on the left side of the graph. This seems to lead to the conclusion that a lower level of intensity might be beneficial for the crowd engagement process, when applied to manage complex situations which require a very rapid answer like natural disasters, instead of careful planning like when dealing with sustainability goals, regardless of the initiative's span. This can be justified by considering the fact that more standardized data will be easier to elaborate and therefore enable a quicker response by authorities.

Similar considerations must be done for the "*generate precise and useful data*" challenge, which appears only on the top left corner of the map, meaning in cases showing high span and low intensity. Such placing can be motivated by the fact that very complex and diverse submissions, typical of high-intensity crowd engagement processes, are very hard to manage and analyze. On the other hand, more standardized data provided by participants can be elaborated more easily, leading to more accurate results. Moreover, the more data is collected, the more robust the final results will be, as it enables the triangulation of data coming from different resources, thus leading to a clearer understanding of the object of analysis.

Finally, "*counteract political apathy*", "*educational effect on citizens*", "*restore and increase trust*" and "*close the gap between citizens and politicians and strengthen democracy*" all appear only on the right side of the chart, thus being connected to high-intensity level crowd engagement initiatives, regardless of their span. Indeed, the cases belonging to this part of the map are all directly related to the enhancement of democratic processes, with cases B and H being implementations of the concept of deliberative democracy, all featuring a very active involvement of the citizens in the decision-making process. It is no wonder that all these benefits together with the "support and inform decision-making" one form the "democratic value and consensus building" cluster discussed in the benefits sub-section.

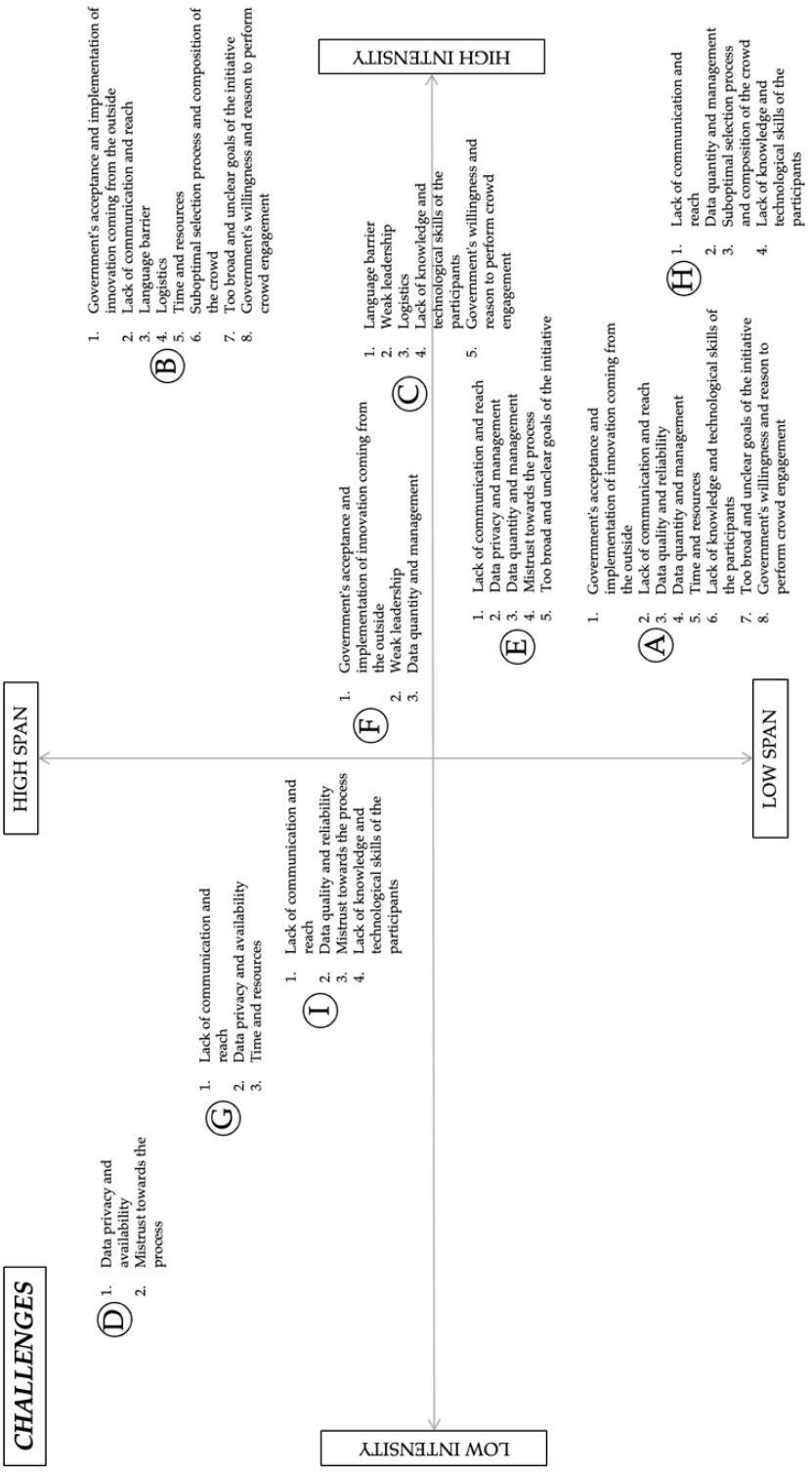


Figure 16 Mapping the challenges of crowd engagement emerged from the nine cases based on the span and intensity of their corresponding initiative

