Establishing Expert Consensuses on the Value of Open Data in Open Social Innovation Ideation

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ABSTRACT

There is little conclusive evidence as to whether OD provides value to social innovation ideation scenarios. Furthermore, OD as a resource is severely contested as to its openness, availability, quality, importance, and usefulness within innovation ideation. Therefore, understanding how Open Data (OD) can be leveraged for innovation ideation practices has become a topic at the mainstream of management literature. However much of the effort thus far has been focused on ideation and innovation for-profit, specifically when in papers examining Open Innovation (OI), even though OD has been depicted as a resource for providing social, economical and entrepreneurial benefit. Therefore this paper presents an initial study of the perceived value of OD, in research phase Open Social Innovation (OSI), amongst academic and professional experts in OI, Innovation Networking and OD. Consequently, a Modified Delphi Study (MDS) is conducted, aimed at forming a convergence of opinion amongst academic and professional experts. From converging expert opinions from both academic and professional perspectives, optimal managerial practices within this field can be shaped. Furthermore, management processes and practices can be justified in collecting and targeting particular datasets that are opportune for a social innovation context. In addition to the primary objectives, and with respect to the paper's findings, barriers of utilizing and leveraging OD for this purpose are duly noted with proposed methods of overcoming such challenges.

1. INTRODUCTION

The majority of information and resources reside outside of the boundaries of an organization (Rothwell 1975), and as such, it is necessary for innovators within any business sector to obtain and utilize external information, data and personnel within their innovation processes (Ames 1961). However, leveraging of such resources is not presented without its limitations. For example, the assumption that every organization can utilize data effectively and that it is simple to publish OD are fallacies, dissuading managerial professionals, specifically within smaller firms, from releasing, using and applying such resources (Janssen, Charalabidis, and Zuiderwijk 2012). Parallel to this notion, although the availability of OD is indeed on the increase on the World Wide Web, the perception of its usefulness in management and innovation practices are severely contested. This is partly due to the apparent questioning of the degree of openness of OD, to what extent the data provided is complete and whether it is representative of the population of data. Secondly, the spread of OD that is currently present on the Web is limited, is mostly of low quality, and can be difficult to obtain, detracting from the notion of 'openness'. Nevertheless, it is stated that organizations which operate an 'open' strategy tend to be more productive and adaptable to changes in the economic climate, and as such have a developed competitive advantage (Chesbrough, 2003).

Even so, there are particular sectors that appear to lag behind on the utilization of OI strategies and applying OD for innovation practices: the social and third sectors. This could derive from the current nature of OD being below the expectation of innovation professionals' within the aforementioned sectors. Alternatively this may be due to barriers such as: lack of in-house expertise, or lack of internal tools to analyze such data sources. Even so, firms such as these have recently begun to explore outside the boundaries of the organization for leveraging of

such resources, personnel and tools through an OI framework e.g. The Young Foundation. This appears as a drive in order to gather new perspectives to tackle social challenges rather than to obtain utility for potentially solving the issue. In turn, such solutions appear to provide more intrinsic value than the financial support of donations. Along this vein, various agendas such as the 'European Union Digital Agenda for Europe' (*Horizon2020*) strive towards the formation of new business models and innovation practices for tackling current and topical, social and societal challenges, for example: neurodegenerative diseases, antimicrobial resistance, and the atrophy of antibiotics, to name a few.

This paper examines issues associated with the use and application of OD in OSI ideation, a process of creating viable and feasible social innovation ideas (Björk and Magnusson 2009), providing consensuses of agreement among industry and academic experts for optimum application in future similar settings. Particular focus is maintained upon the social sector, establishing an early study in this recently founded field. As this field is considered as being relatively new, developing consensuses of agreement between both academic and professional experts is deemed appropriate for establishing a preliminary exploration of this field. As such, an MDS is chosen to pursue this exploratory study, aiming to define what 'should be' rather what 'could be' (Miller, 2006).

The consensuses are formulated utilizing a three-round MDS aimed at investigating the appropriateness, importance, and usefulness of key OD characteristics, dimensions, values and formats within early-stage OSI. These consensuses are then retested through each subsequent round from different analysis points to establish consensus reliability, validity and consistency. Producing consensuses from these perspectives, and with three-round testing and retesting, enables a contribution to be determined in understanding the perceived value of OD in OSI

ideation practices from a collection of expert viewpoints. Thus, this paper is presented as one of the early writings of OSI and indeed the application and value of OD within such ideation scenarios.

The results detail 14 variables that formed a consistent, reliable and valid consensus across the three rounds of the MDS. Namely, the Innovation Process and Social Impact are highly influenced by the use and application OD, the combined use of Textual and Statistical OD is appropriate and important, along with the use of data that is Temporally-relevant. Additionally, Societal and Economical OD can enable contexts to be drawn for innovation perspective, but the data must be Accessible, Credible, Consistent, simple to Interpret, Relevant, have a high Provenance, and be easy to Understand by the innovators. These valid, reliable, and consistent variables provide management professionals, operating OSI practices, with a basis for extracting and mining opportune datasets that are deemed most appropriate for these specific innovation ideation contexts.

2. LITERATURE REVIEW

2.1 (OPEN) SOCIAL INNOVATION

MacCallum (2009) states that Social Innovation (SI) is not a new term; it is one that has returned to the mainstream due to its ability to present organizations and individuals positively, because of its focus on offering solutions to growing social and cultural challenges. Through recognizing this conceptual perspective, the earliest writings of SI appear to have stemmed from the works of Taylor (1970); who explains SI as a means to explain the dynamics of social and collaborative community development. Since that time, Drucker (1987) refers to SI as a means to encourage societal change by implementing new initiatives and/or strategies. Akin to this, Pol & Ville (2009) identify SI as a form of innovation that is dedicated to having a significant impact on wider social challenges in the remit of producing social goods, products or services. More

recently, Murray et al. (2010) add to this by noting that SI is a structure to which communities and organizations can operate in unison to tackle pressing issues of the time. For example, chronic disease, widening inequalities and climate change, among others. In accordance, Young (2011) conceptualizes SI as a coordinated novel mechanism to develop the welfare of individuals affected by SCs, in turn, changing the status quo. Therefore, this concept appears as similar to OI due to its ability to encourage people to collaborate for the production of a specific innovation: in this case, a social outcome that challenges the status quo.

