

Hybridization of Technology Adoption Models (TAM, TOE, UTAUT) Adapted to Decentralized Territorial Authorities (CTD) in Cameroon

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Abstract

The adoption of digital technologies by Cameroonian decentralized local authorities remains a complex and insufficiently theorized process. Classical technology adoption models (TAM, TOE, UTAUT) developed in Western contexts have limitations when applied to the institutional, socio-cultural, and economic realities of Africa in general, and Cameroon in particular. This research proposes a hybrid model integrating individual, organizational, and environmental dimensions while incorporating contextual factors specific to Cameroonian local administrations. Based on a quantitative survey of agents and elected officials from three pilot decentralized local authorities (Yaounde Urban Community, Yaounde 3 District Municipality, and Mbankomo Rural Municipality), as well as Officials from the Ministry of Decentralization and Local Development. Using structural equation modeling (PLS-SEM), we demonstrate that technology adoption in these contexts is primarily determined by institutional capacity, transformational leadership, social influence, enabling conditions, and perceived usefulness. The proposed hybrid model exhibits superior explanatory power ($R^2 = 0.68$) compared to traditional models applied in isolation. This research contributes theoretically to the development of a contextualized theory of technology adoption in the Cameroonian public sector and provides practitioners with a diagnostic framework for identifying priority levers for action.

Keywords

Technology Adoption, TAM, TOE, UTAUT, Hybrid Model, Decentralized Local Authorities of Cameroon, Digital Transformation, E-Government, PLS-SEM, Institutional Capacity

1. Introduction

1.1. Research Context and Problem

The digital transformation of African public administrations is a major strategic challenge for improving local governance and delivering quality public services. According to the United Nations e-Government Survey (UNDESA, 2022), African countries have an average e-government development index of 0.39, significantly lower than the global average of 0.60. This administrative digital divide reflects not only infrastructural deficits but also difficulties in the appropriation and effective adoption of technologies by local public actors (Yavuz & Van Welsum, 2020).

Local authorities, the administrative level closest to citizens, play a crucial role in delivering essential services (civil registration, local taxation, urban planning, and sanitation). Yet, their capacity to adopt and effectively utilize digital technologies remains limited (Mawela, Ochara, & Twinomurinzi, 2017). Considerable investments in municipal information systems, e-service platforms, and management tools remain underutilized or even abandoned, revealing a failure that is not technological but rather organizational and human (Heeks, 2003; Schuppan, 2009; Twizeyimana & Andersson, 2019).

The literature on technology adoption offers several proven theoretical models: Technology Davis's Acceptance Model (TAM) (1989), Tornatzky and Fleischer's Technology-Organization-Environment (TOE) framework (1990), and Venkatesh et al.'s Unified Theory of Acceptance and Use of Technology (UTAUT) (2003) have demonstrated robustness in Western contexts and the private sector (Williams, Rana, & Dwivedi, 2015; Dwivedi et al., 2019). However, their direct application to African public administrations raises questions of external validity and contextual relevance (Walsham, 2017; Sein et al., 2019).

1.2. Research Question and Objectives

Main research question: How to construct and empirically validate a hybrid model of technology adoption integrating the institutional, socio-cultural and economic specificities of Cameroonian local authorities?

This research pursues three complementary objectives:

1. Theoretical objective: To identify the limitations of classical models (TAM, TOE, UTAUT) when applied to Cameroonian public contexts and to propose an integrative framework enriched with relevant contextual factors.

2. Empirical objective: To quantitatively test and validate the proposed hybrid model with a representative sample of local authorities in three pilot local authorities (Yaoundé Urban Community, Yaoundé 3 District Municipality and Mbankomo Rural Municipality).

3. Managerial objective: To provide public decision-makers and support organizations with a diagnostic framework to identify priority levers for action to promote technology adoption.

1.3. Expected Contributions

This research makes a threefold contribution:

Theoretical contribution: Development of a contextualized theory of technology adoption in the Cameroonian public sector, enriching the corpus of ICT4D and public information systems.

Methodological contribution: Validation of a suitable measurement instrument and demonstration of the explanatory superiority of a hybrid approach over mono-theoretical models.

Practical contribution: Provision of an operational diagnostic tool to guide local digital transformation public policies.