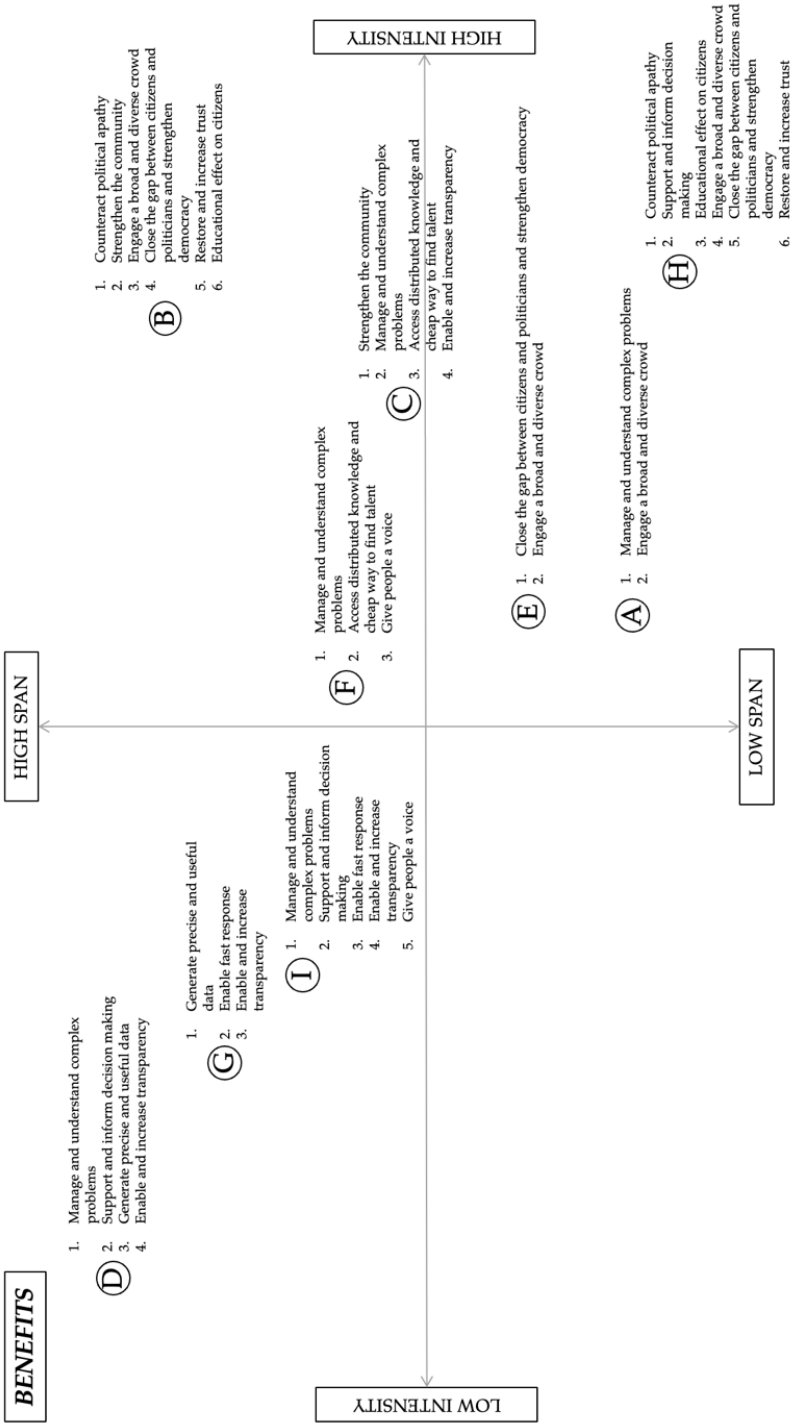


Figure 17 Mapping the benefits of crowd engagement emerged from the nine cases based on the span and intensity of their corresponding initiative

2.5. Conclusions

The semi-structured interviews conducted on the sample of nine cases of crowd engagement initiated by public institutions and non-profit organizations enabled a deep exploration of the process' challenges and benefits which led to very interesting findings. These different perspectives on the implementation of these initiatives allowed for a robust comprehension of the process. It was so possible to gather the findings coming from different cases to generate a comprehensive framework of crowd engagement's challenges and benefits.

The result of this research was the identification of a total of 14 challenges and 13 benefits, that emerged from the case studies, that have been grouped based on some shared features.

The cases allowed to distinguish the challenges based on the fact that they were caused by the process' initiator, its participants, the nature of their contribution or its design. This highlighted how the culture of governmental institutions will significantly influence the process' outcomes by potentially creating friction when it comes to accepting and implementing solutions coming from outside of its boundaries. Moreover, the participants' skills and knowledge could significantly impact the quality of their submissions, while reducing the effectiveness of the initiative. The main challenges originating from the collected contributions are related to their quality and quantity, which might overwhelm initiators, making it hard for them to identify the most relevant themes and capitalize on their value. Finally, when designing the initiatives, extreme attention must be paid to implementing effective communication and selection processes, to guarantee broad participation and representativeness of the selected crowd for society at large, therefore ensuring the legitimacy of the reached outcomes.

Benefits have instead been classified according to the value they provided for citizens and initiators. The cases indeed highlighted how certain crowd engagement's benefits motivated the use of the process for four purposes: strengthening democracy and building consensus, increasing social value, supporting innovation and solving complex problems. The first one is mainly related to crowd engagement's potential to close the gap between citizens and politicians by allowing the former to be involved in the decision-making process while helping the latter to get a clearer understanding of what people need, consequently restoring trust in politics. Moreover, the process can generate social value by giving a voice to marginalized people when standard democratic processes fail to do so and strengthen the sense of community and unity.

Innovation is supported by crowd engagement as it enables the collection and combination of existing and distributed knowledge. Finally, there are certain benefits offered by the crowd engagement process which make it very effective in handling complex issues. It was so possible to support one of the conclusions drawn at the end of the first chapter of the dissertation according to which crowd engagement had great potential for the resolution of societal and multi-dimensional problems. Indeed, as it stood out from the cases, there are some features which make the process especially suited to handle complex problems. It emerged, how crowd engagement can be applied by governmental institutions and nonprofit organizations to enable fast response to critical situations. At the same time, by allowing to combine different sources of information it can be exploited to generate very precise data in quite a limited time, which can be used to support decision-making in very complex situations. At the same time, the approach allows for a more coordinated response and a deeper understanding of the problems to be solved.

Furthermore, it was possible to identify and discuss the connections between the challenges and benefits of the crowd engagement process and two variables defining the initiatives: span and intensity. This provides useful insights to initiators, which can exploit them to improve the design of the process based on what benefits they are seeking from it, while anticipating which will be the most urgent challenges they will have to face. This could lead to more effective and successful crowd engagement initiatives.

It stood out how poor communication of the process will limit the process's outcome regardless of its span and intensity, as citizens who do not get informed about it will automatically be excluded from the process, limiting so the breadth of the engagement process.

Similarly, crowd engagement's potential for supporting and informing decision-makers seems to be intrinsic to the process itself, as the cases reported it on the whole spectrum of the two variables.

However, when it comes to achieving very quick responses, for instance to tackle crisis situations like natural disasters or violence, a lower level of intensity appears to be recommended. Indeed, this feature generally implies a lower degree of freedom given to participants, in terms of submission they can generate, leading to more standardized data. This will reduce the time required to analyze the collected submissions, making it more efficient, therefore enabling a faster response than what would have been reached otherwise.