Nevertheless, authors in this field question the evidence of the impact from SIs. For example, Young (2011) queries whether a social institution has the quantitative metrics or methods to measure the impact of the SI against the status quo. Furthermore, theories of innovation subjectivity and contextual dependency (MacKenzie & Wajcman 1985; Baregheh et al. 2009) also appear to apply. It may be noted however that SI appears as a construct that abides even more so to these preconceptions due to its dependency on social change for an understanding of its success. In recognition of this, papers attempt to reconcile this challenge by determining a variety of properties and metrics to which SI can be quantified in its successes. For instance, Taylor (1970) hypothesizes that successful SI stems from the implementation and utilization of five primary principles: 1) maximum investment, 2) co-optation, 3) egalitarian responsibility, 4) research as creative play, and 5) ideological research leadership. Although it is evident that these particular properties may indeed determine the strength of a particular innovation production process, it fails to note the communication and community sides of the SI process, and their respective capacities. Coinciding with this recognition, Taatila et al. (2006) detail a framework for studying the various factors of SI through understanding the psychological, creative and inventive competences of the individuals involved with the

innovation process, additionally mapping out how the cultural environment and resources fit in with the fundamental success of an SI process. This framework allows many elements to be modeled into a systematic process whereby innovation professionals and community managers can indeed manage and coerce efficient innovation for social change.

Even with all the aforementioned assertions Moulaert (2013) states that understanding SI is posed with a number of epistemological challenges. For instance, in order to analyze the effectiveness and new directions of SI, ideological, cultural and political structures would need to be contested to encourage social change from previous status quos. Furthermore, social, cultural and ideological norms may vary across a certain geographic location, thus, what may be a beneficial social change away from the status quo for one individual or community may have a detrimental affect on other individuals within the same respective community. This perhaps causes some theoretical constraints when understanding SI in the context of managerial practice. Even so, Mumford (2002) contests that SI in context is founded upon a common goal that the majority of all individuals are striving for. This appears to be in parallel to the objectives of OI, but with SI being on the community level, not solely on the organizational or network level. From this, we can determine that the core principle of OSI is to combine both OI and SI practices: organizational and communitarian outputs respectively.

As a result OSI is represented as an application of the OI (Chesbrough, 2003) paradigm in an SI setting; completing a predetermined social objective through collaborative technological facilitation (Chesbrough, Vanhaverbeke, & West, 2014). It is also prescribed that OSI is the collaborative work of organizations, individuals, groups and communities for sustainable, transformative change in a given oppressed society (Chesbrough, Vanhaverbeke, & West, 2014). In this model, it is detailed that the innovators and organizations must focus on the social

objectives of the initiative and refrain from standard profit-seeking innovation practices. This paradigm, coined in 2014, represents a shift from large corporations to organizations that operate to tackle social challenges, utilizing a wealth of personnel from outside the boundaries of the firm that have a drive for social change. As a result, there is an increasing amount of organizations such as OpenIdeo that press for SI through utilizing OI platforms, principles and/or practices. Such organizations utilize a multitude of resources and personnel that reside and work outside the boundaries of the seeking organization in order to encourage open collaborative network of social innovation. Akin to the objectives of such organizations, OD is dedicated to encouraging trustworthiness, amiability and moral action, being represented as part of the drive to encourage social change through openness and transparency.

2.2 OPENNESS AND OPEN DATA

Conceptualizations of openness have been evident in the literature since the mid 1800's with Stewart (1858) noting that there is a degree of pleasure and amiableness in sincerity, openness and truth. Akin to this notion, organizations and institutions that operate a certain degree of openness are deemed as being perceivably more trustworthy, due to their drive for transparency and the willingness to share information (Norman, Avolio, and Luthans 2010). Lee et al. (2004) add that openness also has the intrinsic ability to generate faster growth due to the underlying element of transparency that is central to the initiative. Nevertheless, openness is demonstrated and actualized in the business and technology literature stream in a number of different ways.

For example, open markets have been widely noted in the literature as a particular drive for local governments to support flexibility for new entrants, and markets for those in need of an economic upturn (Elliott 2009). This strategy restrains markets from being overtly competitive, enabling smaller organizations and individuals to leverage economic growth more effectively

and with fewer barriers. Many papers also appear to note that democratic institutions that conduct a degree of openness within their strategies tend to be more productive (Harrison 1996), adaptable (LePine, Colquitt, and Erez 2000), and more established as a result. This factor coincides with Chesbrough's (2003) definition of OI, in which organizations that utilize external resources and collaborate with external personnel become largely more open, adaptive and productive. In a later paper by Chesbrough & Appleyard (2007), it was stated that the openness concept requires shifting internal ownership of any assets, to value creation and value capture, enabling others to benefit from such internal resources. Akin to this practice, OD is widely distributed by organizations and institutions to enable others, consumers or organizations, to benefit from its review, use or application (Gurstein 2011). In doing so, OD has been used across many different disciplines and sectors such as the sciences (Murray-Rust 2008) and publishing (Vision 2010), to perform research and develop innovations from the respective datasets. For example, Ushahidi utilizes crowdsourced, real-time OD to analyze and share information about geographical crises that are occurring at that time. This demonstrates a use of the open format to offer information to those residing in the affected areas, raising social awareness of such crises.

Murray-Rust (2008) notes OD as a form of data that is published without restrictions on access, reuse, price or permissions. In addition, Murray-Rust (2008) suggests that the 'gratis' free version of data that is now being made available through the Web is largely valuable for many operating business, performing research, or empowering social and economic communities, should they be able to interpret and utilize the data appropriately. As such one may note that the value of the data is realized upon the application of the data in a human-readable form that provides information or knowledge to the wider community. In addition to this however, Miller et al. (2008) detail that there is a moral obligation for those that utilize the data

to increase the pool of available OD on the Web from their personal or organizational resources, directing the initiative towards an altruistic community of data that can be used for any respective purpose and by anyone, subject to the terms of the license. Furthering these utopian ideals, Bizer et al. (2009) suggests that all data should not only be openly accessible and usable to the wider community, but also should be linked and interlinked in a Web of data: Linked Data. Nevertheless, Jain et al. (2010) notes that the current state of OD on the Web is, for the most part, loosely connected, primarily through variances in schema and compatibility, making it difficult to ensure effective linking.