2. Theoretical Framework and Literature Review

2.1. Classic Models of Technology Adoption

2.1.1. The Technology Acceptance Model (TAM)

The Technology Adoption Model (TAM), developed by Davis (1989) and extended by Venkatesh & Davis (2000), is the dominant model of technology adoption at the individual level. Grounded in Fishbein and Ajzen’s theory of reasoned action, it posits that the behavioral intention to use a technology is primarily determined by two beliefs:

Perceived usefulness: The degree to which a person believes that using a system will improve their job performance. Perceived ease of use: the degree to which a person believes that using a system will be effortless.

The TAM has been validated in multiple contexts and technologies, demonstrating remarkable robustness (King & He, 2006; Marangunic & Granic, 2015). However, its limitations are documented: exclusive focus on individual perceptions, neglect of organizational and environmental factors, and reduced applicability in mandatory usage contexts such as the public sector (Bagozzi, 2007; Benbasat & Barki, 2007; Taherdoost, 2018) (Table 1).

Table 1. The TAM (Technology acceptance model).

Variable	Definition
Perceived usefulness	The degree to which a person believes that using a system will improve their professional performance
Perceived ease of use	The degree to which a person believes that using a system will be effortless
Behavioral intention	Strength of a person’s intention to perform a specific behavior
Effective use	Actual and measurable use of the technological system

2.1.2. The Technology-Organization-Environment (TOE) Framework

The TOE framework of Tornatzky & Fleischer (1990) adopts an organizational perspective by identifying three categories of factors influencing technology adoption by firms:

Technological context: characteristics of the technology (compatibility, com-

plexity, relative advantage).

Organizational context: organizational resources (size, financial slack, managerial support, skills).

Environmental context: industry characteristics, competitive pressures, regulatory framework.

The TOE has the advantage of considering the organization as the unit of analysis and integrating external contextual variables. It has been widely used to study technology adoption in companies (Baker, 2012; Awa, Ukoha, & Igwe, 2017). However, it neglects the individual and behavioral dimension of adoption, limiting its ability to explain actual use beyond the formal organizational decision (Oliveira & Martins, 2011; Alshamaila, Papagiannidis, & Li, 2013) (Table 2).

Table 2. The TOE (Technology-organization-environment) framework.

Context	Key factors	Impact on adoption
Technological	Compatibility, complexity, relative advantage, observability	Perceived characteristics of the technology influence the adoption decision
Organizational	Size, financial resources, managerial support, technical skills	The organization's internal capabilities determine the feasibility of adoption.
Environmental	Competitive pressures, regulatory framework, business partners	External factors create incentives or constraints to adopt

2.1.3. The Unified Theory of Acceptance and Use of Technology (UTAUT)

The UTAUT model, developed by Venkatesh et al. (2003) and later extended into UTAUT2 (Venkatesh, Thong, & Xu, 2012), synthesizes eight competing models of technology acceptance. It identifies four direct determinants of behavioral intention and use.

Table 3. The UTAUT model (Unified theory of acceptance and use of technology).

Determinant	Definition	Moderating variables
Performance expectation	The degree to which the use of a technology will bring benefits	Gender, age, experience
Expected effort	Degree of ease associated with using the technology	Gender, age, experience
Social influence	The degree to which an individual perceives that other important people believe they should use technology	Gender, age, experience, volunteering
Enabling conditions	The degree to which an individual believes that the organizational and technical infrastructure exists to support the use	Age, experience

Performance expectancy: the degree to which the use of a technology will bring

benefits in the accomplishment of certain activities.

Effort expectancy: the degree of ease associated with using the technology.

Social influence: the degree to which an individual perceives that other important people believe they should use the new technology.

Facilitating conditions: the degree to which an individual believes that the organizational and technical infrastructure exists to support the use of the system.

The UTAUT model incorporates moderating variables (age, gender, experience, voluntary use) and has demonstrated superior explanatory power ($R^2 = 70\%$) compared to previous models (Williams, Rana, & Dwivedi, 2015; Tamilmani et al., 2021). However, its development within Western organizational contexts limits its external validity in African public administrations (Dwivedi et al., 2019) (Table 3).

2.2. Limitations of Classical Models in the African Context

Despite their empirical robustness, the TAM, TOE, and UTAUT models have limitations when applied to African local authorities. The literature identifies five main shortcomings (Table 4).

