Formulating Open Data-Based Value Propositions
An Evaluation and Comparison of Two Canvas Tools

Clarinval, Antoine; Simonofski, Anthony; Castiaux, Annick; Gao, Yingying; Janssen, Marijn

DOI
10.1145/3598469.3598506

Publication date
2023

Document Version
Final published version

Published in
Proceedings of the 24th Annual International Conference on Digital Government Research - Together in the Unstable World

Citation (APA)
Clarinval, A., Simonofski, A., Castiaux, A., Gao, Y., & Janssen, M. (2023). Formulating Open Data-Based Value Propositions: An Evaluation and Comparison of Two Canvas Tools. In D. D. Cid (Ed.), *Proceedings of the 24th Annual International Conference on Digital Government Research - Together in the Unstable World: Digital Government and Solidarity, DGO 2023* (pp. 327-337). (ACM International Conference Proceeding Series). Association for Computing Machinery (ACM). https://doi.org/10.1145/3598469.3598506

Important note
To cite this publication, please use the final published version (if applicable).
Please check the document version above.

Formulating Open Data-Based Value Propositions: An Evaluation and Comparison of Two Canvas Tools

Antoine Clarinval
antoine.clarinval@unamur.be
University of Namur, NaDI
Namur, Belgium

Anthony Simonofski
anthony.simonofski@unamur.be
University of Namur, NaDI
Namur, Belgium

Annick Castiaux
annick.castiaux@unamur.be
University of Namur, NaDI
Namur, Belgium

Yingying Gao
lostandbuff@163.com
Huazhong University of Science and Technology
Wuhan, China

Marijn Janssen
M.F.W.H.A.Janssen@tudelft.nl
TU Delft, Faculty of Technology, Policy and Management
Delft, The Netherlands

ABSTRACT

The publication of Open Government Data (OGD) is expected to deliver economic value creation through innovation. In any OGD-based value creation, it is essential to formulate a value proposition (VP). However, previous literature has devoted little attention to the tools that support the formulation of OGD-based VP, and none has evaluated the performance of such tools with OGD infomediaries. In this article, we evaluate and compare the Business Model Canvas (BMC) and the Open Data Canvas (ODC) performance in supporting the formulation of VP. Questionnaire feedback was obtained from infomediaries who formulated OGD-based VP using the BMC and the ODC. The results show a superiority of either the BMC or the ODC in terms of perceived usefulness, depending on the focus of the feasibility evaluation of the VP. The ODC provides OGD-specific guidance on evaluating technical feasibility while the BMC covers economic feasibility more extensively. We recommend investigating the emerging field of OGD-based VP formulation tools by replicating our research with other types of infomediaries, in other settings, and completing it with qualitative insights.

CCS CONCEPTS

• **Applied computing** → **E-government**.

KEYWORDS

Open Government Data, Value proposition, Feasibility evaluation, Business Model Canvas, Open Data Canvas

ACM Reference Format:
Antoine Clarinval, Anthony Simonofski, Annick Castiaux, Yingying Gao, and Marijn Janssen. 2023. Formulating Open Data-Based Value Propositions: An Evaluation and Comparison of Two Canvas Tools. In *24th Annual International Conference on Digital Government Research - Together in the unstable world: Digital government and solidarity (DGO 2023), July 11–14, 2023, Gdańsk, Poland.* ACM, New York, NY, USA, 11 pages. https://doi.org/10.1145/3598469.3598506

DGO 2023, July 11–14, 2023, Gdańsk, Poland

ACM ISBN 979-8-4007-0837-4/23/07…$15.00
https://doi.org/10.1145/3598469.3598506

1 INTRODUCTION

Open Government Data (OGD) is interoperable data published on the Internet by public organizations to be freely used and redistributed by anyone [4]. OGD is heralded for the creation of value through the development of innovative services. This is well emphasized in the EU Open Data Directive, which starts its general provisions with "promote the use of open data and stimulate innovation in products and services" and states that the re-use of OGD by enterprises is a success factor for this legislation (Directive (EU) 2019/1024). However, the use of OGD remains low in practice due to a variety of reasons [6, 37, 41, 49, 61], including a lack of tools supporting interested infomediaries (i.e., intermediate consumers of data who facilitate the consumption of raw data by transforming it in a more usable form for others [62]) in creating value [15].

For value to be captured, it is necessary to formulate a specific value proposition (VP) [59] and to evaluate its economic and technical feasibility [1, 2]. Several tools, usually in the form of a canvas, support the formulation of VP and the evaluation of their feasibility. However, few papers focus on the tools that support infomediaries in formulating VP based on OGD and none has evaluated the performance of VP formulation tools with OGD infomediaries. We aim to address this research gap by conducting an evaluation comparing two VP formulation tools: the Business Model Canvas (BMC) and the Open Data Canvas (ODC). Practitioners have traditionally used the BMC to formulate VP [43] but it does not totally correspond to the specificities of the OGD context. The ODC was developed specifically to support OGD infomediaries attempting to create value [23], but it is very recent and has yet to be refined and extensively tested for usefulness.

We have collected questionnaire feedback from OGD infomediaries who used both the BMC and the ODC to formulate a VP and evaluate its feasibility. The results show a superiority of either the BMC or the ODC in terms of perceived usefulness, depending on the focus of the feasibility evaluation of the VP. The ODC provides OGD-specific guidance on evaluating technical feasibility while the BMC covers economic feasibility more extensively.

This paper is structured as follows. First, we present related literature on OGD-based value creation and VP formulation tools.

Second, we explain how we collected data in two academic courses settings through a questionnaire. Third, we present the findings of the questionnaire. Fourth, we expose the implications of the findings, their limitations, and future research leads. We then close the article with a summary of its findings and implications.

2 RELATED WORK

2.1 Value Creation Based on Open Government Data

The publication of OGD is expected to deliver public and economic value [36, 59]. This is one of the main motivations for publishing OGD reported in the literature. In an analysis of the open data strategies of five countries, Huijboom and Van den Broek [27] reported that product and service innovation is one of the three main motivations for releasing OGD. Welle Donker et al. [17] identified that the most important motivations of National Mapping and Cadastral Agencies, besides complying with legislation, are the creation of economic growth and social benefits. This is also stated in the EU Open Data Directive, which considers the re-use of OGD by enterprises as a success factor for OGD publication efforts (Directive (EU) 2019/1024).

However, the creation of value based on OGD implies the development of an innovative product or service, as OGD has no value in itself [3]. In practice, this process involves a minimum of three actors [10] represented in Figure 1. OGD made available by publishers is used by infomediaries, who act as "intermediate consumers of data such as builders of apps and data wranglers" [62], and the products or services thus developed are used by final users, who benefit from OGD through the use of these products or services.

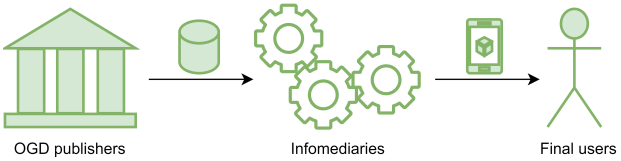

Figure 1: Actors present in an OGD ecosystem. OGD is made available in raw format by publishers and infomediaries transform the raw data into a product or service that benefits final users.

For value to be captured from this process, it is necessary to formulate a specific VP [59]. Indeed, in their framework describing open data business model analysis, Ferro and Osella [19] mention that the VP is the intermediary layer between processed open data and the capture of economic value from open data.

Previous works have identified numerous types of VP. These are often referred to as business model archetypes, each describing one approach through which value can be captured from open data. For example, Magalhaes et al. [38] distinguish three archetypes. *Enablers* provide customers with services that are mainly based on OGD. *Integrators* take advantage of OGD to improve their internal processes such as decision-making. *Facilitators* support the exchange of data between the publishing institutions and the infomediaries. Janssen and Zuiderwijk [29] listed six business model archetypes for infomediaries working with open data. *Single-purpose apps* provide information-based services that have one purpose (e.g., weather, transportation). *Interactive apps* allow users to add content themselves. *Information aggregators* combine and process several open data sources to present them to users. *Comparison models* aggregate data from several providers to compare the performance of several entities. *Open data repositories* make government data available to users and reusers. *Service platforms* offer features such as filtering and visualization to support working with open data. Other archetypes are presented in [20, 25, 59]. Once a VP is formulated, it should be assessed in terms of feasibility. The feasibility evaluation of a business model should encompass economic (i.e., possibility of capturing value) and technical (i.e., possibility of implementing the value proposition) feasibility at minimal [1], but can include other aspects such as legal and organizational feasibility [2]. Several tools, usually in the form of a canvas, have been developed to support the formulation of a VP as well as the evaluation of its feasibility.