Furthermore, in order for external personnel to develop a better understanding of the quality and trustworthiness of the data, the granter must endeavor to include metadata that describes the uses and gratifications of the data (Hartig 2009), and place it within a format that enables access by a wider community without the need for proprietary processes or software (Bizer, Heath, and Berners-Lee 2009). This could inevitably provide the granter with an increased drain on their time and resources to ensure that these requirements are met. Furthermore, there may be technological and personnel constraints with regards to accessing, understanding or being creative with the data that is available through the open licenses. As such, it is recognized that those lacking the in-house capabilities, namely smaller organizations and those in the social and third sectors, should endeavor to utilize an OI platform to encourage data-driven SI. Nevertheless, one may note that there is a distinct lack of research into how these processes can take place, to what extent social and third sector organizations can operate such strategies, and what data characteristics are most useful, appropriate and important for those working within these sectors. This gap in research provides the justification for this paper in

performing a preliminary study in this field, aiming at providing a theoretical and practical foundation for academics and professionals within this and surrounding fields.

3. METHODOLOGY

3.1 THE DELPHI METHOD

This paper employs a three-round MDS through which to gather exploratory quantitative data, and understand the practices that should be put in place for non-profit organizations to effectively utilize OD within OSI initiatives. Used widely in innovation research, Delphi Studies (DSs) are detailed as being a method through which themes are analyzed within a certain topic area and expert opinions are converged through a series of rounds to form managerial theories and encourage the development of policies (Hsu and Sandford 2007). Developed by Dalkey & Helmer (1963) at the RAND Corporation in the 1950s, the DS maintains the ability to build a consensus of expert knowledge, constituting an exploratory method for detailing what 'should be' rather than what 'could be' (Miller, 2006). Cuhls (2003) also notes that this particular method is used widely in innovation research both in industry and academia due to its ability to develop 'best practice' through a series of theoretical and practical consensuses or agreements among industry and academic experts. Furthermore, a DS can alleviate some biases in polling opinions (e.g. noise, dominant individuals, group pressure), as each participant remains anonymous to each other and to the researcher (Dalkey, Brown, and Cochran 1969). Delbecq et al. (1975) detail that the DS is primarily used for understanding any number of five key objectives:

1. To determine or develop a range of possible program alternatives;

2. To explore or expose underlying assumptions or information leading to different judgments;

3. To seek out information that may generate a consensus on the part of the respondent group;

4. To correlate informed judgments on a topic spanning a wide range of disciplines, and;

5. To educate the respondent group as to the diverse and interrelated aspects of the topic.

Hsu & Sandford (2007) state that the DS can be formed utilizing a sequence of 'rounds' each with their own purpose that provides the root for the subsequent round. For instance, a DS may study a particular series of topics by their appropriateness, then their usefulness in the second round, and importance in the final round. Each of the consensuses that are formed across the three rounds can be analyzed and converged to understand which topics have valid and reliable consensuses of opinion among the expert group of participants, and across the three different points of analysis. Through these rounds, Graham (2003) also adds that items, topics or variables may be dropped or added into each subsequent round, constituting an iterative process where the researcher learns from the data of the previous round. The design of the method employed within this paper is modified from Hsu & Sandford's (2007) four-round design, detailed below:

Round 1: Open-ended based upon themes of the literature

Round 2: Using importance rankings to enrich the data of the first survey

Round 3: Participants may be asked to revise their inputs and produce qualitative data to contextualize their answers

Round 4: Provides a summary of all data and asks the participants to comment on it

3.2 MODIFICATIONS TO THE TRADITIONAL DELPHI STUDY

The structure of the study is based upon the guidelines of the initial four-phase process presented by Hsu & Sandford (2007) so as to ensure that consensuses of agreement are created in line with appropriate DS practice. Even so, some operational modifications are conducted for the reduction of a number of methodological biases and limitations that may emerge from operating a DS. Firstly, the number of rounds within this study was limited to three, due to implications of participant attrition that occurs as a result of an increased number of rounds (Mullen 2003), and furthermore, the possibility for combining Round 3 and 4 to shorten the overall procedure, reducing participant attrition rates further still. Supporting this decision, Brooks (1978) notes that three rounds are usually enough to develop and validate a series of consensuses. Secondly, those variables that do not reach a minimum of 60% (weak) and 70% (strong) (Green 1982) agreement among participants were discarded from the subsequent rounds, and other variables were introduced into subsequent rounds according to the qualitative responses of the participants (Graham 2003). For example, a participant mentioned that 'Education' was a Data Theme that required analysis, and so was added into the following survey to be analyzed. The reduction of the variables across the rounds is in order to focus the degree of analysis on the remaining valid variables that attained the minimum 60% agreement threshold. Additionally, consensus data from the previous round was provided at the end of the subsequent survey so as to avoid the potential 'social pressure' biases detailed by Zolingen & Klaassen (2003). The above design techniques within this method enabled the researcher to examine the longitudinal reliability of consensuses, performing consensus change analyses on opinions of experts.

3.3 SAMPLE SIZE AND RECRUITMENT

In order to develop a series of consensuses based upon a number of different variables, a moderate sample of 23 expert participants were selected and recruited to participate in the study

MDS Round	*Sample Frame*	*Sample Size*	*Sampling Method*
1	276	23	Purposive
2	61	13	Panel
3	27	10	Panel

Table 1. MDS Sample Frame, Size and Method

in the first round. A purposive sampling method was used in round 1 to recruit only those participants who fit the necessary participant criteria of having researched or worked in OI, SI, OD or Innovation Networking for a minimum of 3 years. The participants were invited based upon either their attendance to the World Open Innovation Conference (WOIC) 2014 and/or their authorship in a peer-reviewed journal through searches of "Open Innovation", "Social Innovation", "Open Data", and "Innovation Networking" in large journal databases, namely EBSCOhost, Emerald and Web of Science. This presented a sample frame of participants whom were invited to the study (*Table 1*). Not all invitees met the minimum participant criteria and thus were discarded from the dataset, leaving 23 participants. Rounds 2 and 3 used a panel sampling method to ensure that only those that responded to the previous survey were invited to participate in the subsequent rounds of the MDS. The sample frame in rounds 2 and 3 constitutes all participants whom responded to the survey invite, but may not necessarily have responded to the questions. It was conducted this way as all participants remained anonymous and thus it was not possible to determine who had responded and who had not. Nevertheless, a series of questioning was used to cross-reference each participant's demography i.e. years of working or researching in aforementioned sectors, and their country of residence.