Table 4. Limitations of classical models in an African context.

Limit	Description	Reference authors
Western bias	Models developed and validated primarily in North American and European contexts	Walsham (2017), Avgerou (2008)
Neglect of the institutional context	Little consideration is given to the specific characteristics of the public sector (mandatory use, lack of profit, budgetary constraints).	Schuppan (2009), Twizeyimana & Andersson (2019)
Omission of institutional capacity	Absence of variables measuring pre-existing organizational capabilities (skills, processes, resources)	Heeks (2002), Unwin (2009)
Underestimation of cultural factors	Limited consideration of specific national and organizational cultural values	Hofstede (2001), Srite & Karahanna (2006)
Absence of leadership as a variable	Critical role of unmodeled political and administrative leadership	Yavuz & Van Welsum (2020), Mutula (2008)

2.3. Contextual Factors Specific to African Communities

The literature review on ICT4D and e-government in Africa identifies several critical contextual factors absent from classical models:

Institutional capacity: The ICT4D literature highlights that the weak institutional capacity of African administrations (limited skills, informal processes, constrained financial resources) constitutes the main bottleneck to technology adoption (Heeks, 2002; Avgerou, 2008; Unwin, 2009). This dimension, absent from classical models, nevertheless appears crucial in contexts of low administrative maturity.

Transformational leadership: Research on e-government in Africa identifies political and administrative leadership as a critical success factor (Yavuz & Van Welsum, 2020; Mutula, 2008). Transformational leadership capable of articulating a clear digital vision and mobilizing stakeholders is essential but is not addressed by traditional models.

Institutional pressures: Neo-institutional theory (DiMaggio & Powell, 1983) suggests that organizations adopt practices through institutional mimicry or under normative pressure. In the African context, donor pressure, imitation of other communities, or government directives strongly influence adoption (Mawela et al., 2017).

Cultural factors: The work of Hofstede (2001) and Srite & Karahanna (2006) demonstrates that national cultural values (power distance, collectivism, uncertainty aversion) moderate technology adoption. African societies, characterized by high power distance and pronounced collectivism, exhibit specific adoption dynamics (Table 5).

Table 5. Contextual factors specific to African communities.

Contextual factor	Demonstrations in African communities	Estimated importance
Institutional capacity	Limited technical skills, informal processes, constrained financial resources, high turnover	Very high
Transformational Leadership	Digital vision supported (or not) by elected officials and senior managers, capacity to mobilize stakeholders	High
Institutional pressures	Government directives, donor conditions, imitation of other communities	High
Cultural factors	High power distance, pronounced collectivism, aversion to uncertainty, respect for authority	Average
Infrastructural constraints	Unreliable internet connectivity, frequent power outages, outdated equipment	High

2.4. Proposal for an Integrative Hybrid Model

Faced with the limitations of single-theoretical models, we propose a hybrid model of technology adoption for African local authorities. This model integrates:

Individual variables of the TAM/UTAUT: perceived usefulness, ease of use, social influence.

The organizational variables of TOE: managerial support, resources, skills.

Specific contextual factors: institutional capacity, transformational leadership, institutional pressures, cultural factors (Table 6).

Alignment of the conceptual model:

The final conceptual model selected for the empirical analysis includes the following variables:

- Perceived usefulness

- Ease of use
- Social influence
- Enabling conditions
- Institutional capacity
- Transformational Leadership
- Institutional pressures

Table 6. Proposed hybrid model of technology adoption.

Level	Integrated variables	Theoretical origin
Individual level	Perceived usefulness, ease of use, performance expectation, social influence	TAM, UTAUT
Organizational level	Managerial support, financial resources, technical skills, enabling conditions	TOE, UTAUT
Institutional/ contextual level	Institutional capacity, transformational leadership, institutional pressures, cultural factors	ICT4D, neo-institutional theory, Hofstede
Dependent variables	Intention to adopt, actual use	TAM, UTAUT

The variables initially explored in the literature review (cultural factors, managerial support, organizational resources, technical skills, performance expectancy) were excluded from the final model after exploratory analysis and statistical validation, due to their weak empirical contribution or conceptual redundancies.

Table 7. Assumptions of the hybrid model.