2.2 Value Proposition Formulation Tools

The Business Model Canvas (BMC) is defined as a "visual modeling method that is used to capture the business model of a company" [22]. A business model "describes the rationale of how an organization creates, delivers and captures value" [43]. At the center of a business model lies the VP, which consists of the products and services destined to deliver the value that customers seek. VP is represented at the center of the BMC (Figure 2). At the right of the canvas, the customer segments, that is, the customers who receive the value, are noted. Between the VP and the customer segments, the channels and customer relationships indicate how the customers are connected to the company and how the VP is delivered to them. On the other side of the canvas, the network of partners and key assets (i.e., resources) needed to deliver the VP are noted, as well as the activities that the company must perform to deliver the intended value. Financial aspects are addressed in the lower part of the BMC, with the costs on the left and the revenue streams on the right.

Figure 2: The Business Model Canvas.

The BMC is designed to be able to represent any type of business model [43] and can be used as an analysis, discussion support, or creativity support tool [11, 56]. Through its nine cells, the BMC can

also support economic, technical, and organizational feasibility evaluation [39]. Although there is currently a lack of knowledge of why the BMC is so widely adopted [30], its genericity, allowing it to accommodate business models from many different areas, is probably an important factor. As a result, the BMC enjoys great popularity in the literature on open data and business models [13, 32] and stands as the gold standard for formulating value propositions [50]. For example, it has been used to identify the elements needed for conducting business based on open data [28], to illustrate archetypes of business models based on open data [19, 20], and to describe specific VP centered on open data [18, 24, 60].

However, the genericity of the BMC can be a limitation as well. For example, the Lean Canvas was created because the BMC was found to be too general [42]. Another limitation of the BMC is that it fails to capture some aspects [50] because it is focused solely on economic value and as such does not capture other types of value [11]. The traditional response to this limitation is the creation of variants based on the BMC. For example, the Creative Business Model Canvas [9] and the Triple-Layered Business Model Canvas [31] were developed based on the BMC to capture symbolic and social/environmental value, respectively. The creation of value from OGD is a specific process [15] and the social value is an important expectation from OGD. Therefore, the two limitations of the BMC exposed in the previous lines may hamper its use to formulate VP based on OGD.

The Open Data Canvas (ODC) was created to address these limitations. The ODC is based on the BMC, but customized to take the idiosyncratic nature of OGD into account [23]. Like the BMC, the ODC is centered around the VP (Figure 3). On the rightmost side, partners refer to stakeholders helping to process OGD, data users are those who benefit from the OGD-based VP, channels indicate how the VP is delivered to data users, and costs refer to the financial and non-financial expenses induced by the OGD reuse. On the leftmost side, data providers make the OGD available, activities refer to the actions performed on OGD such as data processing, infomediaries extract, aggregate, and transform data, and resources are the material, non-material, and human assets needed to realize the VP. At the bottom of the canvas, the private benefits refer to the financial and non-financial benefits gained by the company that delivers the VP and the infomediaries. Lastly, the public values refer to the public values (e.g., transparency, participation) that the VP helps achieving. A key difference between the ODC and the BMC is that the ODC is focused on technical feasibility. The partners, activities, and resources cells relate to technical feasibility aspects, i.e., working with data, whereas they cover both technical and organizational feasibility in the BMC [39]. As a result, the guidance provided in the cell descriptions of the BMC are broader than those of the ODC and give less specific information. Also, the ODC misses the customer relationships cell that is present in the BMC and needed to conduct an economic feasibility assessment [39]. Thus, the ODC provides more support for assessing technical feasibility but less for economic feasibility.

Previous literature has devoted little attention to the tools supporting the formulation of OGD-based VP, and there has not been an evaluation of the performance of tools for that purpose. While the BMC has the inconvenience of being too general but has proven

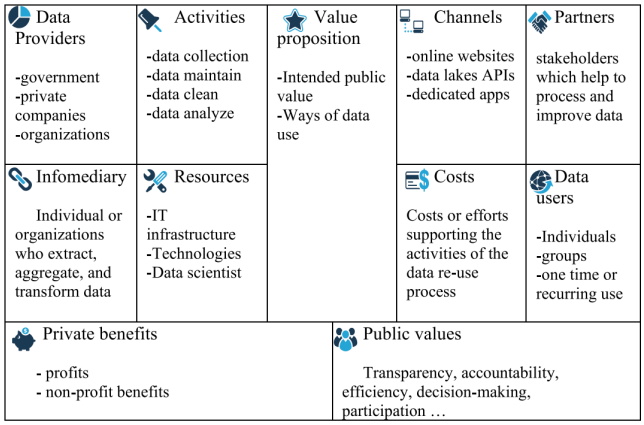

Figure 3: The Open Data Canvas (reproduced from [23]).

to be useful [8, 50], the ODC has the advantage of being specifically tailored to formulating VP based on OGD but, being a recent research contribution, still lacks thorough evaluation. The complementarity of strengths and weaknesses of these two models motivates the choice of comparing how both perform.

2.3 Evaluation of Value Proposition Formulation Tools

Although not in an OGD context, several authors have conducted evaluations of tools supporting the formulation of VP.

Teixeira and Pereira [48] have studied former entrepreneurship students' perceived usefulness of multiple business planning tools. Fritscher and Pigneur [21] compared the perceived performance of paper-based and computer-aided BMC design. They measured, among others, the perceived usefulness, perceived ease of use, and task outcome. Türko [52] compared the BMC and the Business Plan on several aspects, including perceived usefulness, perceived ease of use, and performance on specific business planning tasks. It was done by means of a questionnaire distributed to students who had used both tools in the context of two separate courses. Lima and Baudier [35] studied the acceptance of the BMC among entrepreneurship students. They found that three factors significantly influence the behavioral intention to use the BMC, namely the performance expectancy (related to perceived usefulness [54]), the effort expectancy (related to perceived ease of use [54]), and the hedonic motivation (defined as the enjoyment of use [7]). John and Szopinski [30] researched how the visual presentation of the BMC affects the behavioral intention of using it. They relied, among others, on the Technology Acceptance Model (TAM) [16] to design their research model, and as such included the perceived usefulness. Reijers et al. [46] created the Ethics Canvas, a tool inspired by the BMC used to represent and discuss the ethical impacts of a product or a service. The authors assessed the perceived usefulness of the Ethics Canvas by means of a questionnaire distributed to students after they had used the canvas in a class project. Turetken et al. [51] introduced a novel business planning tool, the Service-Dominant Business Model Radar, which is structured around the co-created value of a service. The authors relied on the TAM to measure the

perceived usefulness of their tool. Baldassarre et al. [5] introduced a novel tool for formalizing sustainable business models. The authors grounded their research design in the TAM and evaluated the perceived usefulness of the tool.

These previous works mostly implement the same approach to evaluate tools. By means of a questionnaire, they measure the perceived usefulness and, in some instances, other constructs, including perceived ease of use. Regarding the data collection setting, evaluations with students are common. In order to evaluate the BMC and the ODC in this article, we follow this established line of research and proceed alike.