A moderate sample is utilized as a series of strict exclusion criteria is administered to increase the quality of the data, ensuring that only those with a perceived expert opinion can participate in the study. In support of this decision, Delbecq et al. (1975) note that a small sample

of ten-to-fifteen participants is often sufficient for a valid study, and the majority of research studies utilizing this method tend to have between fifteen and twenty participants. As an MDS is a method through which only experts within a particular subject area are able to participate, there is little empirical evidence regarding the increase in reliability and validity in large samples (Murphy et al. 1998). Even with a moderate sample, an increasingly heterogeneous set of experts within a respective topic area can significantly increase the studies' validity and the wider application of the studies' results (Delbecq, Ven, and Gustafson 1975; Rowe and Wright 1999). Thus, an appropriate expert panel of researchers, practitioners and users are recruited for the study, as is shown in *Figure 1*.

3.4 PARTICIPANT DEMOGRAPHY

All participants who were selected qualified as experts for the study. This is because they had a minimum of 3 years experience in any of the respective fields of OI, SI, OD and/or Innovation Networking (*Figure 1*). A minimum of 3 years experience was chosen as it is the minimum length of a doctoral study in established educational institutions, and depicts the incubation period for the majority of start-ups (Phillips 2002), which represented the researchers and practitioners respectively. Akin to the expectations of a DS, participants represented a wide array of years experience in their respective fields and a number of different representative countries, roles and sectors within various academic and professional organizations were collected (*See Figure 2 and 3*). In *Figure 2* the majority of participants tended to attribute themselves to a non-specific sector or one that was not identified, namely 'Other'. This is because many of the participants (the academics) may be reviewing OSI from a theoretical perspective rather than from an industrial perspective, researching the general opportunities and challenges associated with its adoption. Additionally, there was a wide spread of countries that were represented in the data as shown in *Figure 3,* broadening the scope of the study. However,

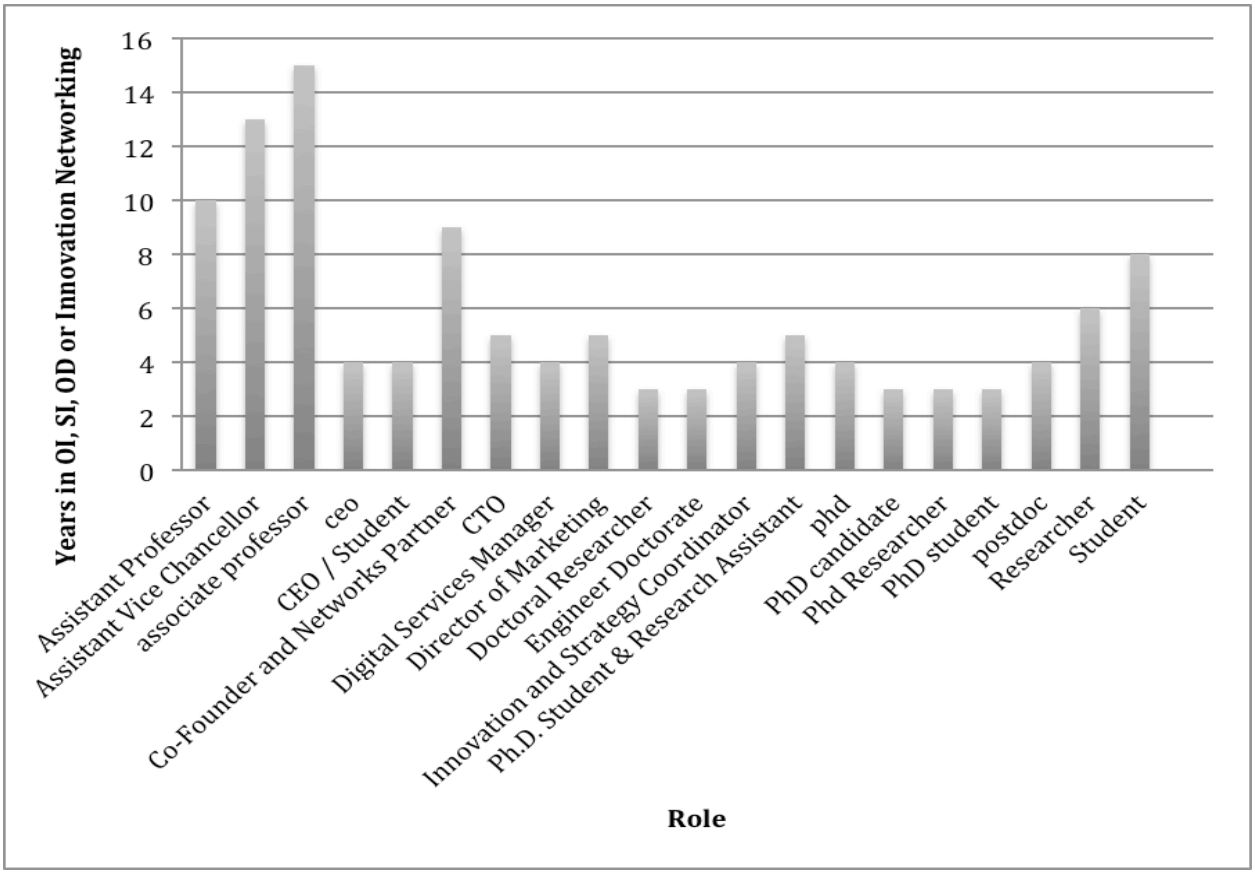

Figure 1. Years of Experience Among Participants

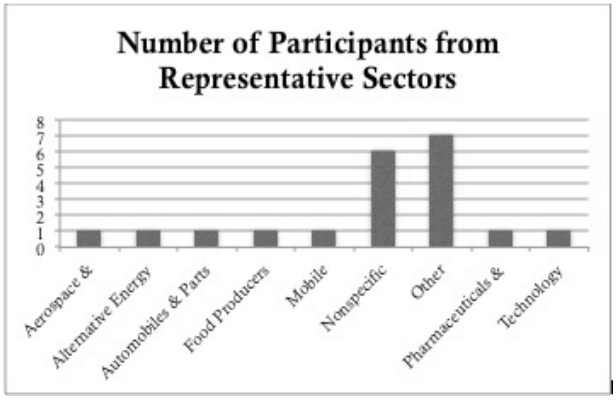

Figure 2. Participants By Sector

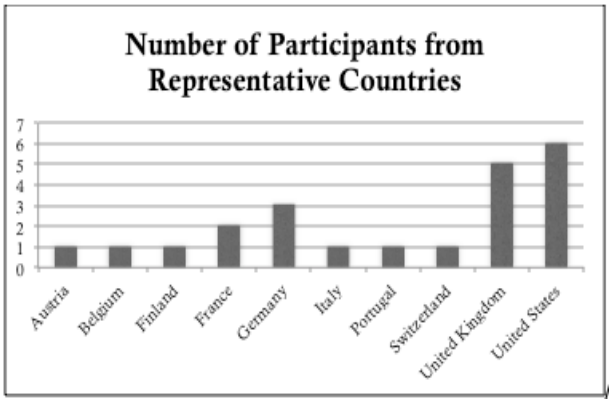

Figure 3. Participants By Country

it is notable that the majority of the participants were from either UK or the United States of America (USA). This was due to the fact that the surveys and communications were written in English and thus may have made it difficult for others outside of English-speaking countries to

