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Abstract

Collaborative innovation (CI) plays a vital role in the public sector, and encompasses innovation in collaboration with the private sector and other public institutions. This study examines the organisational performance of municipalities collaborating with higher-tier governments (upward collaboration), local stakeholders (inward collaboration), and peers (outwards collaboration) through exploitative and explorative innovation. Structural equation model (SEM) was used for analysing data collected via 405 questionnaire responses from Japanese cities.

The results provide supporting evidence for the impact of CI on organisational performance and per capita administrative costs as outcome variables. Beyond analysing the direct relationships of exploitative and explorative innovation with organisational outcomes, it uncovers how various types of collaboration exert indirect effects on those outcomes through their influence on innovation. As extant research has not clearly established CI's impact (Barrutia & Echebarria, 2018; Torfing, 2016), the present study's finding of explorative innovation enhancing organisational performance and exploitative innovation lowering administrative costs constitutes an important advancement of the literature. Moreover, while Barrutia and Echebarria (2018) rejected the direct effect of inward collaboration on exploitative innovation, this study incorporates inward collaboration into the model, considering Japan's long-standing practices of collaboration with citizens and non-profit organisations, and finds that it significantly contributes to reducing administrative costs via exploitative innovation.

Keywords:
Collaborative innovation, exploitative innovation, explorative innovation, organisational performance, Public management.

1 Introduction

According to Torfing (2018), the public sector faces a shortage of resources (e.g., finances and personnel), increasing demands from citizens, and a need for innovative

solutions. Under these circumstances, collaborative innovation (CI) plays a vital role in promoting innovation in the public sector, seeking innovation by working with the private sector and other public institutions. Through fieldwork, Lindsay et al. (2021) found that existing administrative services in Scotland improved through collaboration among multiple stakeholders, including public administration. However, few quantitative empirical studies have enhanced the external validity of these results, particularly for local governments in Japan.

Intermunicipal cooperation (IMC) is common in Japan. The IMC framework is a policy stipulated in the Local Autonomy Law that allows multiple local governments to establish a corporate body to implement IMC (Baba and Asami (2019). In August 2015, the Minister of Internal Affairs and Communications (2015)' notice, 'Points to Keep in Mind Concerning the Promotion of Reform of Local Administrative Services', requested each local public body to promote business reform to provide administrative services efficiently and effectively amid a difficult local fiscal situation. In response, local public bodies have pursued administrative reforms such as outsourcing and business process reengineering (BPR). By incorporating CI, as advocated by Torfing (2018), new administrative reform initiatives may be implemented, promoting efficient and effective administrative services. Thus, Japan provides a relevant case study for assessing the effects of administrative reform and collaboration. This study examines how CI affects organisational performance and administrative costs in Japanese municipalities.

2 Literature Review

2.1 Types of Collaboration and Innovation

Based on a survey of Spanish local governments, Barrutia and Echebarria (2019) measured forms of collaboration as upward, inward, and outward, following the typology proposed by Agranoff (2013). Upward collaboration refers to collaboration with higher tiers of government (HTG), such as central or broader local governments. Inward collaboration refers to collaboration with local stakeholders. Finally, outwards collaboration refers to collaboration among local governments (e.g., inter-municipal collaboration). This study adopts these definitions of these concepts.

Considering the resource-based view (RBV; (Barney, 1991; Wernerfelt, 1984), Barrutia and Echebarria (2019) developed indicators of exploitative and explorative innovation based on the three forms of collaboration described above, and a survey conducted by Jansen et al. (2006) of the European financial services industry. Public organisations engage, to varying degrees, in both exploitative and explorative innovation (Criado et al., 2023).

Exploitative innovation refers to activities that are similar to existing knowledge and practices, and involve low levels of discontinuity and controlled risks. Typically, local governments test these innovations in advance. Meanwhile, explorative innovation requires significant deviation from established knowledge and practices, involves more radical change and higher levels of risk, and tends to be rare and distinctive, even among comparable local governments.