3 RESEARCH METHODOLOGY

3.1 Data Collection Setting

We collect data on the performance of the BMC and the ODC by issuing a questionnaire to students participating in two university courses. Both courses are elective and followed by students enrolled in computer science or management studies for the larger part. First, in the **Data Analytics** course (DA), students are asked to design and implement an innovative product or service based on OGD. This course has an important technical part as students are expected to deliver a functional prototype of the product or service they envision. Since the assignment involves implementation, they are expected to put a strong emphasis on the evaluation of the technical feasibility of their VP, and a lesser emphasis on the economic feasibility. The VP formulation and the implementation are the two outcomes of the assignment. Second, in the **Entrepreneurship and Business Development** course (EBD), students are required to identify a business opportunity that involves OGD. Students focus solely on the business aspects and are not required to implement the product or service they envision. Due to the entrepreneurship focus of the course, they are expected to put a strong emphasis on the economic feasibility evaluation of their VP, but a lesser emphasis on technical feasibility. As such, they were expected to detail some parts of the business plan described by Teixeira and Pereira [48], in particular external and risk analyses of their VP. The VP formulation is the sole expected outcome of the assignment. All students participating in DA and EBD had to formulate their VP using the BMC and the ODC. The assignment guidelines were left voluntarily open to avoid limiting students to few business model archetypes.

Instead of grouping all students into one sample, we evaluate and compare the performance of the BMC and the ODC for these two courses as they present key differences. Our goal is to determine whether the BMC and the ODC (1) perform satisfactorily and (2) perform better than the other in supporting an OGD-based VP formulation focused more on technical (i.e., the DA course) or economic (i.e., the EBD course) feasibility. Given the differences between the two courses and the BMC and ODC, we expect that the performance of these tools may differ across the courses. We refer to students from the DA course as the DA group and to those from the EBD course as the EBD group in the rest of this article.

3.2 Data Collection Instrument

As discussed in Section 2, the evaluation of the performance of VP formulation tools, and in particular the BMC, is commonly grounded in the TAM. Therefore, we measured performance by asking questions on the perceived usefulness and the perceived ease of use of the tools. The perceived usefulness is measured with 4 statements adapted from [51], which were adapted from the TAM [16]. The second and third statements are reverse-coded. The perceived ease of use is measured for the canvases overall and for each of their cells separately.

Hartson and Pyla [26] indicate that existing questionnaires can be adapted by adding questions specific to the research objective, which is commonly done in research based on TAM. Therefore, domain-specific questions were added as well. Obviously, the questionnaire starts by asking students the course in which they are enrolled. Teixeira and Pereira [48] identified that academic background can influence the perceived usefulness of business planning tools. Therefore, a question asks respondents to indicate their enrolled studies. John and Szopinski [30] explain that the beliefs formed by users after seeing the BMC for the first time act as anchors influencing future beliefs and intention of use. Hence, respondents are asked about their experience with the BMC prior to the course project. Questions comparing the BMC and the ODC are taken from a questionnaire comparing the BMC and the Business Plan designed by Turkö [52] after removing the questions focusing on aspects not covered extensively enough in DA or EBD. Two of these questions ask respondents to compare the ODC and the BMC in terms of usefulness and appropriateness of the cells, thus relating to perceived usefulness. Two others ask a comparison on ease of use and clarity, thus referring to perceived ease of use. Another question asks respondents which tool they liked using the most. The full questionnaire can be consulted in the supplementary material[1].

3.3 Data Analysis

The analysis of the collected data was performed by reporting distributions and means as well as conducting statistical hypothesis testing. Following the research objective, both the comparison between the tools and their individual performance were evaluated. Table 1 summarizes which tests were used and for what objective.

The comparison between the ODC and the BMC was studied in four ways. First, by comparing the EBD group and the DA group using the Mann-Whitney U test [40]. This test was applied to each of the four statements related to perceived usefulness and to the statement measuring overall ease of use, for both the ODC and the BMC. Second, by comparing the answers from the EBD group and the DA group to the five comparison questions. The Mann-Whitney U test was applied as well. Third, by comparing the tools according to the answers given to the four statements related to perceived usefulness and to the statement measuring overall ease of use. The Wilcoxon signed rank test [57] was used for this purpose. The EBD and DA groups were considered separately. Fourth, by computing the Wilcoxon signed rank test to compare the observed median to the theoretical value of 3, for the five comparison statements. A significant result (i.e., significant p-value) indicates that the median is significantly different than 3, and that the respondents express a significant preference for one tool over the other. Then, the orientation of the distribution indicates which tool receives the preference.

[1] Available online at https://doi.org/10.5281/zenodo.7555963

A non-significant result indicates that the respondents express no significant preference.

The individual performance of the ODC and the BMC was studied by considering the EBD group and the DA group separately. For each statement related to perceived usefulness and for the statement measuring overall ease of use, the Wilcoxon signed rank test compared the observed median to the theoretical value of 3, indicating a neutral performance (i.e., neither positive nor negative). A non-significant result indicates an observed median not significantly different than 3, which is interpreted as no significantly positive nor negative performance. Otherwise, a significant result indicates that the median significantly differs from 3, and that the performance of the considered tool is either positive or negative, depending on the orientation of the distribution. For instance, a significant result with a distribution leaning more toward an agreement to the statement indicates that the performance of the tool positive regarding the statement (the interpretation is reversed for reverse coded statements).

4 RESULTS

In total, 18 students completed the questionnaire for the DA course and 21 for the EBD course.

4.1 Background and Previous Experience with the BMC

The majority of the students are enrolled in management studies. This represents 19 (90%) and 10 (56%) of students from the EBD and DA group, respectively. Among the remaining students, 2 from the DA group are enrolled in mathematics studies, and the rest (2 from the EBD group and 6 from the DA) study computer science. Among the EBD group, 18 respondents (86%) reported that hey have a previous experience with the BMC. On average, they rated their experience at 3.1 on a scale from 1 (no experience at all) to 5 (very experienced). As for the DA group, 11 (61%) have a previous experience with the BMC. DA respondents rated their experience with the BMC at 2.4 on average. While this suggests that respondents from the EBD group have more experience with the BMC, the Mann-Whitney U test shows that there is no significant difference between the two groups ($p = 0.073$).

4.2 Perceived Usefulness

The perceived usefulness of the BMC and the ODC was measured by four 5-point Likert items. Cronbach's alpha [14] is slightly below the commonly accepted 0.7 threshold and its computation is questionable due to low sample size and eigenvalues [58]. Therefore, the items cannot be aggregated into a single measure and must be analyzed separately.

When asked whether the ODC provides an **effective solution** to the problem of formulating a VP from open data (Figure 4), 14 (67%) of the EBD students and 15 (83%) of the DA students agreed. When asked about the BMC, 19 (90%) of the EBD and 10 (56%) of the DA agreed. The Mann-Whitney U test showed no significant difference across the two groups for the BMC ($p = 0.069$) nor the ODC ($p = 0.183$). The Wilcoxon tests show no significant preference for a tool, neither for the EBD group ($p = 0.090$) nor the DA ($p = 0.071$). The tests indicate that the observed medians significantly differ from 3 for both tools across both groups, thus meaning that the EBD and the DA groups found that the ODC and BMC achieved positive performance. The p-values are shown in Figure 4.

When asked whether VP formulated using the ODC would be **difficult to understand** for users (Figure 5), 9 (43%) of the EBD students and 14 (78%) of the DA students disagreed. When asked about the BMC, 16 (76%) of the EBD and 13 (72%) of the DA disagreed. The Mann-Whitney U test showed a significant difference across the two groups for the ODC ($p = 0.022$) but not for the BMC ($p = 0.900$), which indicates that EBD students find that VP using the ODC would be significantly more difficult to understand than DA students. The Wilcoxon tests show a significant preference of the EBD group for the BMC ($p = 0.021$), but the DA group has no preference ($p = 0.739$). The tests indicate that both groups find the BMC performance positive, but the ODC performance is found positive only by the DA group.

When asked whether using the ODC would make it **harder to communicate** the VP to others (Figure 6), 14 (67%) of the EBD students and 16 (89%) of the DA students disagreed. When asked about the BMC, 17 (81%) of the EBD and 11 (61%) of the DA disagreed. The Mann-Whitney U test showed no significant difference across the two groups for the ODC ($p = 0.100$) nor the BMC ($p = 0.165$). The Wilcoxon tests show no significant preference for a tool, neither for the EBD group ($p = 0.070$) nor the DA ($p = 0.057$). The tests indicate that the observed medians significantly differ from 3 for both tools across both groups, thus meaning that the EBD and the DA groups found that the ODC and BMC achieved positive performance.