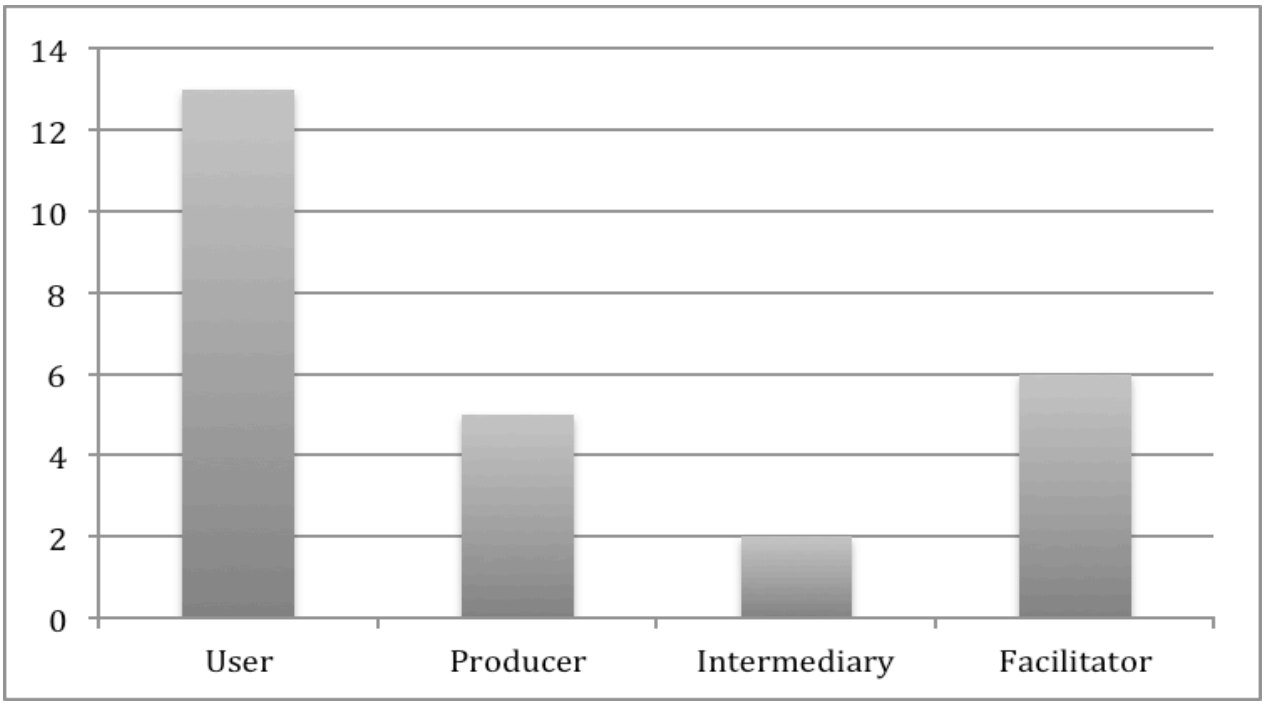

Figure 4. Participant Interactions with OD

participate wholly. This may indeed present a limitation in the data, in that the surveys were only written in English, and may have discouraged others to refrain from responding to the surveys upon viewing the language. Nevertheless, such a study can be repeated in an alternative language to gain insight into different respective cultural and social contexts.

The participants within each of the surveys were either OD users, producers, intermediaries or facilitators, shown in *Figure 4*. The participants of the surveys were able to 'tick all that apply' for the question relating to the above data, as they may have multiple roles when interacting with OD. This was deemed as an important demographic question as it detailed whether the experts had a solid understanding of what OD was prior to giving their opinion on the subject in relation to OSI. OD in this study is constituted as any data that is freely available to use, republish, and apply without copyright or patent restriction. This definition of OD runs in parallel to the literature reviewed in section 2.2.

3.5 METHOD

The three rounds were completed with the following round objectives: 1) creation of consensuses, 2) retesting of consensuses and rankings of importance of remaining variables, and 3) confirmation of variable value in the field, with qualitative contexts and longitudinal analyses to determine the theoretical contexts and the consensus change over time respectively. The MDS consisted of 23 panel members in the first round, 13 in the second and 10 in the third, each having varying levels of expertise (3 to 15 years) working or researching in the fields of OI, OD, SI or Innovation Networking. This fit the quota of participants required for validity in being at either 10 or above participants for study validity (Delbecq, Ven, and Gustafson 1975). The variables were tested from numerous perspectives, namely appropriateness, usefulness, agreement, and importance where applicable, with a particular focus maintained on one perspective in each survey round.

Each variable was tested utilizing five-point Likert scale judgments of the aforementioned points of analysis. For example, importance criteria options were tested on a scale as follows: 1.'Not Important', 2.'Of little Importance', 3.'Moderately Important', 4.'Important', and 5.'Very Important'. Five-point Likert scales were used in order to collect the degree and strength of agreement among participants. Only those responses that responded with point 4 or 5 were considered as contributing to the consensus of agreement in favor. This avoided including those participants' answers that were either uncertain of their position (point 3) or disagreed with the statements (points 1 and 2 ('strongly disagree' and 'disagree')). Of those that received points 4 and 5, only those variables that achieved a minimum of 60% agreement (the weak threshold) amongst the sample of participants were retested in the subsequent round through an alternative point of analysis. This enabled the study to reduce the number of variables, focusing on those that were perceived as being important, useful and appropriate. This

method ensured that the variables were tested, retested and confirmed for validity and reliability purposes across the sample of participants.

