



POLICY BRIEF

Implementation of the digital government public policy in Colombia: Lessons learned from public entities

[version 1; peer review: 2 approved with reservations]

Maribel Puentes-Poloche¹, Alfredo Guzmán Rincón², Favio Cala-Vitery¹

¹Universidad de Bogota Jorge Tadeo Lozano, Bogotá, Bogota, 140196, Colombia

²Corporacion Universitaria de Asturias, Bogotá, Bogota, 110221, Colombia

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Abstract

The digital government policy aims to improve the efficiency, transparency, and quality of the services provided by the state. Research on this policy has been conducted from the perspective of the interaction between the state and each of the actors in society, neglecting the decisive role of public entities in its proper implementation. This policy brief focuses on the Colombian case and aimed to provide evidence to decision-makers and public entities on which variables should intervene to effectively implement the digital government policy. The recommendations given arise from a regression model, which identified that variables of web accessibility and usability, IPV6 adoption, the strategic component of Information and Communications Technology (ICT) use, the use of emerging technologies, transparency, and access to public information should be intervened.


Keywords

digital government, public policy, public entities, policy brief, Colombia

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1. **Diana Teresa Parra-Sánchez** , Centro de Innovación y Productividad InnovaCTIon, Cartagena, Colombia
2. **Giancarlo Vecchi**, Politecnico di Milano, Milano, Italy

Any reports and responses or comments on the article can be found at the end of the article.

Corresponding authors: Maribel Puentes-Poloche (maribel.puentesp@utadeo.edu.co), Alfredo Guzmán Rincón (alfredo.guzman@asturias.edu.co)

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Introduction

The digital government policy is conceptualized as “the use of digital technologies as an integral part of government modernization strategies to create public value”.¹ The goal of this policy is to improve the efficiency, transparency, and quality of services offered by the State through the public entities that comprise it.^{2–5} There has been a growing interest in the study of this public policy from social actors and the academic community (see Refs. 6–8). Thus, most of the research that has been carried out analyses digital government public policy from the perspective of the interaction between the state and each of the actors in society, especially citizens (G2C), companies (G2B) and the state itself (G2G). In the context of these interactions, there has been a tendency to study which variables explain the implementation of the digital government policy from the perspectives of citizen value perceptions (e.g., Refs. 9, 10) and business owners (e.g., Ref. 11).

This policy brief approaches digital government policy from a perspective centred on the use of technologies, considering both the interaction of the state with society’s actors and the central role of public entities in the implementation of this policy.¹² While previous research has examined governmental actions for the implementation of the digital government policy (e.g., Refs. 13–15), the approach adopted here highlights the importance of understanding the strategies and efforts implemented by public entities to achieve effective implementation of the digital government policy. This allows decision-makers and public entities to have stronger evidence and recommendations on the variables they should intervene in to achieve successful implementation of this policy.

Due to the heterogeneity of digital government policy worldwide, this policy brief is framed within the Colombian public policy. The selection of the country is based on its performance in this policy compared to other OECD countries. According to the OECD (2019), Colombia had a 75% progress in the implementation of this policy, being surpassed only by Korea and the United Kingdom with 76% and 78%, respectively, and surpassing countries such as Denmark, Japan, Canada, Spain, and Israel, as well as the OECD average, which was 50%. Therefore, the study on public entities in Colombia provides feedback on the variables that public entities should intervene to achieve the implementation of the digital government policy, especially in developing countries.

Contextualization of the digital government policy in Colombia

In 2009, the Colombian government enacted the “Gobierno en Línea” (Online Government) as a policy to adopt the use of Information and Communication Technologies (ICTs) in public entities, with the aim of providing efficient services to different interest groups of the state (citizens, businesses, employees, and public entities). Subsequently, Law 1712 of 2014 regulated the application of the online government policy in all sectors.¹⁶ In 2015, “Gobierno en Línea” became the digital government policy through Decree 1078, becoming one of the policies for institutional planning and performance of public entities. Decree 1078 of 2015 regulated the digital government policy, where governance is one of its elements based on the relationship between national and territorial entities, central and decentralized level, under the leadership of the Ministry of Information and Communications Technology.¹⁷ Currently, Decree 767 of 2022 established guidelines articulated with Decree 1263 of 2022, orienting them towards the integration of the digital government policy with digital transformation.