When asked whether they found the ODC overall useful in their project (Figure 7), 11 (52%) of the EBD students and 12 (67%) of the DA disagreed. When asked about the BMC, 19 (90%) of the EBD and 9 (50%) of the DA agreed. The Mann-Whitney U test showed a significant difference across the two groups for the BMC ($p = 0.011$), but not for the ODC ($p = 0.477$), which indicates that EBD students find that the BMC was significantly more useful in their project than DA students. The Wilcoxon tests show a significant preference of the EBD group for the BMC ($p = 0.018$) but the DA group has no preference ($p = 0.130$). The tests indicate that both groups find the ODC performance positive, but the BMC performance is found positive only by the EBD group.

As for the comparison questions, regarding usefulness (Figure 8), 29% of the respondents from the EBD group expressed a preference for the ODC, while 61% from the DA group did so. On the contrary, 71% from the EBD group rated the BMC as more useful than the ODC, while only 6% of the DA group did. The Mann-Whitney U test shows that the difference between the two groups is significant ($p = 0.000$). The Wilcoxon tests show that the preference of the EBD group for the BMC ($p = 0.038$) and that of the DA group for the ODC ($p = 0.004$) are both significant.

Regarding the adequacy of the cells (Figure 8), 24% (resp. 78%) of respondents from the EBD (resp. DA) group preferred the ODC, while 66% (resp. 0%) from the EBD (resp. DA) group found the cells from the BMC more adequate. The Mann-Whitney U test shows that the difference between the two groups is significant ($p = 0.000$). The Wilcoxon tests show that the preference of the DA group for the ODC ($p = 0.001$) is significant, but the EBD group has no significant preference ($p = 0.085$).

Table 1: Statistical tests performed for data analysis.

Research question	Objective	Test performed
For the four statements related to perceived usefulness and the statement related to the overall perceived ease of use		
For the ODC/BMC, is there a significant difference between the EBD and DA groups?	Comparison of tools	Mann-Whitney U
For the EBD/DA group, is there a significant difference between the ODC/BMC?	Comparison of tools	Wilcoxon signed rank
For the EBD/DA group and the ODC/BMC, is the performance significantly positive or negative?	Standalone performance evaluation	Wilcoxon signed rank
For the five comparison questions		
For the ODC/BMC, is there a significant difference between the EBD and DA groups?	Comparison of tools	Mann-Whitney U
For the EBD/DA group, is there a significant preference for the ODC/BMC over the other tool?	Comparison of tools	Wilcoxon signed rank

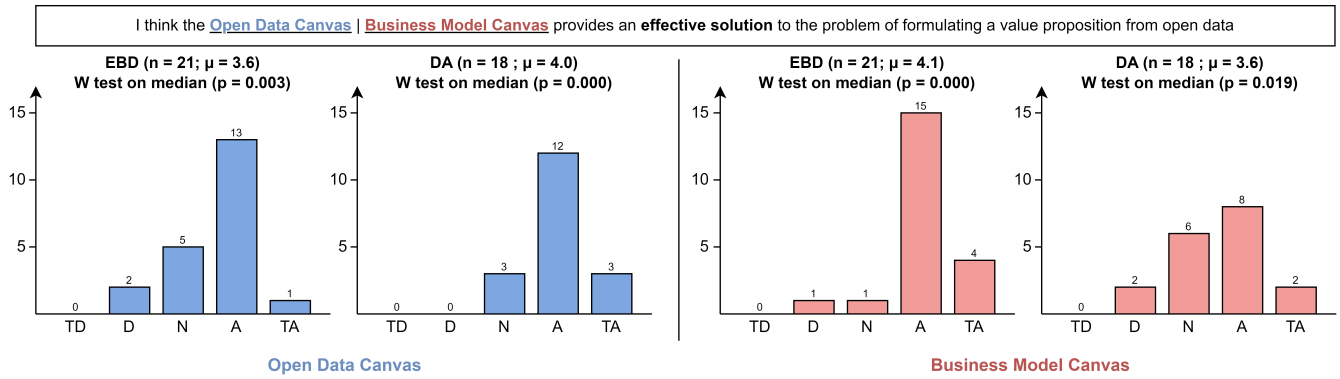

Figure 4: Distribution of the answers to the question related to the efficiency of the ODC and the BMC.

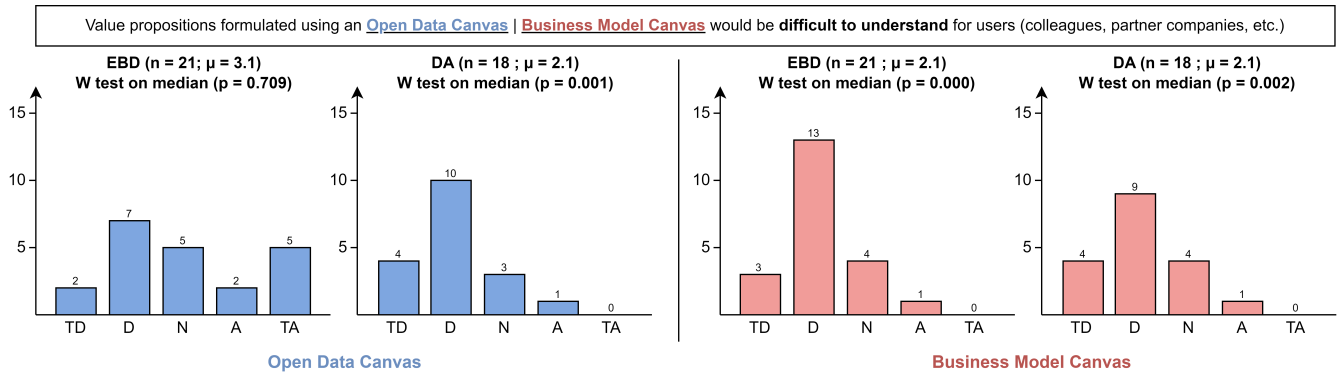

Figure 5: Distribution of the answers to the question related to the understanding of VP formulated with the ODC and the BMC.

4.3 Perceived Ease of Use

38% of the respondents from the EBD group reported that they found the ODC difficult to use overall, while no respondent from the DA group gave such a rating (Figure 9). Respondents from the EBD group found the ODC significantly more difficult to use than those from the DA group (p = 0.000). The Wilcoxon test shows that the overall ease of use does not significantly differ from 3 for the EBD group (p = 0.782), indicating that this group does not find the ODC difficult to use, but not easy either. However, the test indicates a good performance of the ODC according to the DA group (p = 0.000). The difference between the two groups also appears clearly at the level of cells. Several cells were found significantly more difficult to complete by respondents from the EBD group, namely data users (p = 0.002), channels (p = 0.002), costs (p = 0.026), VP

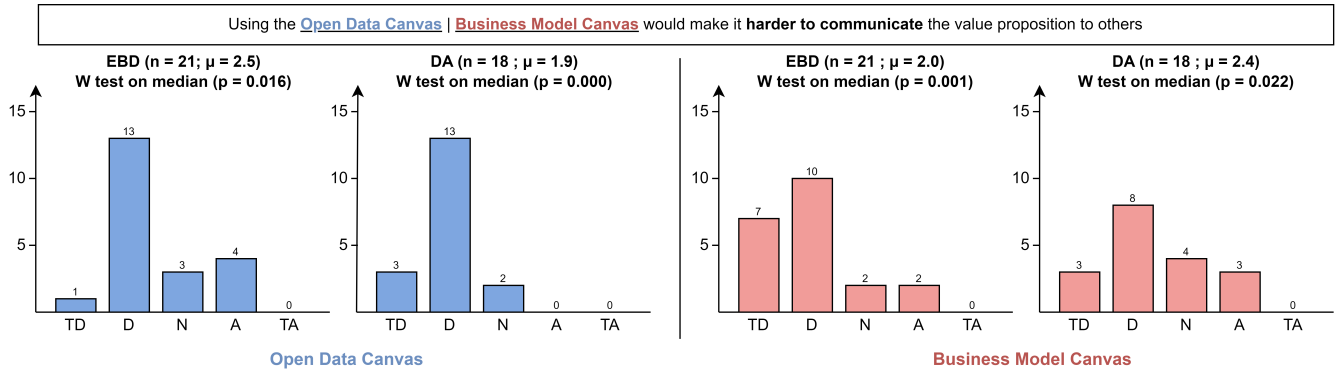

Figure 6: Distribution of the answers to the question related to the communication of VP formulated with the ODC and the BMC.