Similarly, to exploit crowd engagement's potential to generate very precise data, it is recommended to design the process in order for it to have a broad span and low intensity. Indeed, such conditions will generally enable the collection of large quantities of standardized, therefore enabling the data analysis process to generate reliable results by combining effectively combining the perspectives provided by different sources of information.

On the other hand, initiatives with higher intensity levels will have to deal with a more effortful process to manage the citizens' generated solutions, as they will be granted more freedom when contributing to the initiative. This can be made even worse when the goals of the initiative are not clearly defined or too broad, as it will result in many of the submissions being not aligned with the initiator's purpose and therefore not applicable and low in quality. To compensate for these risks, it is suggested that initiators make sure the targets of the initiative are clearly stated and understood by the participants while not underestimating the effort that will have to be put into managing and analyzing the submissions, and correctly sizing the mechanisms enabling these tasks.

Moreover, crowd engagement initiatives that are high in intensity can be implemented by governmental institutions to strengthen democratic values and build consensus. Indeed, such processes have the potential to bring citizens closer to politicians by involving the former in the decision-making procedures while helping the latter to take the perspective of the participants, therefore restoring and increasing public trust in politics.

However, when implementing such initiatives, initiators must make sure to design the process to make the involved crowd truly representative of society at large, therefore legitimizing the solutions it provides, while truly committing to evaluate and possibly implement the citizens' proposal.

2.5.1. Theoretical implications

Given the novelty of the crowd engagement phenomenon, which was defined at the end of the systematic literature review in the first chapter of the dissertation, this qualitative research was the first that identified its challenges and benefits.

The first implication to the literature regards new findings about the subject which had not yet been discussed in any of the papers included in the sample used to define the process. Indeed, the research added to a set of already explored challenges and benefits of crowd engagement new ones, as discussed in the previous sub-sections. It was so

found out that the process' outcome can be significantly limited by the lack of trust by potential participants in crowd engagement itself, as a result of concerns about the technologies used and privacy-related issues, mainly deriving from their lack of skills and knowledge. Moreover, the potentially overwhelming quantity of collected submissions from the participants can hinder the initiators from finding the most relevant contributions while an improper organization of the initiative's logistics supporting the diverse and complex tasks composing the process will reduce its effectiveness. Finally, attempts to institutionalize the process through a rigid methodology will not compensate for the effort put in by leaders who are truly passionate about the project.

From the benefits side, it was added to the literature how crowd engagement can successfully be applied to counteract political apathy among citizens, long-lastingly increasing their political participation even after the initiative itself has ended. Moreover, the process has the potential to bring people together in crisis situations, fostering a united response and strengthening the sense of belonging to the community.

Furthermore, this research enriched the already existing literature about the challenges and benefits of crowd engagement, enlarging their theoretical boundaries and possible implications. This was for instance the case of the process' benefit of making it possible to involve marginalized people (Jalonen et al., 2021). Indeed, to the already in the literature explored potential of the phenomenon to reach people who would be otherwise neglected because of their social or demographical characteristics, the interviews made it possible to add how crowd engagement can also be leveraged to give a voice to those who, because of crisis situations like natural disasters, have no means to communicate, while also being those who probably need to be heard the most.

Moreover, the literature regarding crowd engagement's success to solve complex issues was enriched (e.g. Nesti, 2018; Gebremedhin et al., 2020) by grounding it to the process' benefits of enabling fast response, generating precise data and managing and understanding complex problems, which emerge from multiple cases and were discussed in their implications.

Finally, this research adds to the literature the results of an investigation into the relationships between crowd engagement's benefits and challenges and the process' design discussing how some of them are caused or strengthened by the chosen span and intensity of the event, therefore potentially giving initiators some guidelines for the design of the initiatives.

2.5.2. Managerial implications

The conducted research provides some interesting insights that could be used by public institutions and nonprofit organizations to increase the success of crowd engagement processes. The provided framework for challenges can be exploited by initiators to understand on which levers to intervene to prevent a certain challenge from negatively affecting the outcomes of the initiative. Indeed, each challenge has been connected to one of four possible aspects of a crowd engagement process: the initiator, the participants, the submissions generated by the participants and the design of the initiative's organization and implementation. Consequently, it is possible to know exactly from what a certain challenge originated, therefore helping initiators to be more effective in overcoming them by facilitating the identification of the lever to act on. At the same time, the research clarifies what are the benefits of the crowd engagement process that lead to the generation of value for society and democracy and support for different processes.

Moreover, finding relationships between the defined challenges and benefits and the span and intensity of a crowd engagement initiative can support initiators in designing the process. Indeed, it is so possible, given the features of a certain initiative, to predict to a certain extent what will be the most relevant challenges to face. This gives initiators a tool to understand which countermeasures to take to overcome these problems. At the same time, if the organizing entity is looking to exploit certain benefits of the crowd engagement process, span and intensity can be set accordingly, while also knowing which challenges will follow from such a decision. For instance, if a public institution wants to implement crowd engagement to strengthen the democratic processes by leveraging on its benefit of facilitating the closing of the gap between citizens and politicians, a possible suggestion could be to design the initiative giving it high intensity. Consequently, the management and quantity of the citizens' contribution will be one of the biggest challenges to face, potentially amplified by the initiative's span, while the clear definition of the initiators' goals will be of paramount importance.

2.5.3. Limitations and future development

This sub-section is dedicated to the discussion of the main limitations of the conducted qualitative research and the directions that might be taken for future research to expand the validity of its results.

To begin with, since the sample is limited both in terms of cases and interviewees, the obtained results could lack some challenges and benefits of the crowd engagement process which, by not being reported by one of the transcripts, could not be coded and included in the final results. In other words, there might be challenges and benefits which are indeed typical of crowd engagement, and which were maybe even discussed by existing literature, that did not appear in the coding tree. Consequently, the analysis of additional case studies and interviews, might have led to their inclusion. As a result, it must be stated that this research cannot provide the certainty of having empirically gathered absolutely all possible challenges and benefits of crowd engagement and future research might expand its findings.

Moreover, since the coding phase of the transcripts of the interviews followed an inductive approach, the final codes might be affected by the researchers' subjective perspectives (O'Connor and Joffe, 2020). This means that a different team of coders, given their individual knowledge and experience in the field, may have come to conclusions that differ from the ones reported in this work, in terms of coding trees.