Regarding the evaluation of the implementation of the digital government policy, the state developed the “Formulario Único de Reporte de Avances de la Gestión” (Single Management Progress Report Form – FURAG in Spanish), it consists of 54 questions, of which 27 are single selection (50%). In these questions, entities are asked about their level of progress in the development of documents such as the Information Technology Strategic Plan (PETI in Spanish), the implementation of topics such as privacy and information security, information systems, data analytics, among others. Similarly, of the 20 multiple-choice questions (37%), entities can select one or several options associated with web access or usability, information technology topics such as management performed, PETI content, projects, purchases, IPV6 adoption, use and appropriation, process automation, implementation of emerging technologies, and information contained in the Electronic Headquarters for transparency and access to public information. Finally, the remaining 17 questions (13%) are numerical selection and are associated with amounts of open data, services on the interoperability platform, exchange of information, and the status of IT projects in each entity.

The measurement methodology, as well as its periodicity and other guidelines for the application of FURAG, are carried out by the Administrative Department of Public Function in coordination with the Council for Institutional Management and Performance. The latter is composed of the leading policy entities, including the Ministry of Information and Communication Technologies. In the first measurement, a baseline was established for each entity to report its progress in the implementation and development of the digital government policy. Based on the annual results, a self-diagnosis of strengths and weaknesses is conducted, along with the proposal of an action plan that establishes concrete actions to improve performance in areas where lower scores were obtained.

Finally, the calculation of the level of implementation of the public digital government policy is the result of a polytomous model that describes the probability that an entity i with a performance θ_i responds to an item j in category k or any higher category, compared to responding in a category lower than k . The probability $P_{xj}(\theta_i)$ is calculated using the following formula:

$$P_{xj}(\theta_i) = \frac{1}{(1 + e^{-\alpha_j(\theta_i - \delta_j)})}$$

Where:

- θ_i represents the performance of entity i in relation to the evaluated item or set of items.
- x_j represents the number of categories k for item j , i.e., the number of response options or levels available for that item.
- α_j is the item discrimination parameter, which determines the sensitivity of the item to differentiate between different levels of performance.
- δ_j is the parameter that defines the item difficulty, indicating at what performance level individuals are expected to have a 50% probability of responding in the category or higher.

Methods

To fulfill the objective of the policy brief, which is to provide evidence to decision-makers and public entities on which variables should intervene to effectively implement the digital government policy, a model based on multiple linear regression was proposed using data obtained from the FURAG of the 147 national public entities that make up the executive branch of the State. The multiple linear regression model is mathematically defined as:

$$y = b_0 + b_1 \times x_1 + b_2 \times x_2 + b_3 \times x_3 + \dots + b_k \times x_k + u$$

In the case of the policy brief, the dependent variable (y) was the level of implementation of the digital government policy, which is evaluated on a scale of 0 to 100. For each of the independent variables, they were quantified as the total number of requirements that each entity complies with regarding the FURAG evaluation model. The independent variables are described in [Table 1](#).

Table 1. Predictors of the model description.

Variables	Abbreviation	Conceptualization
Data analytics usage	PAD	Refers to handling data with the intention of identifying patterns and/or trends that generate projections for evidence-based decision making.
Web accessibility	PAW	Is the possibility of universal access to the Web, regardless of the type of hardware, software, network infrastructure, language, culture, geographic location, and users' abilities.
Web usability	PUW	Refers to the qualities of websites that make them easy to use and understand by those who access and use them.
Strategic information technology planning	PPETI	Corresponds to the strategic planning process of the public entity for the implementation of ICT.
Information technology management	PGTI	Refers to the process of planning, organizing, controlling, and coordinating the use of information technologies.
Document management	PDI	Relates to the documentation of policies, processes, instances, and ICT infrastructure.
Information technology purchasing	PCTI	Relates to the operations of purchasing ICT.
Information technology project management	PGPTI	Configuration of a set of administrative and organizational policies, strategies, methodologies, techniques, and mechanisms in relation to ICT projects.