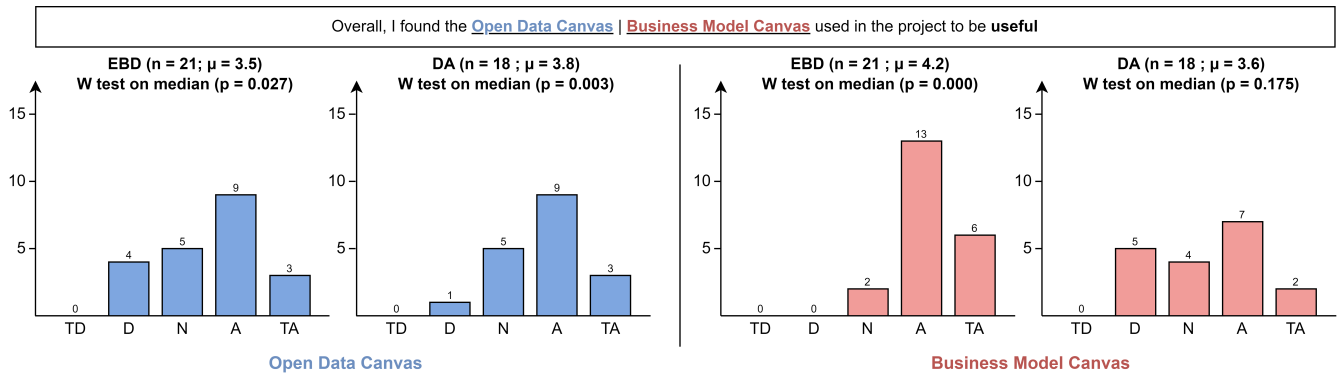

Figure 7: Distribution of the answers to the question related to the overall usefulness of the ODC and the BMC.

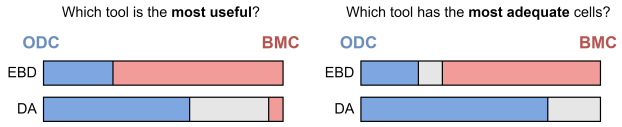

Figure 8: Comparison of the usefulness and adequacy of cells of the ODC and the BMC.

(p = 0.000), activities (p = 0.049), resources (p = 0.043), and data providers (p = 0.001). For the EBD group, the most difficult cells to complete are the costs (found difficult by 67%), the VP (62%), and the infomediary (57%). As for the DA group, the most difficult cells are the infomediary (44%), the private benefits (39%), the costs (28%), and the partners (28%).

The BMC was found difficult to use by 6% of respondents from the DA group and none from the EBD group (Figure 10). The Wilcoxon test shows that both the EBD group (p = 0.000) and the DA group (p = 0.002) report a significantly positive performance of the BMC regarding its overall ease of use. Notable difficulties are observed with the revenue streams (found difficult to complete by 38% of the EBD group), the cost structure (33% of the EBD group), the key activities (22% of the DA group), and the key partners (22% of the DA group). There is no significant difference in the perceived use of the BMC across the two groups, neither at the overall nor the cell level.

The BMC was found significantly easier to use overall than the ODC by the EBD group (p = 0.002), but no difference was observed for the DA group. Also, although it cannot be statistically measured at the cell level because the cells differ across the tools, it appears clearly that while the perceived ease of use of the ODC and the BMC is similar for the DA group, the BMC is found much easier to use by the EBD group, which is in line with the scores observed for the tools overall.

10% of the respondents from the EBD group expressed that the ODC is easier to use than the BMC, 85% found the BMC easier, and the remaining 5% found both equally easy (Figure 11). The opinion is more mixed in the DA group, which nonetheless expressed a preference for the ODC relative to the BMC. Indeed, 44% (resp. 17%) find the ODC (resp. BMC) easier to use, and 39% expressed a neutral opinion. The Mann-Whitney U test shows that the difference between the two groups is significant (p = 0.000). The Wilcoxon test shows that the preference of the EBD group for the BMC over the ODC is significant (p = 0.000), but there is no significant preference for the DA group (p = 0.109).

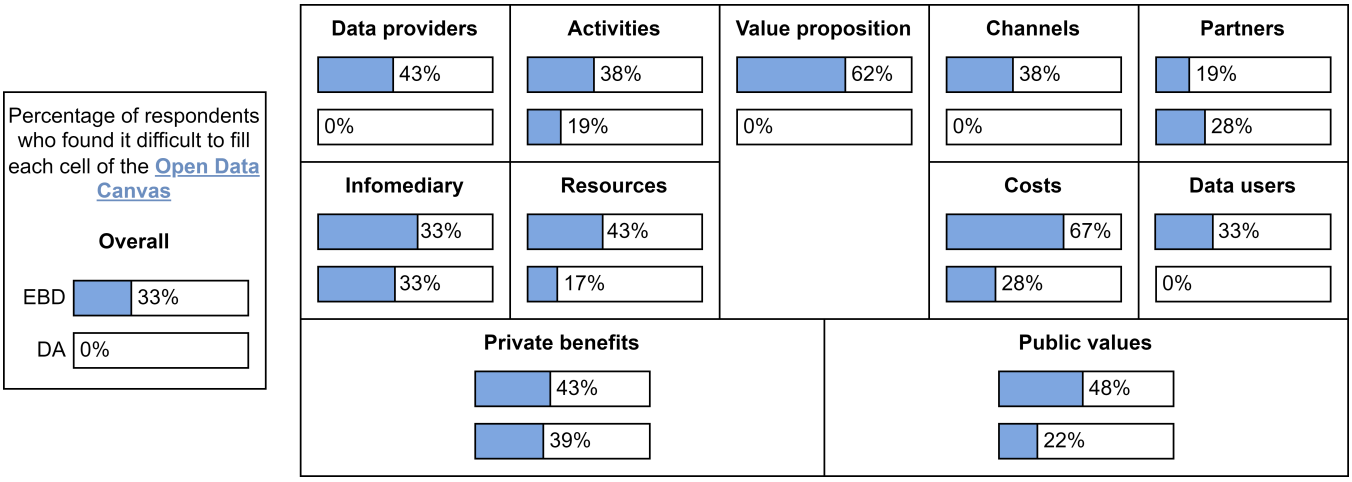

Figure 9: Ease of use of the ODC, reported for the canvas overall and for each cell.

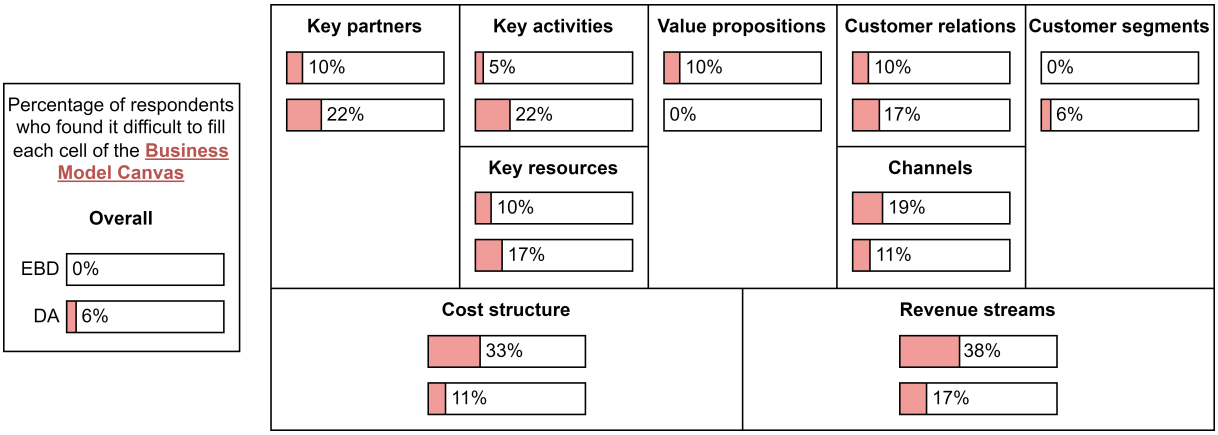

Figure 10: Ease of use of the BMC, reported for the canvas overall and for each cell.