Barrutia and Echebarria (2019) also demonstrated that exploitative innovation occurs in upward collaboration, whereas exploratory innovation occurs in inward and outwards collaboration, as shown in Figure 1. Upward collaboration tends to focus on easy, low-risk changes using common knowledge for small innovations. It may not effectively leverage new bottom-up ideas, despite tools such as virtual platforms which facilitate knowledge sharing. Inward and outwards collaborations involve forming ties with stakeholders and peer municipalities to access shared knowledge, which is particularly useful in the absence of networks. Networks facilitate efficient knowledge exchange and reduce the need for direct interactions to achieve straightforward innovation. However, the aforementioned authors' results on the relationship between inward and exploitative innovation are not statistically significant. This may be because inward collaboration tends to involve high implementation costs. In addition, relatively easy measures can often be implemented within the administrative framework without necessarily involving local stakeholders, such as citizens. Therefore, inward collaboration does not directly affect exploitative innovation. Regarding outwards collaboration, complex and uncertain projects require strong, direct relationships to transfer unique knowledge, as observed in the varied success of door-to-door waste collection in Spanish municipalities, which is significantly influenced by local management practices.

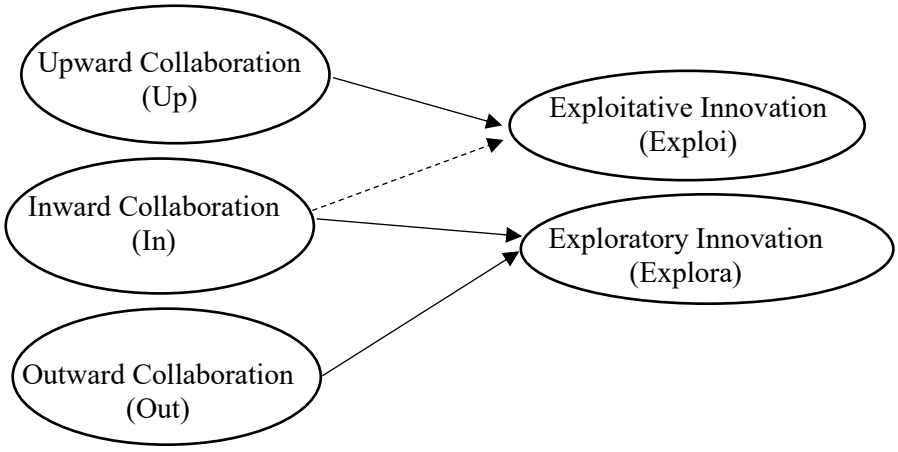

Figure 1. Relationship between various forms of collaboration and innovation (source: Barrutia and Echebarria (2019)).

2.2 Collaborative Innovation and Performance

According to Barrutia and Echebarria (2019), CI is one of the most effective instruments for knowledge development in the public sector because it allows learning through collaboration among partners. However, Torfing (2016) stated that innovation in the public sector does not always yield positive results. Therefore, examining the impact of CI and conditions under which it generates positive results for public institutions is useful.

Chen et al. (2019) classified innovation in administrative services into six categories based on Bason (2010) and other scholar: management, service, mission, policy, partner,

and citizens. According to Torfing (2018), CI initiatives in Denmark have led to innovation and crime reduction, but only in the context of administrative reforms. As noted before, in August 2015, the Minister of Internal Affairs and Communications (2015, p.3) issued a notice stating that administrative reforms should be carried out efficiently and effectively. As administrative reform aims to provide administrative services efficiently and effectively, this study measures the impact of CI on organisational performance, which cannot be measured using financial items.

3 Hypothesis Development

3.1 Collaborative Innovation Effects on Performance

The proposed model is based on the RBV (Barney, 1991; Wernerfelt, 1984), consistent with Barrutia and Echebarria (2019). This perspective posits that organisations adopt distinct strategies which are explained by their resources. Organisations are viewed as bundles of assets and resources that are not easily imitated in terms of strategic positioning (Wernerfelt, 1984). Accordingly, the RBV offers a useful framework for explaining the relationship between organisational strategies or goals, and available resources.