H	Assumption	Theoretical justification
H1	Perceived usefulness positively influences adoption intention	TAM (Davis, 1989), UTAUT (Venkatesh et al., 2003)
H2	Perceived ease of use positively influences adoption intention.	TAM (Davis, 1989)
H3	Social influence positively affects adoption intention.	UTAUT (Venkatesh et al., 2003), cultural theory (Hofstede, 2001)
H4	Facilitating conditions positively influence adoption intention	UTAUT (Venkatesh et al., 2003), TOE (Tornatzky & Fleischer, 1990)
H5	Institutional capacity positively influences adoption intention	ICT4D (Heeks, 2002; Avgerou, 2008)
H6	Transformational leadership positively influences adoption intention	Africa e-gov literature (Yavuz & Van Welsum, 2020)
H7	Institutional pressures positively influence adoption intention	Neo-institutional theory (DiMaggio & Powell, 1983)
H8	The intention to adopt a product positively influences its actual use.	TAM, UTAUT, theory of planned behavior (Ajzen, 1991)
H9	Facilitating conditions positively influence actual usage	UTAUT (Venkatesh et al., 2003)

Addition of institutional pressures:

The variable “institutional pressures” was measured using three items inspired by neo-institutional theory (DiMaggio & Powell, 1983), adapted to the Cameroonian context:

- Pressure from central authorities
- Imitating other communities
- Influence of technical and financial partners

The model postulates many research hypotheses structured into three levels (Table 7).

3. Research Methodology

3.1. Research Approach and Epistemological Positioning

This research adopts a positivist stance and a hypothetico-deductive approach aimed at empirically testing the proposed theoretical model (Creswell & Creswell, 2018). Quantitative methodology using questionnaire surveys is particularly well-suited for:

Testing causal relationships between latent variables.

Generalize the results to a larger population.

Compare the explanatory power of competing models.

Psychometrically validate measurement instruments.

Partial least squares structural equation modeling (PLS-SEM) is retained as the main analysis technique, in accordance with methodological recommendations for complex models with formative and reflective constructs (Hair et al., 2017; Sarstedt, Ringle, & Hair, 2021).

3.2. Sampling and Data Collection

The survey targeted local agents and elected officials from the three pilot decentralized territorial authorities and 07 directorates of the Ministry of Decentralization and Local Development to represent the diversity of French-speaking, English-speaking and digital maturity levels.

The sample for this study is based on a reasoned (non-probabilistic) sampling strategy aimed at capturing the diversity of institutional contexts across Cameroonian decentralized territorial communities.

The three selected local authorities: Yaounde Urban Community (CUY), Yaounde 3 District Municipality (CY3), and Mbankomo Rural Municipality (CRM) were chosen according to three criteria:

- Their level of digital maturity (high, intermediate, low)..
- Their territorial typology (metropolitan urban, intermediate urban, rural).
- Their accessibility and institutional availability for data collection.

The seven directorates of the ministry in charge of decentralisation were selected because of their direct role in defining, coordinating, and implementing public policies for the digital transformation of local and regional authorities.

The other subgroup (107 respondents) includes technical agents, administra-

tive managers, IT managers and operational staff involved in digital processes.

This sample, while not probabilistic, captures a diversity of profiles and institutional situations, thus supporting the analytical validity of the results for Cameroonian CTDs. The inclusion of ministry officials reflects an analytical rationale aimed at integrating a multi-level perspective on digital governance.

Indeed, ministerial actors play a central role in:

- The definition of digital public policies.
- Resource allocation.
- Technical support for local authorities.

An exploratory comparative analysis was conducted to compare the perceptions of local stakeholders (CTD) with those of central stakeholders (ministry). However, the conclusions of this study are interpreted with caution and considered representative of a mixed administrative sample (**Table 8**).

Table 8. Sample characteristics.

Characteristic	Detail
Sample size	247 respondents (response rate: 68%)
Distribution	CUY (80), CY3 (40), CRM (20) others (107)
Respondent profile	Elected officials (28%), General secretaries (19%), IT managers (22%), Administrative staff (31%)
Gender	Men (64%), Women (36%)
Middle age	41.3 years (standard deviation: 9.7)
Average seniority	8.4 years in the community

The questionnaire, developed using validated scales and adapted to the Cameroonian and African context, comprised 68 items measured on 7-point Likert scales. English-French translation and back-translation were performed. A pre-test with 35 respondents allowed for refinement of the question wording.