Table 1. *Continued*

Variables	Abbreviation	Conceptualization
Information components management	PGCI	Are the mechanisms of the public entity to ensure and guarantee information components within it.
Information systems management	PGSI	Refers to the process of planning, designing, implementing, managing, and maintaining the information systems of the public entity.
Information systems life cycle	PCDSI	Is the documentation of the process that describes the stages that information systems go through, from their conception to their elimination.
ICT infrastructure support and operation	PSOITI	Refers to the necessary activities and processes to ensure that ICT systems and services operate optimally and without interruptions.
IPv6 adoption	PAIPV	Is the process of migrating from IPv4 (Internet Protocol version 4) to IPv6 (Internet Protocol version 6) in the public entity.
Strategies for the use and appropriation of ICT	PEAUTIC	Set of actions and decisions that an organization, institution, or community carries out to use and effectively and sustainably take advantage of ICT.
Process automation	PAP	Is the use of ICT to automate tasks and processes of the public entity, reducing the need for human intervention and improving the organization's efficiency and effectiveness.
Emerging 4.0 technologies	PTE	Is a set of technologies that are expected to have a significant impact on the public entity in relation to its operation.
Use of artificial intelligence	PUIA	Corresponds to the use of artificial intelligence for the development of the entity's processes.
Value group participation	PPGV	Is the participation of value groups in decision-making, making it more effective, relevant, and useful for society on digital governance issues.
Transparency and access to public information	PTAIP	Are fundamental principles in a democracy and refer to the government's obligation to provide relevant and timely information to citizens.

The operationalization of the model was performed in version 29 of the SPSS software¹⁸ using the multiple linear regression technique INTRO. For the replicability of the results in case they do not have SPSS, they can use R Studio.¹⁹ To evaluate the quality of the model, various statistics were used, including R^2 , adjusted R^2 , ANOVA test, and VIF collinearity test. The R^2 coefficient represents the proportion of the total variability in the dependent variable explained by the multiple linear regression model, where values close to 1 indicate that the model explains the variability in the data well. The adjusted R^2 coefficient, which takes into account the number of predictor variables in the model, represents a better fit of the model when values close to 1 are obtained. The ANOVA test evaluates the overall significance of the multiple linear regression model, with a p-value less than 0.05 indicating that the model is significant and at least one of the predictor variables is important in explaining the variability in the dependent variable.

The Variance Inflation Factor (VIF) collinearity test measures how much the variance of the regression coefficient of a predictor variable is inflated due to the presence of other predictor variables in the model. In this case, the presence of collinearity problems in the model was discarded if the VIF result for each variable was less than 4. Finally, the statistical significance of the predictive variables in the final model was analyzed, with those having a p-value less than 0.05 considered statistically significant.

Performance of public entities in the implementation of digital government public policy in Colombia

In Colombia, there are 147 national-level public entities distributed across 24 sectors, where 17.7% are affiliated with the Ministry of Finance and Public Credit, 11.6% with the Ministry of Defense, 7.5% with the Ministry of Health and Social Protection, 6.1% with the Ministry of Education, and 57.1% with other administrative departments. Based on the results obtained from the FURAG for the year 2021, last measurement, the average level of implementation of the digital government policy was 85.67% with a deviation of 9.95%. As shown in [Figure 1](#), the results obtained by the “Corporación De Alta Tecnología Para La Defensa” (Defence High Technology Corporation) with an implementation level of 44.02%, “Sociedad De Televisión De Las Islas LTDA” (Society Of Television Of The Islands LTDA) with



Figure 1. Box diagram of the level of implementation of digital government policy in Colombian national public entities.

Table 2. ANOVA test of the model.

	Sum of squares	df	Mean square	F	p-value
Regression	9231.62	19	485.87	29.20	<0.001
Residual	2046.20	123	16.63		
Total	11277.83	142			

52.81%, “Centro De Diagnostico Automotor De Caldas LTDA” (Centre For Automotive Diagnostics Of Caldas LTDA) with 58.96%, and “La Imprenta Nacional De Colombia” (The National Printing Office of Colombia) with 59.22% are considered outliers.