Furthermore, the items used to measure upward, inward, and outwards collaboration, and exploitative and explorative innovation follow Barrutia and Echebarria (2019). In the Japanese context, collaboration between local governments and actors such as citizens and non-profit organisations has been widely promoted. Therefore, although the relationship between inward collaboration and exploitative innovation has been rejected in extant studies, it is still re-examined here.

In measuring organisational performance, many management accounting studies have used the seven items from Van de Ven and Ferry (1980): productivity; quality or accuracy of work produced; number of innovations, process improvements, or new ideas; reputation for work excellence; attainment of production or service-level goals; efficiency of operations; and morale of unit personnel. This choice reflects the fact that in government organisations, outcomes cannot be measured using financial indicators such as sales and profit. Verbeeten and Speklé (2015) measured organisational performance in a survey of Dutch municipalities and found that these items appropriately captured organisational performance indicators. Various factors are negatively correlated with financial items such as net debt ratio, net debt per resident, and net debt change per resident, indicating that organisational performance indicators are reliable. Therefore, this study uses these indicators.

Noda (2022) Japanese municipal data on capital-intensive waste management services, Noda (2022) demonstrated that outwards collaboration contributes to the problem-solving capacity of local governments.[1] Based on this finding, the model includes a path from outwards collaboration, as this form of collaboration is also

[1] Noda (2022) referred to upward collaboration as vertical relationships and outward collaboration as horizontal relationships.

considered to influence organisational performance. Regarding upward collaboration, while Noda (2022) showed that its impact on financial efficiency varies depending on organisational and contractual arrangements, this study focuses on organisational performance in local governments. Therefore, no paths are drawn that would yield different conclusions depending on such arrangements. In the relationship between CI and organisational performance, outwards collaboration can directly affect organisational performance and indirectly impact it through innovation. This result extends the relationship proposed by Barrutia and Echebarria (2019). Accordingly, the following hypotheses are proposed:

H1: Upward collaboration (Up) indirectly and positively affects organisational performance (Op) through exploitative innovation (Exploi).
H2: Inward collaboration (In) indirectly and positively affects organisational performance (Op) through exploitative innovation (exploit).
H3: Inward collaboration (In) indirectly and positively affects organisational performance (Op) through exploratory innovation (Explora).
H4: Outwards collaboration (Out) directly affects organisational performance (Op) and has positive indirect effects through exploratory innovation (Explora).

Jansen et al. (2006) pointed out that in the private sector, where competitive markets demand high efficiency and low prices, exploitative innovation contributes to efficiency improvement. Accordingly, this study examines whether exploitative innovation also contributes to public sector efficiency.

The Minister of Internal Affairs and Communications (2015) requested that each local public government promote business reforms to deliver administrative services more efficiently and effectively. Therefore, if explorative innovation is implemented alongside exploitative innovation, it may contribute to efficiency.

As an indicator of efficiency, the model employs the latest available data published by the Ministry of Internal Affairs and Communications for the fiscal year 2022. Specifically, per-capita administrative costs, calculated by dividing total administrative costs by the population based on the Basic Resident Register in Japan, as the dependent variable. It is assumed that CI enhances efficiency and reduces per capita administrative costs. This assumption is reflected in Figure 2. Based on the earlier arguments, the following hypotheses are proposed:

H5: Upward collaboration (Up) indirectly and negatively affects administrative cost per capita (ACperPop) through exploitative innovation (Exploi).
H6: Inward collaboration (In) indirectly and negatively affects administrative cost per capita (ACperPop) through exploitative innovation (Exploi).
H7: Inward collaboration (In) indirectly and negatively affects administrative costs per capita (ACperPop) through exploratory innovation (Explora).
H8: Outwards collaboration (Out) directly affects administrative costs per capita (ACperPop) and indirectly negatively affects exploratory innovation (Explora).