Regarding clarity, similar results are observed (Figure 11). The ODC is found clearer than the BMC by 14% of the EBD group, while 76% reported that they find the BMC clearer and 10% expressed a neutral opinion. In the DA group, 56% (resp. 17%) found the ODC (resp. BMC) clearer and 27% have a neutral opinion. The Mann-Whitney U test shows that the difference between the two groups is significant as well (p = 0.000). The Wilcoxon test shows that the preference of the EBD group for the BMC is significant (p = 0.002), as well as the preference of the ODC for the DA group (p = 0.026).

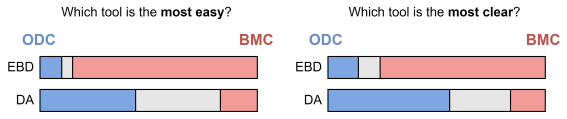

Figure 11: Comparison of the ease of use and clarity of the ODC and the BMC.

4.4 Perceived Enjoyment

14% of the respondents from the EBD group reported that they liked the ODC more than the BMC and 76% preferred the BMC (Figure 12). 10% do not have a preference. As for the DA group, 44% like the ODC more, 24% prefer the BMC, and 44% expressed no preference. The Mann-Whitney U test shows that the difference between the two groups is significant as well (p = 0.001). The Wilcoxon test shows that the preference of the EBD group for the BMC is significant (p = 0.014), but there is no significant preference for the DA group (p = 0.066).

5 DISCUSSION

In this section, we successively discuss the implications of the findings for research and practice, the limitations, and conclude with leads for future research.

5.1 Implications for Research and Practice

This research is the first evaluation of the performance of VP formulation tools that is conducted with infomediaries and in the context

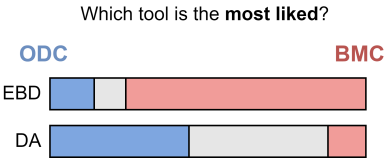

Figure 12: Comparison of the enjoyment of the ODC and the BMC.

Table 2: Summary of the findings.

	EBD course	DA course
Perceived usefulness	Both tools are useful, but the BMC is superior	Both tools are useful, but the ODC is superior
Perceived ease of use	The BMC is easy to use, but the ODC is not	Both tools are easy to use

of OGD. Therefore, it brings novel knowledge on the perceived usefulness and ease of use of such tools, in particular the ODC and the BMC. In this, it also fulfills the call for evaluation of the ODC.

Our results show that the BMC was found superior to the ODC by the EBD group, in terms of both usefulness and ease of use. Nonetheless, the ODC is still considered useful overall, but not to facilitate the understanding of VP by other users. However, it does not achieve satisfactory ease of use. Regarding DA group, the ODC is found superior to the BMC in terms of usefulness but has an equivalent ease of use. Nonetheless, despite the preference for the ODC, the BMC is considered a useful tool. Both tools achieve a good ease of use in the context of the EBD and DA courses. These findings are summarized in Table 2.

The assignment performed by the DA group puts a much stronger emphasis on technical feasibility than economic feasibility evaluation, while the opposite is true for the EBD group. Therefore, it was expected that the DA group would perceive the ODC as more useful since it provides more specific guidelines for the assessment of the technical feasibility of an OGD-based VP. The higher perceived usefulness of the BMC by the EBD group was expected as well, since the BMC covers economic feasibility more extensively than the ODC. These results suggest that OGD practitioners should favor the use of the ODC instead of the standard BMC to formulate VP when technical feasibility evaluation has higher importance than economic feasibility.

As discussed in the background section, the most frequent response to the limitations of the BMC is the creation of a new canvas derived from the BMC. The positive performance and superiority of the ODC for the DA group demonstrates the relevance of a BMC variant specific to OGD. Since only quantitative data was collected, it is not possible to precisely explain the reasons behind the success of the ODC, but its stronger emphasis on technical feasibility and its specific consideration and guidance regarding data-related aspects are likely explaining factors. On the other hand, the limitation of the BMC regarding the capture of social value does not seem to have a substantial impact. The majority of the VP from both groups had a social value but students included it in the VP cell of the BMC together with the economic value.

The results also have implications for the design of the ODC. While it proved to be superior to the BMC in the context of the course more focused on technical feasibility, it showed limitations in both usefulness and ease of use for the course focused on economic feasibility. In order to successfully conduct an economic feasibility evaluation, the ODC could be used in combination with the BMC. However, this approach would be suboptimal due to redundancies between the ODC and the BMC. Instead, we recommend that the ODC is adapted to support economic feasibility evaluation. However, due to the absence of qualitative data, we cannot formulate grounded specific recommendations, but a lead could be to add cells related to the marketability of the VP in the ODC.

5.2 Limitations

One limitation of the research presented in this article is the absence of qualitative data. While the collected data shows interesting findings, qualitative insights would have been useful to give more depth to them [45, 53] and explain the observed numbers. Unfortunately, the timing of the courses prevented the collection of this data. The questionnaire had to be submitted to students at the end of the course projects, which was followed by a 6-week exam period during which students were unavailable to participate in interviews.

The division of the roles of the researchers involved in a study can lead to researcher bias [47]. In this research, two different researchers were in charge of the EBD and the DA courses. Therefore, the BMC and the ODC were presented by a different researcher depending on the course, which may have influenced the students' understanding of the two tools. In order to mitigate this bias, the two researchers presented the tools following a jointly devised protocol. A minimal introduction was given during which students received the templates of the canvases with each cell completed with its definition given in the documents presenting them. Students were then required to read these works (i.e., the BMC is presented in [43] and the ODC in [23]). This ensured that students from both courses were introduced to the canvases the same way.

Another limitation is the generalizability of the findings. The surveyed sample, although meeting the minimal size requirements for group comparison, remains small. Also, the data collection setting consists of academic courses with specific requirements, meaning that the findings could differ had the setting been different. Finally, due to the nature of the courses, all existing business model archetypes are not represented. The business models constructed by the students mostly fall into single-purpose apps (e.g., waste sorting, easy car parking), and some archetypes such as information aggregators and service platforms are not represented at all in our sample. Therefore, the findings on the perceived usefulness and perceived ease of use of the BMC and the ODC are mainly valid for single-purpose app business models.

A fourth limitation is the set-aside of some independent variables. Previous literature indicates that academic background and previous experience may influence the perception of the performance of the ODC and the BMC [30, 48], which is the motivation for their inclusion in the data collection instrument. However, the large majority of respondents from our sample (74%) have a very similar academic background. As for previous experience of the BMC,

results suggest that students from the EBD group have more experience with the BMC than the DA group, but this is not significant. Also, the majority of respondents (74%) have a prior experience with the BMC. Given the sample size and homogeneity, it is not possible to compare respondents according to background and previous experience. However, since no respondent had experienced the ODC while the large majority had done so with the BMC, there is likely an influence of previous experience on the results, as the students may naturally prefer a tool they have already experimented in their cursus.

5.3 Future Research Leads

In addition to the directions stemming from its limitations, this research opens the way toward several valuable avenues.

In the data collection setting, students used the BMC and the ODC as a tool internal to their team. However, in an open data ecosystem that aims to create value, several stakeholders are present, including infomediaries (which was the role undertaken by the students), citizens, and publishers [28]. In such ecosystems, collaboration between different actors is key to success [10, 34, 55]. Therefore, a valuable research avenue would be to study whether the BMC and the ODC are suitable tools to support this collaboration. One of the items measures respondents' opinion regarding the quality of the tools as a way to communicate a VP to others. Our findings show that the BMC and ODC perform similarly (28 and 30 respondents disagree that the BMC and the ODC would make VP communication harder, respectively). Although not significant ($p = 0.100$), our data suggests a preference for the ODC as communication support in the DA course. Pursuing research with a larger sample and qualitative data would allow verifying and explaining the results reported in this article.