3.6 DATA FILTRATION

Variables were filtered according to the following criteria, which reduced the variables in each round (57>43>28>16). The first data filtering method used was to determine the level of expertise amongst participants. This was completed by gathering data regarding the years of experience that each participant had with regards to the fields in question, namely OI, SI, OD and Innovation Networking. If any participants answer with below the minimum 3 years threshold, the respondent data was not utilized to form the consensuses and they were not invited to the subsequent rounds of the study. Secondly, a 60% weak consensus threshold was introduced as part of the method to enable the researcher to filter out any variables that did not reach this predetermined consensus criteria. A strong threshold was introduced at 70% agreement (Green 1982). The above two data filtering methods reduced both the variables and participants in the study leaving only qualified data in the first round. Throughout each of the subsequent rounds a consensus change data filtration method was introduced. This resulted in any consensus change over ±15% being considered unreliable (Scheibe and Skutsch 1975) and as such was retested in the subsequent rounds to better determine the contexts for this consensus change. Finally, blank and knowledge-lacking (e.g. “Not Used”) responses were also discarded from the dataset, as they produced no valid additions to the data. Further details regarding the data filtration methods can be viewed in *Table 2*.

4. FINDINGS

This paper identified a number of key variables with regards to OD that achieved a high and reliable consensus. This section shows the findings from the MDS, dividing them into their respective variable categories.

4.1 OD in OSI

OD was tested with regards to their overall application into OSI practices, focusing on three primary variables, namely: innovation process, social impact, and market appropriability. The innovation process represents the ability for the data to provide a resource for innovation development during the ideation stage of OSI, the social impact constitutes the data type as being a resource to positively affect the social impact of an innovation, and the market appropriability of an innovation is the ability for a resulting innovation to more closely appropriate market needs. In round 1 OD was tested with regards to the frequency that such data resources have on the respective variable (innovation process, social impact, market appropriability). This resulted in high consensuses of agreement in all three variables (91.67% for innovation process, 92.86% for social impact, and 84.62% for market appropriability) (*See Table 3*). This indicated that the experts thought that OD could frequently impact OSI, and thus constituted a key area for further analysis.

In accordance with the high consensuses, the data was retested in round 2 on an importance Likert-scale, obtaining rankings in terms of how important it is for an OI ideation initiative to utilize such data. In this particular analysis, all consensuses dropped significantly by a minimum of 22.44% (*Table 4*), presenting the finding that data is not wholly important to utilize in order to affect the three variables. Furthermore, although data was perceived as having a high likelihood to have a positive impact on OSI, it was only regarded as being marginally

Data Filtration Criteria	*Changes to Validity*
Minimum 3 years experience.	Reduced sample size, but ensured that only experts were recruited.
60% Minimum Variable Threshold	Only valid consensuses were retested.
±15% Maximum Consensus Change Between Rounds	Only reliable consensuses were retested.
Not using data that does not provide any insight into a question.	Reduced the lack of expert knowledge in the consensuses. Data anomalies do not then skew the creation of consensuses.
Not using data that is left blank.	Only valid data is left in the dataset and consensuses were based upon actual responses.

Table 2. Data Filtration Criteria

important. This may be due to the idea that "there should always be a balance for using data and other sources" (Participant ID: 1310254) or that "innovation … implies the use of many informations to meet the needs of the users" (Participant ID: 1334415). In addition, "data can inform the overall process" (Participant ID: 1306091), stating that such data is perceivably important. In alignment with these assertions, 3/3 of the variables in this section of the study remained above the 60% weak threshold, and as such were tested in the third round. In the final round of the MDS the data was tested from a third perspective, namely the degree of usefulness that each respective data type has with regards to each variable. The results showed that 2/3 of the remaining variables had reached the minimum weak threshold, whereby OD were deemed as being useful to encourage social impact of an innovation (88.89%), and was deemed as somewhat useful for application within an innovation development process (66.67%). Nevertheless, the results show that OD is not deemed as useful for determining and leveraging an innovation's market appropriability.

OD in OSI	*Frequency (% Point ≥4)*	*Importance (% Point ≥4)*	*Usefulness (% Point≥4)*
Innovation Process	*91.67*	*69.23*	*66.67*
Social Impact	*92.86*	*61.54*	*88.89*
Market Appropriability	*84.62*	*61.54*	*55.56*

Table 3. OD in OSI

OD in OSI	*Consensus Change (1/2)*	*Consensus Change (2/3)*	*Mean Consensus Change*
Innovation Process	-22.44%	-2.56%	-12.50%
Social Impact	-31.32%	27.35%	-1.99%
Market Appropriability	-23.08%	-5.98%	-14.53%

Table 4. OD in OSI Consensus Stability

This section of the study also determined that each consensus change between rounds 1 and 2 were larger than the ±15% threshold previously prescribed, and thus represented a potentially unreliable set of consensuses. However, each variable was retested as they still remained above the 60% weak threshold, and retesting would enable the researcher to examine whether this was a data anomaly. As a result, the mean consensus change ((consensus change 1/2 + consensus change 2/3) ÷ 2) in each of the variables was below the ±15% threshold and so constituted reliable consensuses. As has been identified in the Government of Canada (GoC), use of OD in social innovation practices can indeed boost social impact of the innovation produced, and enable innovators to take inspiration from such data.

4.2 Data Formats

This analysis studied OD as a whole, as defined in section 3.4, and as such overarching conclusions of OD can provide insight into the applications of OD in this context. It was first identified that both data formats, textual/qualitative and numerical/statistical, returned

consensuses above the weak threshold of 60%, with 5/6 of the rounds returning above the strong threshold of 70%. This determined that experts perceived both qualitative and statistical data as appropriate (78.57%, 64.29%), important (91.67%, 83.33%), and also having a high agreement with the consensuses (87.5%, 87.5%) (*Table 5*) respectively.

The Textual/Qualitative data format represented a more reliable consensus, constituting a consensus change of 13.1% between rounds 1 and 2, and -4.17% between round 2 and 3 (*Table 6*). This equated to a mean consensus change of 4.47% depicting a highly reliable consensus. In alignment with these results, data that is qualitative and or textual can provide technological and market-orientated contexts to the innovation being produced. For instance, OpenIdeo utilize qualitative feedback from social networks and within the OI platform to constitute an understanding of the surrounding market for that particular innovation. Thus, it is understood by both the data retrieved from the MDS and case examples that OD should provide textual and qualitative elements in order to enrich any quantitative data. Unexpectedly, Numerical/Statistical data formats were perceived as being less appropriate to OI ideation (64.29%). However, it was still regarded as highly important (83.33%) and receiving a high consensus of agreement (87.5%) (*Table 5*). This variable returned a consensus change above the ±15% threshold between rounds 1 and 2 (19.05%), with a consensus change lower than the threshold between rounds 2 and 3 (4.17%).