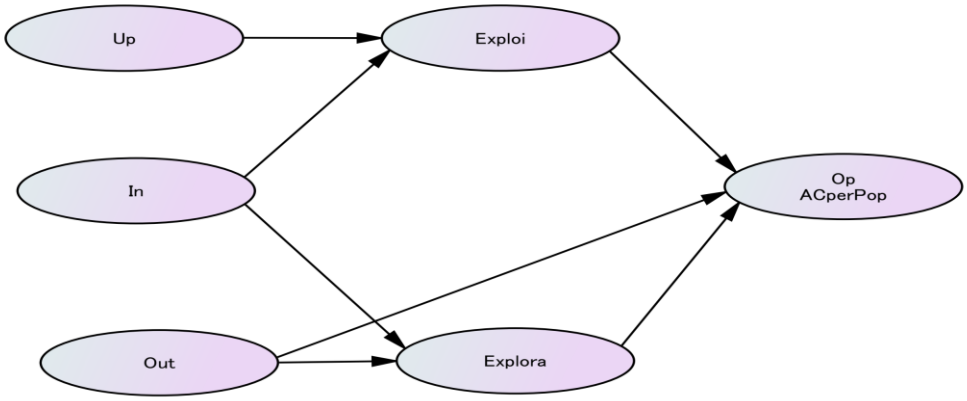

Figure 2. Relationship between collaboration, innovation, and organisational performance (‘core model’) (source: Barrutia and Echebarria, 2019, with author's additions).

4 Data and Methods

Data for the structural equation model (SEM) analysis were collected through a mail questionnaire survey conducted in February 2024 across all 792 cities (government-designated cities, core cities, special municipalities, and other cities) in Japan. Responses were also sent electronically. Before sending the questionnaire, two practitioners working in city halls and two management accounting researchers with expertise in public organisations reviewed and revised the questionnaire to ensure appropriate wording and question items. The questionnaire was sent with a self-addressed stamped envelope, requesting that the person responsible for management in departments involved in administrative reform (e.g., the Administrative Management Division and General Policy Division) complete it. As an incentive, respondents were offered a report on the results of the analysis upon request. To improve response rates, a reminder letter was sent before the deadline. In total, 405 organisations responded (response rate: 51.14%). The questionnaire included additional measures not directly related to this study’s research questions. Appendix 1 presents the complete survey instrument for transparency. Respondents were generally section managers or higher-ranking personnel in the relevant departments.

The analysis employed SEM using the statistical software R and Lavaan package (Rosseel, 2012). SEM is suited to this study as it enables the simultaneous examination of associations among multiple independent and dependent variables with indirect effects within a unified analytical framework. This approach yields more nuanced and realistic estimates of complex relationships than conventional methods such as regression analysis (Kline, 2023).

The proportion of missing values across all responses was 1.06%, with 4.20% of the 405 municipalities having at least one missing value. The rate of missing data did not exceed 2.5% for any item, indicating a limited impact on the analysis. Public sector survey studies (eg., Hameduddin & Lee, 2019) have also employed listwise deletion; accordingly,

this study adopts the same approach. Effectively, the analysis focuses on 388 municipalities without missing values and further narrows the sample to 378 municipalities for which the per capita administrative cost can be calculated.

A significant problem commonly observed in survey research is common method variance (CMV), along with related concepts such as common method bias. CMV can distort assessments of the reliability and validity of latent variables, and lead to biased estimates of parameters that describe the relationships between measures of different constructs if not controlled (Podsakoff et al., 2003; Podsakoff et al., 2024).

To address CMV, Ding et al. (2022) proposed the unmeasured latent method construct (ULMC) technique with the addition of identifying indicators, which performs better than the CFA marker technique. The aforementioned authors showed that the chi-square test for model fit and chi-square difference test can be employed to assess the presence of CMV and identify the number of method constructs. Accordingly, first, CMV is detected by applying the chi-square goodness-of-fit test to the basic confirmatory factor analysis (CFA) model and conducting a chi-square difference test to compare the basic CFA model with the conventional one-dimensional ULMC model without identifying indicators (Step 1). If no significant difference is present, CMV is not confirmed. Otherwise, it is necessary to generate values for the identifying indicators, one per trait factor, using a correlation ($\leq .3$) with the corresponding standardised scale means. The number of method constructs is then determined by sequentially fitting the multidimensional ULMC (for example, two- (Step 2) and three-dimensional models (Step 3)), incorporating identifying indicators until either the chi-square goodness-of-fit or chi-square difference tests become non-significant.