3.3. Measuring Instrument

The constructs of the model are measured using scales validated in the literature, adapted to the context of African local authorities (**Table 9**).

Table 9. Operationalization of constructs.

Construct	Items	Source	Example item
Perceived usefulness	4	Davis (1989)	“Digital tools would improve my efficiency at work.”
Ease of use	4	Davis (1989)	“Learning to use digital systems would be easy for me.”
Social influence	4	Venkatesh et al. (2003)	“My superiors think I should use digital tools.”
Enabling conditions	5	Venkatesh et al. (2003)	“Our community has the necessary resources to use the technologies”

Continued

Institutional capacity	6	Developed for this study	“Our community has the necessary technical skills”
Transformational Leadership	5	Bass & Riggio (2006)	“Our leaders are communicating a clear vision of digital transformation.”
Intention to adopt	3	Venkatesh et al. (2003)	“I intend to use digital tools regularly in my work.”
Effective use	4	Venkatesh et al. (2003)	“I currently use digital systems daily in my work.”

4. Results**4.1. Evaluation of the Measurement Model**

The evaluation of the measurement model follows the recommendations of Hair et al. (2017) for PLS-SEM. All reflective constructs demonstrate satisfactory reliability and validity (Table 10).

Table 10. Quality of the measurement model.

Construct	α Cronbach	CR	AVE	Validity
Perceived usefulness	0.89	0.92	0.74	✓
Ease of use	0.87	0.91	0.72	✓
Social influence	0.91	0.94	0.79	✓
Enabling conditions	0.88	0.91	0.68	✓
Institutional capacity	0.93	0.95	0.76	✓
Transformational Leadership	0.90	0.93	0.73	✓
Intention to adopt	0.92	0.95	0.86	✓
Effective use	0.88	0.92	0.74	✓

Extension of PLS-SEM reporting: The measurement model evaluation was supplemented by:

- Analysis of item loading times (>0.70).
- Discriminant validity (Fornell-Larcker criterion and HTMT ratio < 0.85).
- Collinearity verification (VIF < 5).

All constructs in the model were specified as reflective, in accordance with the recommendations of Hair et al. (2017).

The Fornell-Larcker test indicates that the square root of the AVE of each construct is greater than the inter-construct correlations, confirming discriminant validity.

The HTMT ratio is below the critical threshold of 0.85 for all pairs of variables.

4.2. Evaluation of the Structural Model and Testing of Hypotheses

Analysis of the structural model reveals excellent explanatory power:

R^2 (Adoption Intention) = 0.68 (substantial according to Cohen, 1988).

R^2 (Actual Use) = 0.62 (substantial).

Q^2 (Stone-Geisser) > 0 for all endogenous constructs, confirming predictive relevance (Table 11).

Table 11. Hypothesis test results.

H	Relationship	β	t-value	Result
H1	Perceived usefulness → Intention	0.28	4.82***	Validated
H2	Ease of use → Intention	0.19	3.41**	Validated
H3	Social influence → Intention	0.38	6.94***	Validated
H4	Facilitating conditions → Intention	0.24	4.12***	Validated
H5	Institutional capacity → Intention	0.42	7.86***	Validated
H6	Transformational Leadership → Intention	0.31	5.63***	Validated
H7	Institutional pressures → Intention	0.16	2.89**	Validated
H8	Intention → Actual Use	0.56	10.34***	Validated
H9	Facilitating conditions → Use	0.27	4.71***	Validated

*** means highest value where by ** is high.

4.3. Comparison with Mono-Theoretical Models

To demonstrate the superiority of the hybrid model, we tested the TAM, TOE and UTAUT models in isolation on the same sample (Table 12).

Table 12. Comparison of the explanatory power of the models.

Model	R^2 intention	R^2 usage	Improvement vs. hybrid
TAM alone	0.34	0.29	+100% for intention, +114% for usage
TOE alone	0.41	0.36	+66% for intention, +72% for usage
UTAUT alone	0.52	0.48	+31% for intention, +29% for usage
Hybrid model offered	0.68	0.62	Reference

Control of Common Method Bias:

A single-factor Harman test was performed to assess the presence of a common method bias. The results show that no single factor explains the majority of the total variance, suggesting that this bias is not critical.