While our research identified some pain points of the ODC, it fails at providing an explanation to them as only quantitative data was collected. Students experienced significantly more difficulties with the ODC in the EBD course, and some cells were found especially difficult to complete, including the VP, the costs, the public values, the resources, the private benefits, and the infomediary, the two latter being reported as the most difficult to complete by students who participated in the DA course. Further research could collect qualitative data on the difficulties experienced by users of the ODC to formulate grounded suggestions for refining the canvas' design, as Gao and Janssen [23] recommended.

While this research studied the formulation of VP in the context of two academic courses about entrepreneurship and data analytics, there are other contexts in which infomediaries may use open data to deliver innovative value. A context that would be valuable to study is a social entrepreneurship course. Indeed, as explained earlier in the article, social benefits are an important expectation from OGD, and the opportunities of OGD in contributing to sustainable development have recently been highlighted [12]. Another context is open data hackathons [33, 44] that are characterized by a tight and short timing constraint to formulate and implement a VP. Finally, beyond students, analyzing how professionals formulate VP using OGD would be an interesting avenue as well. Our research could be replicated in these contexts to identify the settings in which the BMC and the ODC bring the most added value.

6 CONCLUSION

This article evaluates the perceived usefulness and the perceived ease of use of value proposition (VP) formulation tools in the context of OGD-based value creation. Two VP formulation tools are considered, namely the generic and long-established Business Model Canvas (BMC) and the OGD-specific recently contributed [23] Open Data Canvas (ODC).

As part of elective academic courses, 39 students formulated a VP based on OGD and completed both the BMC and the ODC. Part of the students conducted a Data Analytics (DA) project requiring them to implement a working product or service delivering their VP, and as such focused more on the technical feasibility of the VP. The other students participated in an Entrepreneurship and Business Development (EBD) project and were not required to implement the VP delivery. The project thus put more emphasis on the economic feasibility of the VP. At the end of the courses, the students completed a questionnaire giving feedback about the perceived usefulness and ease of use of both VP formulation tools. The results show that both the ODC and the BMC are useful for economical and technical feasibility evaluation, but the BMC is superior in the context of an economical feasibility evaluation and the ODC leads for technical feasibility. The BMC is found easy to use, but the ODC does not achieve satisfactory ease of use for an economical feasibility evaluation.

Based on these results, we recommend OGD practitioners use the ODC to formulate VP if they need a stronger emphasis on technical feasibility. We recommend that researchers conduct investigations in the emerging field of OGD-based VP formulation tools by replicating our research in other settings and completing it with qualitative insights to bring more depth to the quantitative findings reported in this article.

ACKNOWLEDGMENTS

The research pertaining to these results received financial aid from the Belgian Science Policy Office according to the agreement of subsidy no. [B2/223/P3/BeCoDigital].

REFERENCES

[1] Vincent Amanor-Boadu. 2003. Assessing the feasibility of business propositions. Available online: https://faculty.kfupm.edu.sa/ri/srehman/projects/CER2280/RI%20projectLiteratureRev/feasibilitybuspropositions.pdf.
[2] Stavros Arvanitis and Leticia Estevez. 2018. Feasibility Analysis and Study. In *The Emerald Handbook of Entrepreneurship in Tourism, Travel and Hospitality*, Mario Sotiriadis (Ed.). Emerald Publishing Limited, 109–129.
[3] Judie Attard, Fabrizio Orlandi, and Sören Auer. 2016. Value creation on open government data. In *Proceedings of the Hawaii International Conference on System Sciences*. IEEE, 2605–2614.
[4] Judie Attard, Fabrizio Orlandi, Simon Scerri, and Sören Auer. 2015. A systematic review of open government data initiatives. *Government Information Quarterly* 32, 4 (2015), 399–418.
[5] Brian Baldassarre, Jan Konietzko, Phil Brown, Giulia Calabretta, Nancy Bocken, Ingo O Karpen, and Erik Jan Hultink. 2020. Addressing the design-implementation gap of sustainable business models by prototyping: A tool for planning and executing small-scale pilots. *Journal of Cleaner Production* 255 (2020), 120295.
[6] Martin Beno, Kathrin Figl, Jürgen Umbrich, and Axel Polleres. 2017. Open data hopes and fears: determining the barriers of open data. In *Proceedings of the Conference for E-Democracy and Open Government*. IEEE, 69–81.
[7] Susan A Brown and Viswanath Venkatesh. 2005. Model of adoption of technology in households: A baseline model test and extension incorporating household life cycle. *MIS Quarterly* 29, 3 (2005), 399–426.
[8] Lukasz Brzeziński, Lukasz Hadas, and Piotr Cyplik. 2021. The Transformation of the Business Model of SMEs due to COVID-19 Pandemic. *European Research Studies* 24, 2B (2021), 915–924.

[9] Michelle Carter and Chris Carter. 2020. The creative business model canvas. *Social Enterprise Journal* 16, 2 (2020), 141–158.

[10] Abiola Paterne Chokki, Anthony Simonofski, Antoine Clarinval, Benoît Frénay, and Benoit Vanderose. 2022. Fostering Interaction between Open Government Data Stakeholders: An Exchange Platform for Citizens, Developers and Publishers. *Proceedings of the International Conference on Electronic Government*, 228—-243.

[11] Bastian Coes. 2014. *Critically assessing the strengths and limitations of the Business Model Canvas.* Master's thesis. University of Twente.

[12] Diego Corrales-Garay, Eva-María Mora-Valentín, and Marta Ortiz-de Urbina-Criado. 2020. Entrepreneurship through open data: An opportunity for sustainable development. *Sustainability* 12, 12 (2020), 5148.

[13] Diego Corrales-Garay, Marta Ortiz-de Urbina-Criado, and Eva-María Mora-Valentín. 2022. Understanding open data business models from innovation and knowledge management perspectives. *Business Process Management Journal* 28, 2 (2022), 532–554.

[14] Lee J Cronbach and Paul E Meehl. 1955. Construct validity in psychological tests. *Psychological Bulletin* 52, 4 (1955), 281.

[15] Jonathan Crusoe, Anthony Simonofski, Antoine Clarinval, and Elisabeth Gebka. 2019. The impact of impediments on open government data use: insights from users. In *Proceedings of the International Conference on Research Challenges in Information Science*. IEEE, 1–12.

[16] Fred D Davis. 1989. Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly* 13, 3 (1989), 319–340.

[17] FM Welle Donker, Joep Crompvoets, and Bastiaan van Loenen. 2017. Adapting National Mapping & Cadastral Agencies business models to open data supply: the survey results.

[18] Amaury Duval and Valérie Brasse. 2014. How to ensure the economic viability of an open data platform. *Procedia Computer Science* 33 (2014), 179–182.

[19] E Ferro and M Osella. 2012. Business models for PSI re-use: A multidimensional framework. In *Proceedings of the Workshop on Using Open Data: Policy Modeling, Citizen Empowerment, Data Journalism Workshop*. European Commission.

[20] Enrico Ferro and Michele Osella. 2013. Eight business model archetypes for PSI re-use. In *Proceedings of the Open data on the Web Workshop*. Google Campus London, 23–24.

[21] Boris Fritscher and Yves Pigneur. 2014. Business model design: An evaluation of paper-based and computer-aided canvases. In *Proceedings International Symposium on Business Modeling and Software Design*. 236–244.

[22] Boris Fritscher and Yves Pigneur. 2014. Visualizing business model evolution with the business model canvas: Concept and tool. In *Proceedings of the Conference on Business Informatics*. IEEE, 151–158.

[23] Yingying Gao and Marijn Janssen. 2022. The Open Data Canvas–Analyzing Value Creation from Open Data. *Digital Government: Research and Practice* 3, 1 (2022), 1–15.