Variables that affect the implementation of digital government policy in Colombia

Based on the results of the FURAG for the 2021 period and using a linear regression model, it was possible to establish which variables influence the level of implementation of the digital government policy in Colombia. The developed model showed an R² of 0.819 and an adjusted R² of 0.79. Table 2 shows that the regression model was statistically significant overall (F = 29.20, p-value < 0.001), indicating that the predictors were collectively related to the dependent variable.

With that being said, the model did not present any problems of collinearity (see Table 3) since the VIF statistic values were less than 4. Thus, it was considered that the variables that affect the implementation of the digital government policy were PAW, PUW, PAIPV, PEAUTIC, PTE, and PTAIP (See the meaning of the acronyms in Table 3), as they presented p-values less than 0.05. Finally, Figure 2 presents the model’s predictions contrasted with the actual data obtained in FURAG, where the dependent variable was the level of implementation of the digital government policy.

Table 3. Model coefficients.

Variable	Code	B	t-value	p-value	Tolerance	VIF
Constant	Constant	16.49	2.87	0.00		
Data analytics usage	PAD	0.43	1.46	0.15	0.60	1.67
Web accessibility	PAW	0.27	2.25	0.03	0.55	1.83
Web usability	PUW	0.87	3.35	<0.001	0.54	1.84
Strategic information technology planning	PPETI	0.79	1.21	0.23	0.36	2.79

Table 3. *Continued*

Variable	Code	B	t-value	p-value	Tolerance	VIF
Information technology management	PGTI	0.75	1.00	0.32	0.36	2.77
Document management	PDI	-0.36	-0.47	0.64	0.27	3.76
Information technology purchasing	PCTI	-0.38	-0.66	0.51	0.76	1.32
Information technology project management	PGPTI	0.63	0.93	0.35	0.58	1.73
Information components management	PGCI	0.88	2.16	0.03	0.55	1.81
Information systems management	PGSI	0.24	0.87	0.38	0.34	2.97
Information systems life cycle	PCDSI	0.73	1.67	0.10	0.40	2.50
ICT infrastructure support and operation	PSOITI	0.59	1.51	0.13	0.40	2.47
IPv6 adoption	PAIPV	0.34	3.21	<0.001	0.56	1.79
Strategies for the use and appropriation of ICT	PEAUTIC	0.94	3.01	<0.001	0.54	1.85
Process automation	PAP	-0.27	-0.61	0.55	0.58	1.72
Emerging 4.0 technologies	PTE	1.11	3.64	<0.001	0.53	1.90
Use of artificial intelligence	PUIA	-0.28	-0.31	0.76	0.55	1.82
Value group participation	PPGV	0.62	3.47	<0.001	0.73	1.37
Transparency and access to public information	PTAIP	0.54	4.46	<0.001	0.83	1.21