This equated to a mean consensus change of 11.61% (*Table 6*), which still remains within the aforementioned consensus change threshold, but depicts a higher variation than that of the data retrieved based upon the Textual/Qualitative variable. Even so, both types of data dimension were perceived as "important for many innovation problems" (Participant ID: 1334415). Furthermore, "mixed methods give a more holistic picture of the situation" (Participant ID:

Data Theme	*Appropriateness (% Point ≥4)*	*Importance (% Point ≥4)*	*Consensus Agreement (% Point ≥4)*
Textual/ Qualitative	*78.57%*	*91.67%*	*87.50%*
Numerical/ Statistical	*64.29%*	*83.33%*	*87.50%*

Table 5. Formats of data for OSI

Data Format	*Consensus Change (1/2)*	*Consensus Change (2/3)*	*Mean Consensus Change*
Textual/ Qualitative	*13.10%*	*-4.17%*	*4.47%*
Numerical/ Statistical	*19.05%*	*4.17%*	*11.61%*

Table 6. Formats of Data for OSI Consensus Stability

1306091). Through combining the consensus data with the qualitative comments, it was identified that both data types were both quantitatively and qualitatively important to include in any dataset when operating an OSI ideation initiative. As such we see both formats of data being applied in a number of OSI initiatives such as Bretagne Creative and MoviLab, constituting a requirement for both data formats in producing feasible and implementable innovations.

4.3 Data Dimensions

Data dimensions were examined with regards to their application into OSI ideation scenarios, with Geospatial and Temporal/Time-Based data dimensions being the primary variables being analyzed. Geospatial data represented a high appropriateness (71.43%), but no consensus at round 2 of the analysis (58.33%) (*Table 7*). This presented Geospatial data as perceivably appropriate to OSI ideation, but not important to include in OSI initiatives. Nevertheless, this may be dependent upon the particular initiative. For example, Open Street Maps requires geospatial data to present its information to its users.

Data Dimension	*Appropriateness (% Point ≥4)*	*Importance (% Point ≥4)*	*Consensus Agreement (% Point ≥4)*
Geospatial	*71.43%*	*58.33%*	*N/A*
Temporal/ Time-Based	*64.29%*	*75.00%*	*87.50%*

Table 7. Dimensions of Data for OSI

Data Dimension	*Consensus Change (1/2)*	*Consensus Change (2/3)*	*Mean Consensus Change*
Geospatial	*-13.10%*	*N/A*	*N/A*
Temporal/Time-Based	*10.71%*	*12.50%*	*11.61%*

Table 8. Dimensions of Data for OSI Consensus Stability

Even so, in line with the requirements of the MDS, this variable was discarded from the series of questioning in round 3. On the other hand, Temporal/Time-Based data was perceived by the experts as being somewhat appropriate (64.29%), highly important (75%) and receiving a high agreement consensus (87.5%) (*Table 7*). Furthermore qualitative comments obtained from the study presented the understanding that "social perceptions can change rapidly, so data needs to show that" (Participant ID: 1306091) and that the "temporal dimension is necessary to perceive evolutions" (Participant ID: 1334415). However, with regards to these assertions it was noted that: "all collected data must be up-to-date to avoid inventing the wheel again" (Participant ID: 1310254), solidifying the necessity for temporal data to be collected for ideation in OSI. In accordance, the Temporal/Time-Based data dimension represented a reliable consensus through both sets of consensus change analyses, returning consensus changes of 10.71% and 12.5% respectively (*Table 8*). This also returned a mean consensus change of 11.61%, within the ±15% threshold. Even with these results one may note that certain organizations such as Ushahidi,

require an open dataset of combined geospatial and temporal data in order to develop their platform.

4.4 Data Themes

An analysis of data themes was also conducted in order to understand which particular data themes are optimum to utilize to tackle social challenges in an OSI ideation scenario. Out of the data themes only two variables returned with valid and reliable consensuses, namely Economical and Societal. It was perceived that "these [themes] are strongly complementary" (Participant ID: 1334415) and they are the "main themes that are useful for OSI" (Participant ID: 1306091). In accordance with the comments, the Economical variable was somewhat useful (69.23%), highly important (72.73%) and returned a high degree of consensus agreement from the panel of experts (87.5%) (*Table 9*).

Furthermore, this variable received a low change in consensus between rounds 1 and 2 (3.5%) and rounds 2 and 3 (14.77%) pertaining to a reliable consensus (*Table 10*). In confirmation of this, the mean consensus change fell within the ±15% threshold (9.14%). Similarly, the Societal variable returned a high degree of usefulness (84.62%), a high degree of importance (75%) and maintained a strong consensus of agreement among the experts (87.5%) (*Table 9*). This particular variable remained in accordance with the thresholds of consensus change with rounds 1 and 2, and rounds 2 and 3 being at a low consensus change: -9.62% and 12.5% respectively (*Table 10*). This totaled a mean consensus change of 1.44%, depicting a marginal change in overall consensus agreements throughout each of the rounds of the MDS.

13 other variables within this section of the study returned a low consensus that did not achieve the minimum consensus criteria of 60% at round 1. Upholding the data filtration methods noted prior, such variables were discarded from further testing and retesting. It may be

Data Theme	*Usefulness (% Point ≥4)*	*Importance (% Point ≥4)*	*Consensus Agreement (% Point ≥4)*
Economical	*69.23*	*72.73*	*87.50*
Societal	*84.62*	*75.00*	*87.50*

Table 9. Data Themes for OSI

Data Theme	*Consensus Change (1/2)*	*Consensus Change (2/3)*	*Mean Consensus Change*
Economical	*3.50%*	*14.77%*	*9.14%*
Societal	*-9.62%*	*12.50%*	*1.44%*

Table 10. Data Themes for OSI Consensus Stability

noted that these particular variables, Economical and Societal, can provide insight into the positioning of an innovation within such a marketplace or societal context. They also provide an idea of how such an innovation will be received within these particular contexts. This is indeed worthy during the production of social innovations. As we see with One Community, societal and social contexts of the particular challenge presented are central to how the innovations are produced to provide sustainable village prototypes. Lacking Societal and Economical data within this example may undermine the feasibility of the innovation ideas and prototypes.

4.5 Data Values

A final analysis of the data values of OD were conducted in order to gain insight into the particular values that a respective dataset must have in order to be applicable to an OSI ideation initiative. Round 1 of this section of analysis resulted in a tentative set of results that are arguably not representative of the opinions of the experts. This was due to a certain level ambiguity in the terminology, noted by some participants within the study. Therefore, retesting of this data, with definitions of the terminology, was conducted to test whether the data is reliable by comparing the round 2 results with that generated by round 1. As a result of this retest it was evident that the data collected in round 1 is not valid, lacking appropriate depiction of the experts' opinions. In

further analysis, those that fell below the 60% threshold in round 1, but maintain a minimum of 60% consensus in round 2 are thus retested in round 3 of the study.