Furthermore, the classification of each relevant interview segment is affected by the researcher's personal point of view as well, even when there is a predetermined coding framework, which was not the case in this research. This means that the same segment could be coded differently by different coders. To limit the impact of subjectivity on the process and increase the results' robustness, a thorough process of intercoder agreement was performed (O'Connor and Joffe, 2020).

These limitations are related to the inductive nature of this research, which makes it difficult to generalize its results in some cases (Yin, 2013).

Four possible directions for future research were identified:

- Given the limitedness of the sample, the results might not be exhaustively representing all possible challenges and benefits of crowd engagement. Additional research might be done to empirically expand the findings, starting from different samples of case studies.
- The focus of the analysis was put on identifying the challenges of the crowd engagement process from nine case studies. Having classified them provides the possibility to explore how each of them can be overcome by the initiator of

the process. The discussed results could therefore trigger research into each identified challenge, aimed at finding ways to master them in the design of the crowd engagement effort.

- Similarly to what has been discussed above, the identification of the benefits could be followed by further research on how each of them can be purposefully exploited by the initiators of the process and their generated value fully captured by its stakeholders.
- Even though the research highlighted a relationship between the span and intensity of the crowd engagement effort and its challenges and benefits, further research is needed to confirm and better understand the connections between the different elements and their implications on the design of the process.

3 Conclusion and future developments

This thesis made it possible, through a systematic literature review and qualitative research, to define crowd engagement**,** its main features, applications and contexts and also to identify the main benefits and challenges of this novel process.

The first chapter combined co-citation analysis and text mining to provide a systematic review of the literature regarding the crowd engagement phenomenon, which is becoming more frequent in recent years as public institutions and nonprofit organizations apply it to solve complex challenges through the involvement of citizens.

The co-citation analysis highlighted how crowd engagement's theory is rooted in the concepts of open innovation, crowdsourcing, co-creation and citizen participation, which are combined with the one of sustainability in the creation of the unique identity defining this novel process.

Furthermore, the text mining analysis made it possible to explore the distinctive features of crowd engagement initiatives by exploring the related literature, also in light of a comparison with similar processes which are instead initiated by private companies. It was concluded that crowd engagement gathers within its theoretical boundaries elements belonging to the concepts of open innovation, citizen participation, crowdsourcing, and co-creation. It was so possible to highlight how the process seeks to integrate within the boundaries of the initiator, which is either a public institution or a nonprofit organization, knowledge generated from external actors via broad engagement initiatives. To do so, "in-person" events are often combined with online ones, enabled by digital technology which proved to play an important role in crowd engagement's success. Moreover, it stood out how the involved crowd is generally made of self-selected and unskilled citizens, who contribute to solving the challenges through a co-creation process with the initiators and the other participants. Therefore, instead of asking the participants to directly provide solutions to compensate for a lack of competencies by the initiators, crowd engagement is focused on engaging citizens according to a co-creation approach to support initiators in the processes of decision-making, defining problems and solving macro-tasks. Furthermore, it was concluded that crowd engagement is generally applied to solve very complex, transversal problems affecting society at large.

This led to the final definition of crowd engagement:

"*Crowd engagement is the process by which public institutions or nonprofit organizations engage an often self-selected and unskilled crowd of citizens, both in online and offline initiatives, to manage and solve, through the co-creation of partial solutions or problem definitions, very complex challenges related to sustainability and affecting society at large*".

Once having properly defined crowd engagement, the second part of the dissertation made it possible to identify the challenges and benefits of the process through qualitative research. The coding of the semi-structured interviews, conducted on a sample of nine cases of crowd engagement, led to the definition of 14 challenges and 13 benefits, empirically confirming some of those which were found in the literature, while also identifying new ones.

It was possible to discuss whether each challenge originated from the initiator, the crowd involved, the contributions provided by the participants, or the design of the initiative. This highlighted how the culture of the initiator might significantly limit the success of the process, especially in the case of public institutions, where there might be inertia and resistance in accepting and implementing the ideas generated by external and non-expert actors.

It was also concluded that crowd engagement's benefits can be exploited by initiators to strengthen democratic processes, provide social value, support innovation and solve complex problems. In particular, it was shown how some of its main benefits are bringing citizens and politicians closer together, supporting the decision-making process and restoring people's trust in politics. Moreover, the process' potential to solve complex problems, defined in the systematic literature review, was grounded in the process' benefits of enabling fast response, improving the understanding of complicated situations and quickly generating precise data.

Furthermore, it was concluded that there is a relation between the defined challenges and benefits, and the span and intensity of a crowd engagement effort, which are respectively the number of participants involved and how actively they are engaged by the initiator.

It was so possible to establish that some of the findings appeared to be independent of the mentioned variables. This is true for the challenge related to the need to properly communicate the initiative to the participants, which initiators always need to manage, and the benefits of supporting decision-making and solving complex problems.

On the other hand, other challenges appear to be amplified by these variables' values. This is exemplarily shown by the fact that the higher the intensity gets, the more

difficult it will become for initiators to manage and analyze the large number of contributions collected from the participants, as the greater freedom given to them will lead to a higher variability in their submissions. Similar considerations are true for most of the benefits strengthening democratic values as they will unfold thanks to a high level of interaction between the citizens, which is related to initiatives with high intensity.

Finally, such analysis supports the initiators in the design of the crowd engagement efforts, as it helps them to set their span and intensity according to the benefits sought, while making it possible to anticipate the most relevant challenges that they will be required to face.

Both studies suggest some possible future directions to be taken by academics to deepen the knowledge about crowd engagement.

The research agenda discussed in the systematic literature review calls for further investigation into how initiators can guarantee that the crowd engagement initiative's results are truly representative of society at large, therefore making sure that not only the most vociferous people, or those who were already interested in the subject of the initiative, are involved.

To obtain such results, it is also highlighted how there is the need to deepen the understanding of the motivation leading those citizens who are generally politically not very active to participate in this kind of initiative.

Moreover, in such contexts, the importance of digital technology was discussed, as it can be exploited to reach otherwise marginalized people. However, the research agenda calls for further investigation to define the circumstances under which digital technology truly leads to the enlargement of the reach of the crowd engagement initiative, instead of obtaining the opposite effect of marginalizing people with limited technological skills.