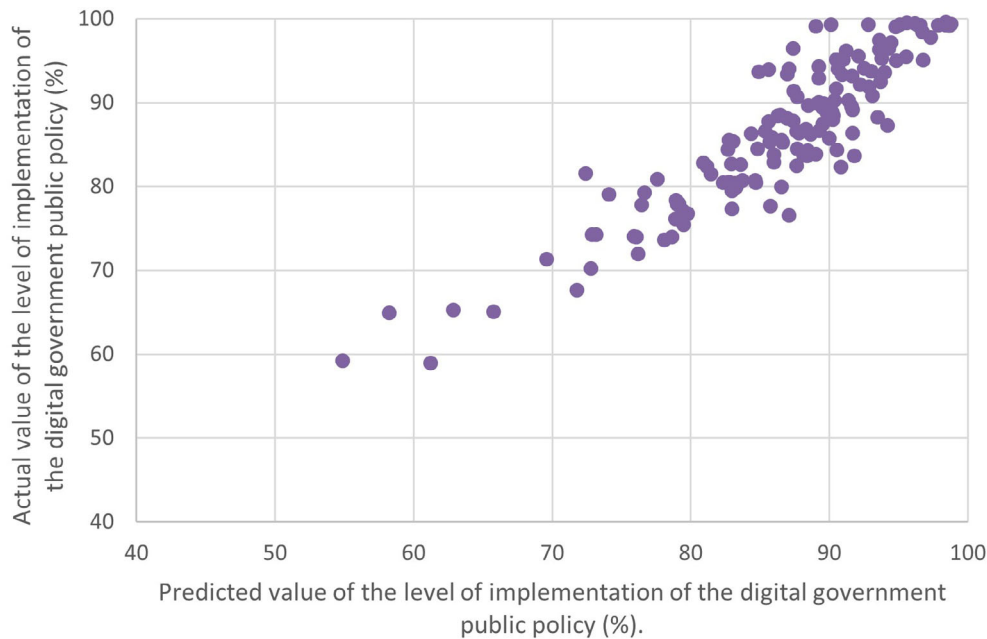


Figure 2. Scatter plot of actual value versus predicted value of the level of implementation of the digital government policy.

Actionable recommendations

Based on the level of implementation of digital government policy in Colombia, there are several actionable recommendations that can be given to decision makers and government entities to achieve the implementation of this policy in various contexts. In relation to web accessibility (PAW), the State should establish standardized criteria so that the portals of public entities allow all people, including those with disabilities or limitations, to access the information and services available to them. This is materialized in the case of Colombia in Resolution 1519 of 2020 from the Ministry of Information and Communication Technologies, where 23 criteria that public entities must comply with in relation to web accessibility are established.²⁰

For web usability (PUW), public entities must design a clear and organized structure of content so that portal users can find the information they are looking for. Similarly, usability testing should be performed to confirm the clarity and organization of the contents. Furthermore, it is necessary for web pages and platforms used for service provision to be compatible with various devices. The processes related to the services provided by the entity should also be simplified so that all stakeholder groups can access them from the same application.

Furthermore, the adoption of IPV6 (PAIPV) is essential for the sustainability of digital government and its implications, since the IPV4 protocol has reached the limit of the number of IP addresses it can support. Therefore, if public entities do not migrate, they may have difficulties in expanding their networks and providing services. This results in the limitation of users' ability to access certain resources of the public entity. Given the relevance of the adoption of IPV6, the transition should be planned carefully, considering the difficulties in accessing information and service provision that may arise from not executing it correctly. In addition, the variety of platforms to be linked within and outside the public entity should be recognized, and the transition should have sufficient budget and time for its implementation.

Due to the role of ICTs in digital government policy, a strategic component for their use and appropriation should be developed (PEAUTIC). In this sense, public entities should plan for the long term, train employees and stakeholders, promote collaboration and citizen participation, ensure the security and privacy of information, ensure universal access and digital inclusion, and evaluate and measure the impact of the strategy.

On the other hand, as public entities become familiar with emerging technologies (PTE) (e.g., blockchain, big data, artificial intelligence, robotics, etc.), it is important that they are prepared to integrate them effectively into their operations, especially in the provision of services. In this context, the implementation and use of emerging technologies by entities should be based on an analysis of how they can be used. Thus, the use of partnerships with the private sector and academia to take advantage of specialized knowledge and technical experience, especially in cases where public entities have no experience in the implementation and use of such ICTs, should be evaluated. Finally, it is not enough to have emerging technologies; the entity's staff, as well as the social actors who will use them, must be trained.

Finally, transparency and access to public information (PTAIP) are fundamental in digital government policy, as they allow stakeholders to be informed and participate actively in decision-making. In this sense, the use of digital technologies facilitates the dissemination of public information and promotes accountability by public entities. Thus, entities should implement tables of retention of documentary evidence, complaint and claim forms, access to reports and open data, public transition reports, directories of information on public servers and employees, and budget execution, among others.

Conclusions

The implementation of digital government policy in countries such as Colombia is a crucial step towards the transformation of the state, allowing for the improvement of efficiency, transparency, and quality of services. In this context, it is recognized that the implementation of digital government policy is not an easy task. Therefore, from the particular case of Colombia, public entities require the adoption of standardized criteria regarding web accessibility and usability, the transition to IPV6, and the integration of emerging technologies, as well as a clear and effective strategy for the appropriation of ICTs by employees and citizens. Additionally, it is important to highlight the relevance of transparency and access to public information as a fundamental tool for accountability and the participation of stakeholder groups in the entities.