For example, Relevance returned consensuses of 58.33%, 91.67% and 77.78%, maintaining a strong consensus in both round 2 and round 3, but returning no consensus from round 1 (*Table 11*). This appears as being due to the lack of definition of such terminology in round 1. In this section of the study, 6 variables maintained a high level of consensus over the 60% weak threshold, with 3 variables being consistently above the 70% strong consensus threshold. These were Accessibility (91.67%, 83.33%, 88.89%), Believability/Credibility (100%, 83.33%, 88.89%) and Consistency (75%, 81.82%, 77.78%) (*Table 11*). The variables also developed reliable consensuses across the 3 rounds with Accessibility returning a mean consensus change of -1.39% (consensus changes of -8.34% and 5.56%), Believability/Credibility being at -5.56% (consensus changes of -16.67% and 5.5.6%) and Consistency being at 1.39% (consensus changes of 6.82% and -4.04%) (*Table 12*). These results show the relative importance of the 3 aforementioned values, even with the terminology discrepancy detailed previously. This indicates the relative impact on data-driven OSI ideation should these values not be included.

5. DISCUSSION

This paper recognizes that there are a series of challenges associated with the use and application of OD: OD is not necessarily widely available, not easy to produce, not every organization has the necessary skills to leverage it, and not every constituent dataset is of use to specified complex social challenges (Janssen, Charalabidis, and Zuiderwijk 2012). Furthermore, it is not to be assumed that innovators within an OSI are capable of accessing, interpreting and analyzing the data for social benefit, particular skillsets are required in order to utilize the OD effectively; data analysis, data interpretation, and data application to name a few. If such

Dataset Value	*Importance (% Point ≥4)*	*Importance (% Point ≥4)*	*Consensus Agreement (% Point≥4)*
Accessibility	*91.67*	*83.33*	*88.89%*
Believability/ Credibility	*100.00*	*83.33*	*88.89%*
Completeness	*58.33*	*33.33*	*N/A*
Consistency	*75.00*	*81.82*	*77.78%*
Ease of Manipulation	*83.33*	*41.67*	*55.56%*
Format Interoperability	*75.00*	*58.33*	*N/A*
Interpretability	*83.33*	*41.67*	*88.89%*
Objectivity	*75.00*	*58.33*	*N/A*
Relevance	*58.33*	*91.67*	*77.78%*
Reputation/ Provenance	*41.67*	*75.00*	*88.89%*
Security	*83.33*	*50.00*	*N/A*
Timeliness	*50.00*	*83.33*	*55.56%*
Understandability	*66.67*	*83.33*	*88.89%*
Volume/Amount	*54.55*	*25.00*	*N/A*

Table 11. Data Values for OI

Dataset Value	*Consensus Change (1/2)*	*Consensus Change (2/3)*	*Mean Consensus Change*
Accessibility	*-8.34%*	*5.56%*	*-1.39%*
Believability/ Credibility	*-16.67%*	*5.56%*	*-5.56%*
Completeness	*-25.00%*	*N/A*	*N/A*
Consistency	*6.82%*	*-4.04%*	*1.39%*
Ease of Manipulation	*-41.66%*	*13.89%*	*-13.89%*
Format Interoperability	*-16.67%*	*N/A*	*N/A*
Interpretability	*-41.66%*	*47.22%*	*2.78%*
Objectivity	*-16.67%*	*N/A*	*N/A*
Relevance	*33.34%*	*-13.89%*	*9.73%*
Reputation/ Provenance	*33.33%*	*13.89%*	*23.61%*
Security	*-33.33%*	*N/A*	*N/A*
Timeliness	*33.33%*	*-27.77%*	*2.78%*

Table 12. Data Values for OSI Consensus Stability

particular skills are lacking within an innovation team, then this indeed may have negative implications for the respective innovation output. Thus, it may be notable that an OSI paradigm aiming to utilize such datasets would require data science roles to be leveraged from the external or internal environment, in order to provide data-driven contexts for other innovators within the ideation scenario. Additionally, it may be noted that what is perceived to be true by experts may not necessarily be evident for innovators when put into practice, as such further studies are required in this field to gain insight into this perspective and compare such results. Even so, there is a recent drive to develop innovations to tackle social and societal challenges, and thus a justification is provided for further research in this field to understand how to develop higher quality data-driven social innovations. From this, we can have a more holistic understanding of how ideation scenarios can be more effectively utilized, with opportune personnel and data.

6. CONCLUSIONS

This paper examines the value of OD usage in OSI from a number of varying perspectives to support the underpinning question of whether gathering such data is valuable and beneficial to OSI ideation scenarios, their innovators and their management professionals. At this stage it is derived that experts perceive OD as being a valuable asset of the OSI process, through providing a resource that frequently impacts the Innovation Process, frequently supports the development of more Socially Impactful and Market Appropriable innovations. Furthermore, through analyzing the data values, Accessibility retained one of the highest and most reliable consensuses throughout the 3 rounds, and as such this value is attributed widely to OD. Moreover, it is derived that it is an important asset to have in all practices of the ideation scenario. In this section of the study, it is found that data requires a number of key values in order for it to useful and appropriate for an OSI ideation initiative: Credibility, Consistency,

Interpretability, Relevant, have high Provenance, and be easy to Understand by users of the data. The study also uncovers that it is a resource that is understood to provide valuable Societal and Economical contexts that are important reference points to have as part of the OSI ideation scenario. Qualitative/Textual data was thought to be the most prominent data format/dimension that OD can provide due to its intrinsic properties of being able to provide contexts of current markets, the potential social impacts of a respective innovation, and other social contexts surrounding the social challenge. Meanwhile Temporal and Statistical data were both perceived as less appropriate to an ideation scenario, but nevertheless highly important if one were to utilize it as a resource. The study enables management professionals operating OSI ideation initiatives to check collected datasets against the given opportune criteria, in order to deem its representative value. Furthermore, innovators can utilize these variables to more quickly differentiate perceivably inadequate datasets against those that would be useful within that particular OSI initiative. For academia, a basis of theory in this field is formed; enabling subsequent research to examine the value of OD to innovators and test the practical usage of the resource in an experimental study aligned with standard OSI practices. In conclusion, the results in this study depict OD as a valuable and important, but challenging resource to use when developing social innovations in an OSI ideation scenario.

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