However, it should be noted that the variables “adoption intention” and “actual use” were measured using the same cross-sectional questionnaire, which could potentially introduce bias. This limitation should be taken into account when interpreting the results.

5. Discussion

5.1. Main Theoretical Lessons

The results reveal three major theoretical lessons:

1. The primacy of institutional capacity: With a coefficient of 0.42 ($p < 0.001$),

institutional capacity emerges as the primary determinant of technology adoption in African communities. This result confirms the postulates of ICT4D (Heeks, 2002; Avgerou, 2008) regarding the importance of aligning technological solutions with pre-existing organizational capacities. It suggests that in contexts of low administrative maturity, strengthening institutional capacities is a prerequisite for any digital transformation initiative.

2. The amplifying role of social influence: Social influence has a significantly stronger effect ($\beta = 0.38$) than in Western UTAUT studies ($\beta \approx 0.15 - 0.25$). This difference corroborates the work of Hofstede (2001) and Srite & Karahanna (2006) on the importance of collectivism and social conformity in African cultures. Technology adoption decisions are not solely rational and individual, but are strongly influenced by peers, hierarchy, and social norms.

3. The catalytic effect of transformational leadership: Transformational leadership exerts a significant direct effect ($\beta = 0.31$) and an indirect effect via institutional capacity. This result confirms the critical importance identified by Yavuz & Van Welsum (2020) and Mutula (2008) of political and administrative leadership capable of articulating a clear digital vision, mobilizing resources, and transforming cultural resistance.

5.2. Practical Implications for Public Decision-Makers

The validated model offers public decision-makers a structured diagnostic framework to identify priority levers for action (Table 13).

Table 13. Strategic recommendations are determined.

Determinant	Recommended levers for action	Priority
Institutional capacity ($\beta = 0.42$)	Massive training programs, recruitment of technical profiles, formalization of processes, improved financial management	Critical
Social influence ($\beta = 0.38$)	Identifying and mobilizing champions of change, creating communities of practice, sharing successful experiences	High
Transformational leadership ($\beta = 0.31$)	Training elected officials and managers in digital leadership, communicating a clear vision, recognizing innovative employees	High
Perceived utility ($\beta = 0.28$)	Concrete demonstrations of the benefits, visible pilot projects, communication on efficiency gains	Average
Facilitating conditions ($\beta = 0.24$)	Improved connectivity, suitable equipment, accessible technical support, documentation in local languages	High
Ease of use ($\beta = 0.19$)	Simplified user interface, hands-on practical training, personalized support	Average

6. Conclusion

This research aimed to build and validate a hybrid technology adoption model

adapted to decentralized local authorities in Cameroon. Faced with the limitations of classic models (TAM, TOE, UTAUT) developed in Western contexts, we proposed an integrative approach combining individual, organizational, and institutional perspectives, enriched by specific contextual factors.

The survey of 247 agents and elected officials, analyzed using structural equation modeling (PLS-SEM), empirically validates the proposed model and all of its assumptions. With an explanatory power of 68% for adoption intention and 62% for actual use, the hybrid model clearly outperforms the mono-theory approaches (TAM: $R^2 = 0.34$; TOE: $R^2 = 0.41$; UTAUT: $R^2 = 0.52$).

The results reveal three major findings:

First, institutional capacity is the main determinant of adoption in contexts of low administrative maturity ($\beta = 0.42$, $p < 0.001$).

Secondly, social influence plays a more important role than in Western contexts ($\beta = 0.38$), reflecting the collectivist values of African societies.

Third, transformational leadership and enabling conditions appear as essential catalysts for digital transformation.

This research contributes to the development of a contextualized theory of technology adoption in the African public sector in general (Avgerou, 2008; Walsham, 2017) and offers practitioners an operational diagnostic framework. It suggests that technological investments must be accompanied by substantial efforts to strengthen institutional capacities, develop leadership, and take into account local social dynamics.

The limitations of this research open up avenues for future work: extension to other African countries to test generalizability, longitudinal studies to capture the temporal dynamics of adoption, multi-level analyses integrating individual, organizational and institutional factors simultaneously, and complementary qualitative research to further explore the causal mechanisms.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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