Moreover, the systematic literature review discussed the sometimes existing gap between knowledge creation and implementation, meaning that initiators sometimes do not apply the ideas generated by the citizens. This challenge, limiting crowd engagement's effectiveness, was then also explored in the following qualitative research, as it also empirically emerged from some of the analyzed case studies. It is therefore suggested to understand how the process can be designed to guarantee that the ideas generated by the crowd are indeed implemented by the initiators, when they meet the desired quality standards.

Finally, it is suggested to explore the possible collaboration between public institutions and private companies to initiate crowd engagement processes.

The qualitative research provided some guidelines for the future development of the subject as well, especially focusing on the need to understand how to overcome each of the defined challenges and how to purposefully leverage all the identified benefits. It also calls for further investigation into the relationship between the design of the span and intensity of crowd engagement initiatives and the resulting benefits and challenges, as it could lead to very useful insights which could help the initiators to organize the process more effectively.

3.1. Theoretical implications

This research added to the literature a thorough analysis of crowd engagement based on a systematic review of the existing literature. It was so shown how the process is rooted in the concepts of open innovation, citizen participation, crowdsourcing and co-creation, which combined with the one of sustainability give crowd engagement its own identity.

Moreover, the literature about the process was enriched by identifying crowd engagement's main features. A comparison between this process and the similar ones initiated by private companies made it possible to highlight the unskilled and self-selected nature of the crowd, made mostly of citizens, its potential wide reach, made possible by combining physical events with digital ones enabled by the use of technology, and the process' potential to solve complex societal problems like climate change.

Finally, the systematic literature review led to adding to the literature a formal definition of crowd engagement, which sets it apart from the other existing processes.

The qualitative research added to a set of challenges of crowd engagement already explored by the literature new ones. It was so found out that the process' outcome can be significantly limited by the lack of trust by potential participants in the process itself. Moreover, the potentially overwhelming quantity of collected submissions from the participants can prevent the initiators from finding the most relevant contributions. Finally, an improper organization of the initiative's logistics and a lack of passionate and motivational leaders will limit the effectiveness of the initiative.

As far as the benefits are concerned, it was added to the literature how crowd engagement can be implemented to reduce political apathy among citizens, long-

lastingly increasing their political participation, and to bring people together in response to crisis situations.

Moreover, this research enriched the already existing literature about the challenges and benefits of crowd engagement, enlarging their theoretical boundaries and possible implications.

The literature regarding crowd engagement's success to solve complex issues was enriched by grounding it to the process' benefits of enabling fast response, generating precise data and managing and understanding complex problems.

Finally, this research adds to the literature the relations found between a crowd engagement initiative's span and intensity and its challenges and benefits, therefore helping initiators in the design of the process.

3.2. Practical implications

From a practical perspective, this systematic literature review provides some useful insights that could be help public institutions to better organize and structure crowd engagement initiatives.

First of all, it was highlighted how crowd engagement has the potential to be applied to solve the most urgent and complex challenges our society is facing today, like the covid-19 pandemic, climate change, and natural disasters or to reach sustainability targets in urban contexts.

Moreover, solving complex problems often requires a wide participation which can be reached through digital technology. However, when selecting the channels to implement the initiatives, initiators should be aware of one of the process' main challenges: the unrepresentativeness of the involved crowd. Indeed, it must be avoided to design a crowd engagement process that gives voice only to those who were already interested in similar initiatives. To solve such problem, technology can be exploited, making it even possible to reach marginalized people.

Furthermore, the conducted qualitative research provides some interesting insights into crowd engagement's challenges and benefits that could help public institutions and nonprofit organizations to increase the success of the initiatives.

Each challenge has been related to a specific aspect of the process originating it, therefore helping initiators to understand on which levers to intervene to prevent a certain challenge from negatively affecting the outcomes of the initiative. At the same

time, the research clarifies the value that can be generated by exploiting each benefit of crowd engagement.

Finally, finding relations between the defined challenges and benefits and the span and intensity of a crowd engagement initiative can support initiators in designing the process. Indeed, it can help initiators to set the intensity and the span of the initiative according to the benefits they are seeking from the process, while also knowing which challenges will follow from such a decision.

In conclusion to the systematic literature review, a future research agenda on crowd engagement was defined. In particular, the questions call for further investigation into how initiators can make sure that the process is truly representative of society at large, while also asking to better understand under which conditions digital technology acts as an enabler for participation instead of causing the marginalization of people with little digital skills. It also suggests exploring possible collaboration between public institutions and private companies to initiate the process. Moreover, the qualitative research provided some guidelines for the future development of the subject as well, especially focusing on the need to understand how to overcome each of the defined challenges and how to purposefully leverage all the identified benefits. It also calls for further investigation into the relationship between the design of the span and intensity of crowd engagement initiatives and the resulting benefits and challenges.

3.3. Limitations

This section is aimed at discussing the main limitations of the conducted research.

First of all, given the novel nature of crowd engagement, the sample on which to base the systematic literature review had to be built from publications about the process' applications which were not explicitly described as "crowd engagement". This meant that the choice of whether to include an article in the sample or not was not only based on the presence of certain keywords but had also to be based on what was considered to be a relevant example of crowd engagement by the researchers. Indeed, during the building of the sample, the search results provided by the chosen research string on Scopus had to be screened based on their abstracts and texts to understand whether to discard them or not in order to reach the final sample. It is difficult to exclude with absolute certainty the impact of personal bias in such selection, meaning that other

researchers might have taken different decisions about the inclusion of certain publications.

To make it possible to interpret the results of the text mining, it was necessary to clean some of the concepts automatically put by Leximancer on the map. Even though this cleaning process was performed based on criteria shared by the researchers, personal bias might have affected the decisions, meaning that different people may have performed it in a way that would have led to different final concept maps in terms of concepts, themes and clusters, therefore impacting the following interpretation of the results.

As far as the qualitative research is concerned, since the sample is limited, the obtained results could lack some challenges and benefits of the crowd engagement process which were not reported in any of the cases. Consequently, the analysis of additional case studies and interviews might have led to their inclusion.

Moreover, since the coding phase of the transcripts of the interviews followed an inductive approach, the final codes might be affected by the researchers' subjective perspectives (O'Connor and Joffe, 2020). This means that a different team of coders, given their individual knowledge and experience in the field, may have come to conclusions that differ from the ones reported in this work, in terms of coding trees. To limit the impact of subjectivity on the process and increase the results' robustness, a thorough process of intercoder agreement was performed (O'Connor and Joffe, 2020).