In this regard, it is important to reflect on the challenges and opportunities presented by the implementation of digital government policy in developing countries. First, it is necessary to consider the importance of investment in technology and training of employees and stakeholders for the success of these policies. Similarly, the need for adequate strategic planning that allows public entities to effectively adapt to changes and technological advances in the long term is highlighted. Second, the need for effective collaboration between the public sector, the private sector, and academia to leverage specialized knowledge and technical expertise in the implementation and use of ICTs should be considered. In this sense, the construction of strategic alliances can be a useful tool for the success of digital government policy. Finally, it is important to highlight the importance of the participation of stakeholder groups in the implementation and evaluation of these policies. Inclusion and universal access to digital information and services are essential to ensure a more just and equitable society.

With the actionable recommendations outlined in this guidance document, as well as the documentation of the Colombian case through modelling, new tools are provided for decision-makers and public entities to implement digital government policy. Furthermore, this policy brief strengthens the literature on the implementation of digital government policies from the perspectives of public entities.

Data availability

Underlying data

Data used in this study are from the FURAG dataset of the Colombia 2023 self report, available from the Función Pública [Public Function] website <https://www.funcionpublica.gov.co/web/mipg/resultados-medicion>. A guide for how to apply for dataset access is available at: <https://www.funcionpublica.gov.co/web/mipg/resultados-medicion>.

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Giancarlo Vecchi

Politecnico di Milano, Milano, Italy

I suggest authors to:

a) to provide comments to the Figure 2, underlining the programs/actions that are in a good or bad trend

b) See the sentence p. 3:

"the approach adopted here highlights the importance of understanding the strategies and efforts implemented by public entities to achieve effective implementation of the digital government policy"

Here change as: "...the importance of understanding the strategies and efforts used/adopted by public entities."

c) Variables p. 5: I cant understand if the 'internal and external interoperability among system' is present or covered by the different variables

d) Page 8:

See the sentence:

"For web usability (PUW), public entities must design a clear and organized structure of content so that portal users can find the information they are looking for. Similarly, usability testing should be performed to confirm the clarity and organization of the contents." You can underline the use of co-design processes with different categories of citizens and internal users.

See: <https://services.blog.gov.uk/2021/03/23/from-user-centred-design-to-co-design/>
https://www3.weforum.org/docs/WEF_Co_designing_Tech_with_Civil_Society_2021.pdf

"A government strategy in the field of digitalization policies, could promote - as in some experiences (e.g. the task forces on national digitalization in UK, Estonia, Italy, etc. (see Mergel I. 2019. "Digital service teams in government." Government Information Quarterly vol. 36, n.4) - a community of developers, based on the involvement of private and third sectors expert, able to test the digital solution, to collaborate in the development of apps, etc."

Does the paper provide a comprehensive overview of the policy and the context of its implementation in a way which is accessible to a general reader?

Partly

Is the discussion on the implications clearly and accurately presented and does it cite the current literature?

Yes

Are the recommendations made clear, balanced, and justified on the basis of the presented arguments?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Digitalisation policies - Public Sector modernization

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 13 September 2023

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Diana Teresa Parra-Sánchez 

Centro de Innovación y Productividad InnovaCTIon, Cartagena, Colombia

The policy brief focuses on the Colombian case to provide evidence to decision-makers and public entities on which variables should intervene to implement the digital government policy effectively.

Introduction: It is recommended to present the article's structure in sections.

There is a need to delve deeper into the digital government policy implemented in Colombia.

The presentation of the equation to calculate the level of implementation of public policy is suggested to be presented in the method section.

The document does not have a Discussion section. The implications of the study carried out are not appreciated. Likewise, there is a lack of greater depth in the recommendations. It is recommended that the authors of the document present the method in greater detail. In this way, readers can understand and replicate what is presented in the document.

Does the paper provide a comprehensive overview of the policy and the context of its implementation in a way which is accessible to a general reader?

Partly

Is the discussion on the implications clearly and accurately presented and does it cite the current literature?

No

Are the recommendations made clear, balanced, and justified on the basis of the presented arguments?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Digital transformation, IoT adoption.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

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