[24] Samy Guesmi. 2014. Open data, big data and crowdsourcing: emergent mobile apps business models. *Communications & Strategies* 96, 4 (2014), 53.

[25] Richard Hammell, Costi Perricos, David Branch, and Harvey Lewis. 2011. Unlocking growth: How open data creates new opportunities for the UK.

[26] Rex Hartson and Pardha S Pyla. 2012. *The UX Book: Process and guidelines for ensuring a quality user experience.* Elsevier.

[27] Noor Huijboom and Tijs Van den Broek. 2011. Open data: an international comparison of strategies. *European journal of ePractice* 12, 1 (2011), 4–16.

[28] Anne Immonen, Marko Palviainen, and Eila Ovaska. 2014. Requirements of an open data based business ecosystem. *IEEE Access* 2 (2014), 88–103.

[29] Marijn Janssen and Anneke Zuiderwijk. 2014. Infomediary business models for connecting open data providers and users. *Social Science Computer Review* 32, 5 (2014), 694–711.

[30] Thomas John and Daniel Szopinski. 2018. Towards explaining the popularity of the business model canvas: a dual coding approach. In *Proceedings of the Multikonferenz Wirtschaftsinformatik*. 1509–1515.

[31] Alexandre Joyce and Raymond L Paquin. 2016. The triple layered business model canvas: A tool to design more sustainable business models. *Journal of Cleaner Production* 135 (2016), 1474–1486.

[32] Fotis Kitsios and Maria Kamariotou. 2019. Open data value network and business models: Opportunities and challenges. In *Proceedings of the Conference on Business Informatics*. IEEE, 296–302.

[33] Fotis Kitsios and Maria Kamariotou. 2022. Digital innovation and entrepreneurship transformation through open data hackathons: Design strategies for successful start-up settings. *International Journal of Information Management* In press (2022), 102472.

[34] Fotis Kitsios, Maria Kamariotou, and Evangelos Grigoroudis. 2021. Digital Entrepreneurship Services Evolution: Analysis of Quadruple and Quintuple Helix Innovation Models for Open Data Ecosystems. *Sustainability* 13, 21 (2021), 12183.

[35] Marcos Lima and Patricia Baudier. 2017. Business model canvas acceptance among French entrepreneurship students: Principles for enhancing innovation artefacts in business education. *Journal of Innovation Economics Management* 23, 2 (2017), 159–183.

[36] Luis Felipe Luna-Reyes, John C Bertot, and Sehl Mellouli. 2014. Open government, open data and digital government. *Government Information Quarterly* 31, 1 (2014), 4–5.

[37] Ruiqu Ma and Patrick TI Lam. 2019. Investigating the barriers faced by stakeholders in open data development: A study on Hong Kong as a "smart city". *Cities* 92 (2019), 36–46.

[38] Gustavo Magalhaes, Catarina Roseira, and Laura Manley. 2014. Business models for open government data. In *Proceedings of the International Conference on Theory and Practice of Electronic Governance*. 365–370.

[39] Tobias Mahl, Christian Köhler, Philipp Collet, Dominik Arnold, Dominik Lins, Bernd Kuhlenkötter, et al. 2022. Dashboard-supported approach for feasibility and benefit analysis of Product-Service System-driven business models. In *Proceedings of NordDesign*. Design Society, 1–12.

[40] Henry B Mann and Donald R Whitney. 1947. On a test of whether one of two random variables is stochastically larger than the other. *The Annals of Mathematical Statistics* 18, 1 (1947), 50–60.

[41] Chris Martin. 2014. Barriers to the open government data agenda: Taking a multi-level perspective. *Policy & Internet* 6, 3 (2014), 217–240.

[42] Ash Maurya. 2022. *Running lean.* O'Reilly Media, Inc.

[43] Alexander Osterwalder and Yves Pigneur. 2010. *Business model generation: a handbook for visionaries, game changers, and challengers.* John Wiley & Sons.

[44] Arie Purwanto, Anneke Zuiderwijk, and Marijn Janssen. 2019. Citizens' motivations for engaging in open data hackathons. In *Proceedings of the International Conference on Electronic Participation*. Springer, 130–141.

[45] Jan Recker. 2013. *Scientific research in information systems: a beginner's guide.* Springer.

[46] Wessel Reijers, Kevin Koidl, David Lewis, Harshvardhan J Pandit, and Bert Gordijn. 2018. Discussing ethical impacts in research and innovation: The ethics canvas. In *Proceedings of the International Conference on Human Choice and Computers*. Springer, 299–313.

[47] Simone Romano, Davide Fucci, Giuseppe Scanniello, Maria Teresa Baldassarre, Burak Turhan, and Natalia Juristo. 2021. On researcher bias in Software Engineering experiments. *Journal of Systems and Software* 182 (2021), 111068.

[48] Aurora AC Teixeira and Isabel Pereira. 2019. The perceived usefulness of the business plan in formal entrepreneurship education: the perspective of alumni entrepreneurs. *Entrepreneurship Education* 2, 3 (2019), 91–133.

[49] Maarja Toots, Keegan Mcbride, Tarmo Kalvet, and Robert Krimmer. 2017. Open data as enabler of public service co-creation: Exploring the drivers and barriers. In *Proceedings of the Conference for E-Democracy and Open Government*. IEEE, 102–112.

[50] Joe Tranquillo, William Kline, and Cory Hixson. 2016. Making sense of canvas tools: Analysis and comparison of popular canvases. In *Proceedings of the Annual Conference & Exposition*. ASEE, 1–15.

[51] Oktay Turetken, Paul Grefen, Rick Gilsing, and O Adali. 2019. Service-dominant business model design for digital innovation in smart mobility. *Business & Information Systems Engineering* 61, 1 (2019), 9–29.

[52] Esra Sena Türko. 2016. Business plan vs business model canvas in entrepreneurship trainings, a comparison of students' perceptions. *Asian Social Science* 12, 10 (2016), 55–62.

[53] Viswanath Venkatesh, Susan A Brown, and Hillol Bala. 2013. Bridging the qualitative-quantitative divide: Guidelines for conducting mixed methods research in information systems. *MIS Quarterly* 37, 1 (2013), 21–54.

[54] Viswanath Venkatesh, Michael G Morris, Gordon B Davis, and Fred D Davis. 2003. User acceptance of information technology: Toward a unified view. *MIS Quarterly* 27, 3 (2003), 425–478.

[55] Nils Walravens, Mathias Van Compernolle, Pieter Colpaert, Peter Mechant, Pieter Ballon, and Erik Mannens. 2016. 'Open Government Data': based Business Models: a market consultation on the relationship with government in the case of mobility and route-planning applications. In *Proceedings of the International Joint Conference on e-Business and Telecommunications*. SCITEPRESS, 64–71.

[56] Michael Wieland and Hans-Georg Fill. 2020. A domain-specific modeling method for supporting the generation of business plans. *Modellierung* (2020).

[57] Robert F Woolson. 2007. Wilcoxon signed-rank test. *Wiley Encyclopedia of Clinical Trials* (2007), 1–3.

[58] Halil Yurdugül. 2008. Minimum sample size for Cronbach's coefficient alpha: a Monte-Carlo study. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi* 35 (2008), 1–9.

[59] Fatemeh Ahmadi Zeleti, Adegboyega Ojo, and Edward Curry. 2016. Exploring the economic value of open government data. *Government Information Quarterly* 33, 3 (2016), 535–551.

[60] Hans-Dieter Zimmermann and Andreja Pucihar. 2015. Open innovation, open data and new business models. In *Interdisciplinary Information and Management Talks*. 449–458.

[61] Anneke Zuiderwijk and Mark de Reuver. 2021. Why open government data initiatives fail to achieve their objectives: categorizing and prioritizing barriers through a global survey. *Transforming Government: People, Process and Policy* 15, 4 (2021), 377–395.

[62] Anneke Zuiderwijk, Marijn Janssen, and Chris Davis. 2014. Innovation with open data: Essential elements of open data ecosystems. *Information Polity* 19, 1-2 (2014), 17–33.