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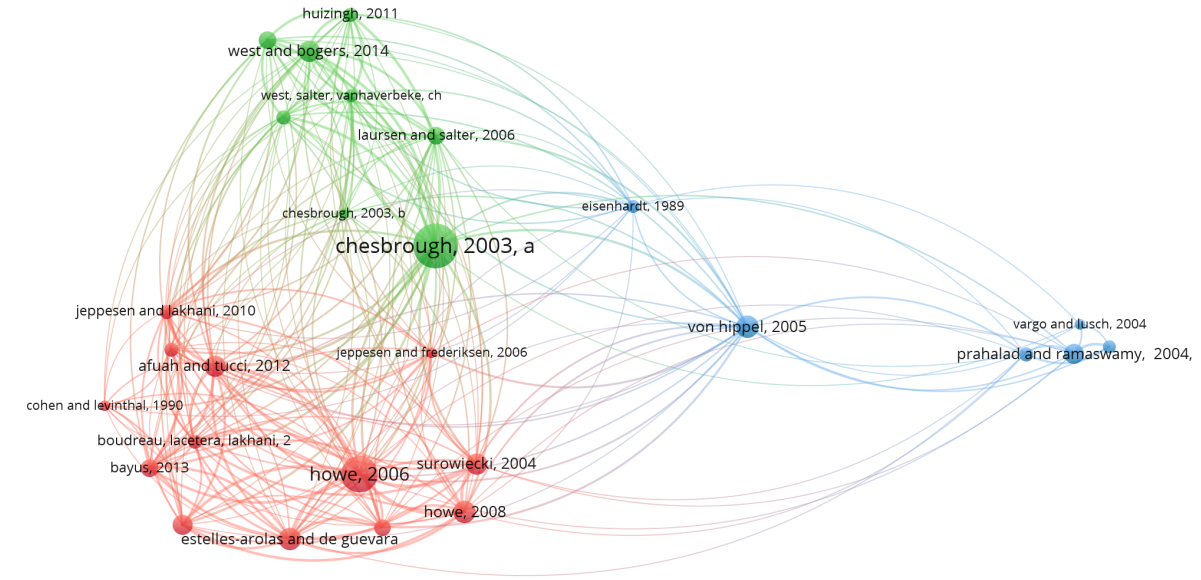
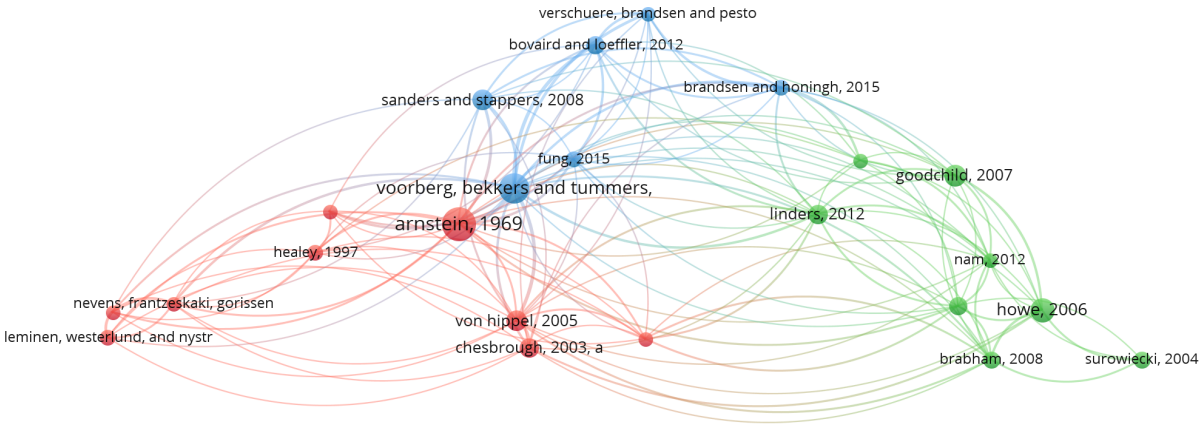
A Appendix A

A.1. Maps of the co-citation analysis

MAP OF THE CO-CITATION ANALYSIS OF THE "PRIVATE" LABELED PAPERS



MAP OF THE CO-CITATION ANALYSIS OF THE "PUBLIC" LABELED PAPERS



A.2. Elements of the co-citation analysis of the "private" labeled publications

ELEMENTS OF THE CO-CITATION ANALYSIS OF THE "PRIVATE" LABELED PUBLICATIONS
Cluster 1 "**Theory**": 1. chesbrough, h., (2003) open innovation: the new imperative for creating and profiting from technology, , harvard business school press:boston, ma, usa 2. chesbrough, h., the era of open innovation (2003) mit sloan manag. rev, 44, pp. 35-41 3. dahlander, l., gann, d.m., how open is innovation? (2010) res. policy, 39, pp. 699-709 4. enkel, e., gassmann, o., chesbrough, h., open r&d and open innovation: exploring the phenomenon (2009) r d manag, 39, pp. 311-316 5. huizingh, e.k.r.e., open innovation: state of the art and future perspectives (2011) technovation, 31, pp. 2-9 6. laursen, k., salter, a., open for innovation: the role of openness in explaining innovation performance among u.k. manufacturing firms (2006) strategic management journal, 27 (2), pp. 131-150 7. west, j., bogers, m., leveraging external sources of innovation: a review of research on open innovation (2014) journal of product innovation management, 31 (4), pp. 814-831 8. west, j., salter, a., vanhaverbeke, w., chesbrough, h., open innovation: the next decade (2014) res. policy, 43, pp. 805-811
Cluster 2 "**Process**": 1. afuah, a., tucci, c.l., crowdsourcing as a solution to distant search (2012) academy of management review, 37 (3), pp. 355-375, https://doi.org/10.5465/amr.2010.0146 2. bayus, b.l., crowdsourcing new product ideas over time: an analysis of the dell ideastorm community (2013) management science, 59 (1), pp. 226-244 3. boudreau, k.j., lacetera, n., lakhani, k.r., incentives and problem uncertainty in innovation contests: an empirical analysis (2011) management science, 57 (5), pp. 843-863 4. brabham, c. d., crowdsourcing as a model for problem solving. an introduction and cases (2008) convergence: the international journal of research into new media technology, 14 (1), pp. 75-90., https://doi.org/10.1177/1354856507084420 5. cohen, w.m., levinthal, d.a., absorptive capacity: a new perspective on learning and innovation (1990) administrative science quarterly, 35 (1). https://doi.org/10.2307/2393553 6. estelles-arolas, e., gonzalez-ladron-de-guevara, f., towards an integrated crowdsourcing definition (2012) journal of information science, 38 (2), pp. 189-200 7. howe, j., (2006) the rise of crowdsourcing, pp. 1-4., wired magazine 8. howe, j., (2008) crowdsourcing: why the power of the crowd is driving the future of business, new york, ny: crown publishing group 9. jeppesen, l.b., lakhani, k.r., marginality and problem-solving effectiveness in broadcast search (2010) organization science, 21 (5), pp. 1016-1033 10. jeppesen, l.b., frederiksen, l., why do users contribute to firm-hosted user communities? (2006) the case of computer-controlled music instruments. organ. sci, 17, pp. 45-63 11. poetz, m.k., schreier, m., the value of crowdsourcing: can users really compete with professionals in generating new product ideas? (2012) journal of product innovation management, 29 (2), pp. 245-256 12. surowiecki, j., (2004) the wisdom of crowds: why the many are smarter than the few and how collective wisdom shapes business, economies, societies and nations, , new york, ny: doubleday publishing 13. terwiesch, c., xu, y., innovation contests, open innovation, and multiagent problem solving (2008) management science, 54 (9), pp. 1529-1543
Cluster 3 "**Application**": 1. eisenhardt, k. m., building theories from case study research (1989) academy of management review, 14 (4), pp. 532-550 2. payne, a.f., storbacka, k., frow, p., managing the co-creation of value (2008) journal of the academy of marketing science, 36 (1), pp. 83-96 3. prahalad, c. k., ramaswamy, v., co-creation experiences: the next practice in value creation (2004) journal of interactive marketing, 18 (3), pp. 5-14. , https://doi.org/10.1002/dir.20015 4. prahalad, c.k., ramaswamy, v., (2004) the future of competition: co-creating unique value with customers, boston: harvard business press 5. vargo, s.l., lusch, r.f., evolving to a new dominant logic for marketing (2004) journal of marketing, 68 (1), pp. 1-17 6. von hippel, e., (2005) democratizing innovation, cambridge, ma: mit press

A.3. Elements of the co-citation analysis of the "public" labeled publications

ELEMENTS OF THE CO-CITATION ANALYSIS OF THE "PUBLIC" LABELED PUBLICATIONS

Cluster 1 "**Application**":

1. bovaird, t., loeffler, e., from engagement to co-production: the contribution of users and communities to outcomes and public value (2012) voluntas: international journal of voluntary and nonprofit organizations, 23 (4), pp. 1119-1138
2. brandsen, t., honingh, m., distinguishing different types of co-production: a conceptual analysis based on the classical definitions (2016) public administration review, 76 (3)
3. fung, a., putting the public back into governance: the challenges of citizen participation and its future (2015) public administration review, 75 (4), pp. 513-522
4. sanders, e.b.-n., stappers, p.j., 'co-creation and the new landscapes of design' (2008) codesign, 4 (1), pp. 5-18. , https://doi.org/10.1080/15710880701875068
5. verschuere, b., brandsen, t., pestoff, v., co-production: the state of the art in research and the future agenda (2012) voluntas, 23, pp. 1083-1101
6. voorberg, w., bekkers, v., tummers, l., a systematic review of co-creation and co-production: embarking on the social innovation journey (2015) public management review, 17 (9), pp. 1333-1357

Cluster 2 "**Process**":

1. bovaird, t., beyond engagement and participation: user and community coproduction of public services (2007) public administration review, 67 (5), pp. 846-860
2. brabham, c. d., crowdsourcing as a model for problem solving. an introduction and cases (2008) convergence: the international journal of research into new media technology, 14 (1), pp. 75-90. , https://doi.org/10.1177/1354856507084420
3. brabham, d.c., crowdsourcing the public participation process for planning projects (2009) plann. theory, 8 (3), pp. 242-262. , http://dx.doi.org/10.1177/1473095209104824
4. goodchild, m.f., citizens as sensors: the world of volunteered geography (2007) geojournal, 69 (4), pp. 211-221
5. howe, j., (2006) the rise of crowdsourcing, pp. 1-4. , wired magazine
6. linders, s., from e-government to wegovernment: defining a typology for citizen coproduction in the age of social media (2012) government information quarterly, 29 (4), pp. 446-454
7. nam, t., suggesting frameworks of citizen-sourcing via government 2.0 (2012) government information quarterly, 29 (1), pp. 12-20. , 2012
8. surowiecki, j., (2004) the wisdom of crowds: why the many are smarter than the few and how collective wisdom shapes business, economies, societies and nations, , new york, ny: doubleday publishing

Cluster 3 "**Theory**":

1. arnstein, s.r., a ladder of citizen participation (1969) journal of the american institute of planners, 35 (4), pp. 216-224
2. chesbrough, h., (2003) open innovation: the new imperative for creating and profiting from technology, , harvard business school press:boston, ma, usa
3. healey, p., (1997) collaborative planning: shaping places in fragmented societies, , basingstoke, macmillan international higher education
4. hilgers, d., ihl, c., citizensourcing: applying the concept of open innovation to the public sector (2010) international journal of public participation, 4 (1), pp. 67-88
5. leminen, s., westerlund, m., nystrom, a., living labs as open-innovation networks (2012) technology innovation management review, 2 (9), pp. 6-11
6. nevens, f., frantzeskaki, n., gorissen, l., loorbach, d., urban transition labs: co-creating transformative action for sustainable cities (2013) j. clean. prod., 50, pp. 111-122
7. torfing, j., sørensen, e., røiseland, a., transforming the public sector into an arena for co-creation: barriers, drivers, benefits, and ways forward (2019) administration & society, 51 (5), pp. 795-825
8. von hippel, e., (2005) democratizing innovation, , cambridge, ma: mit press
9. voytenko, y., mccormick, k., evans, j., schliwa, g., urban living labs for sustainability and low carbon cities in europe: towards a research agenda (2016) j. clean. prod, 123, pp. 45-54

B Appendix B

B.1. Sources used for each case study

CASE STUDY	SOURCES USED TO TRIANGULATE THE DATA
Carbon neutral helsinki 2035, case A	Sources: interview, email, Carbon Neutral Helsinki 2035 webpage, Nesta: using collective intelligence to solve public problems
Conference on the future of europe, case B	Sources. interview, email, CoFoE webpage 1, CoFoE webpage 2, CoFoE webpage 3,
EUvsVIRUS hackathon and matchathon, case C	Sources: interviews, email, EUvsVIRUS webpage 1, EUvsVIRUS webpage 2, EUvsVIRUS pdf document, EUvsVIRUS webpage 3
Global fishing watch, case D	Sources: interview, email, Global Fishing Watch webpage 1, Global Fisching Watch webpage 2, , Nesta playbook for collective intelligence
City plan helsinki, case E	Sources: interview, email, pdfs provided by the interviewed person, City Plan webpage,
Public lab, case f	Source: interview, email, Public Lab webpage, , Nesta playbook for collective intelligence
Safecast, case g	Sources: interview, email, Safecast website, Nesta: using collective intelligence to solve public problems
Belgian sortition model: the "ostbelgien" model, case h	Sources: interview, email, Ostbelgien sortition model webpage 1, Ostbelgien sortition model webpage 2, Ostbelgien sortition model webpage 3, Nesta: using collective intelligence to solve public problems
Ushahidi, case i	Sources: interview, email, Ushahidi webpage, Nesta: using collective intelligence to solve public problems

B.2. Overview of the case studies

CASE STUDY NAME	CODE NAME	INITIATOR	TYPE OF INITIATOR	NAME OF THE INTERVIEWEE (S)	ROLE OF THE INTERVIEWEE	COMPLEX PROBLEM TO BE SOLVED	PURPOSE	PARTICIPANTS	METHOD	INTENSITY (based on method)	SPAN
Carbon Neutral Helsinki 2035	A	The Helsinki's mayor's office	Governmental institution	Eräranta Susa	Member of the team responsible for the new "Carbon neutral Helsinki 2030" program. Participated in workshops, crowdsourcing phases and analysis of the experiences for the "Carbon neutral Helsinki 2035" project.	Reaching carbon neutrality	Identify measures or actions that the city and other actors should take for the city to reach carbon neutrality by the year 2035.	Helsinki residents and businesses	Citizen participation initiatives to collect suggestions about the action plan defined by experts and to support its implementation	High	Helsinki Urban Area. Urban venues visitors: estimated 2000 visitors, digital map questionnaire: 4700 participants, website: 130000 visitors
Conference for the future of Europe	B	The European Commission	Governmental institution	Franca Feisel	Co-facilitator and note taker for the European citizen panel two	Shaping the future of the EU	Involve citizens in the shaping of the EU's long-term future	EU citizens	Deliberative democracy	Very high	Four European citizen panels of 200 participants, leading to a total of 800 citizens, 52346 platform participants, over 600000 event participants
EUvsVIRUS	C	The European Commission	Governmental institution	Michael Ionita; Scotty Shaw	Initiator and Co-coordinator; CTO and national curator of the United States	The COVID-19 Pandemic	Support and enable a united response to the pandemic.	EU citizen, was also opened to participants from non-European countries	Hackathon and Matchathon	Very high	Over 30000 people

CASE STUDY NAME	CODE NAME	INITIATOR	TYPE OF INITIATOR	NAME OF THE INTERVIEWEE	ROLE OF THE INTERVIEWEE	COMPLEX PROBLEM TO BE SOLVED	PURPOSE	PARTICIPANTS	METHOD	INTENSITY (based on method)	SPAN
Global fishing watch	D	Google, Oceana and Sky truth	Nonprofit organization	Luca Marsiglia	Data analyst	Unsustainable use of the oceans	Enable fair and sustainable use of the ocean by increasing the transparency of human activity at sea to make it common knowledge	Vessels and sailors, governments from all over the world	Crowdsourcing of data from the Boats' automatic identification systems (AIS) in combination with official and public governmental data	Low	Global reach, 100 of thousands of vessels
Helsinki City Plan	E	The city of Helsinki	Governmental institution	Suomi Christina	Spatial planner	Urban planning of the city of Helsinki for the next 30 years (until 2050)	Defining the direction for the city's growth over the following 30 years (until 2050)	Helsinki residents and businesses	Organization of various citizen participation events ranging from online maps to physical workshops, allowing participants to provide suggestions about the future development plan of the city	High	Helsinki Urban Area citizens and more than 300 experts from companies, research centers and organizations
Public Lab	F	The no profit-organization itself	Nonprofit organization	Liz Barry	Co-founder and Director of Community development	Complex environmental challenges affecting society	Democratize science to overcome environmental challenges	Anyone willing to join the community	Citizen science, participatory monitoring	High	Active participants: 60000. Broadest community served: 1 million
Safecast	G	The no profit-organization itself	Nonprofit organization	Sean Bonner	Co-founder and global director of Safecast	Mapping nuclear radiation levels	Provide the citizens with accurate and concrete data to help them to better understand their environment and make educated choices	Anyone willing to volunteer and collect data	Crowdsourcing of data through portable devices carried by volunteers while moving around the country	Medium	Exact number of participants could not be provided because of privacy. Spans over whole countries

CASE STUDY NAME	CODE NAME	INITIATOR	TYPE OF INITIATOR	NAME OF THE INTERVIEWEE	ROLE OF THE INTERVIEWEE	COMPLEX PROBLEM TO BE SOLVED	PURPOSE	PARTICIPANTS	METHOD	INTENSITY (based on method)	SPAN
The Ostbelgien sortition Model	H	The parliament of the German-speaking Ostebelgien region	Governmental institution	Pelzen Myriam	Chief of the service for communication	The increasing gap between citizens and politicians	Restore the trust of citizens in politics and increase the citizen's comprehension of political mechanisms and processes	All citizens of the german speaking community of East Belgium aged 16 or older	Deliberative democracy	Very high	Citizen council: 24 members, each citizen assembly: between 25 and 50
Ushahidi	I	Organizations and institutions wanting to help communities in need and communities in need of help	Nonprofit organization	Daniel Odongo	Director of implementation	Manage natural disasters and humanitarian response	Give marginalized people a voice. Help communities quickly collect and share information that enables them to raise their voices, inform governmental decisions about them and influence change.	Three kinds of users: communities who need their voices to be heard, organizations who want to reach these communities, researchers who want to better understand these situations	Crowdmapping powered by the combination of different channels, both online (IOS or ANDROID apps) and offline (SMS) to enable anyone to communicate	Medium	Variable, from whole countries to smaller areas

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