The ULMC technique is used in this study. Regarding the CFA of the core model, a chi-square difference test ($\Delta\chi^2 = 2.501$, $\Delta df = 12$, $p = .9982$) indicates that the inclusion of a method factor does not significantly improve model fit, suggesting that CMV is not a critical issue in this model. Therefore, a more parsimonious measurement model without method factors is retained for the subsequent SEM analyses.

5 Results

5.1 Measurements

All questions in the survey were rated on a seven-point Likert scale, with ‘1’ indicating ‘completely disagree’ and ‘7’ indicating ‘completely agree’. Questions regarding collaboration were as follows: ‘Please circle your level of agreement with the extent to which the following statements represent activities related to administrative reform in your city over the past three years.’ On innovation, participants were asked: ‘Please circle your level of agreement with the extent to which the following statements describe your city's administrative reform-related accomplishments over the past three years.’ On organisational performance, participants were asked: ‘How do you rate the performance of your unit relative to other comparable units (*) on each of the following dimensions? (*) Assumes departments in the public but perhaps also in the private sector.’

5.2 Measurement Model

The measurement model in the core model demonstrated a reasonable fit to the data: χ^2 = 307.45 (df = 190), comparative fit index (CFI) = .980, Tucker–Lewis index (TLI) = .976, and root mean square error of approximation (RMSEA) = .045. Table 1 presents the results of convergent validity and reliability analyses . The wording of the scales, composite reliability (CR), and average variance extracted (AVE) were reported. All items loaded significantly on their respective constructs, with standardised loadings ranging from .674 to .977. The AVE values ranged from .611 to .881, all exceeding the .50 threshold, indicating convergent validity for each latent construct (Hair et al., 2019). All variables exhibited good internal consistency, with CR values ranging from .804 to .937 (Hair et al., 2019).

Table 1. Core model: Convergent validity and reliability assessment

Construct and Item	Stand. Loading	CR	AVE
Indicate your degree of agreement about how well these statements describe your sustainability-related innovation activities during the last three years.			
Upward Collaboration (Up)		**0.927**	**0.824**
(1) The frequency of interaction with HTG is high. (Note) any type of interaction, such as a conference call, a meeting, and so on.	0.951***		
(2) The intensity of interaction with HTG is high. (Note) degrees of detailed information exchange and cooperation.	0.961***		
(3) We have a fluid relationship with HTG representatives.	0.810***		
Inward Collaboration (In)		**0.937**	**0.881**
(4) The frequency of meetings with local stakeholders is high.	0.977***		
(5) The variety of local stakeholders with whom we interact is high. (Note) any type of interaction, such as telephone calls, meetings, and so on.	0.902***		
Outward Collaboration (Out)		**0.935**	**0.815**
(6) The frequency of meetings with other municipality representatives is high.	0.933***		
(7) The number of municipalities with which we interact is high. (Note) any type of interaction, such as telephone calls, meetings, and so on.	0.933***		
(8) The intensity of our interaction with other municipalities is high. (Note) degrees of detailed information exchange and cooperation.	0.936***		

(9) We have a fluid relationship with other municipality representatives.	0.821***		
Exploitative Innovation (Exploi)		**0.804**	**0.638**
(10) We regularly implement small adaptations to our existing service.	0.848***		
(11) We frequently refine the provision of existing services.	0.870***		
(12) We are well known for regularly improving the provision efficiency of our existing services.	0.705***		
Explorative Innovation (Explora)		**0.839**	**0.681**
(13) We are well known for experimenting with new services and operations.	0.731***		
(14) We lead the way in introducing innovations that require brand-new competencies.	0.896***		
(15) We constantly consider introducing innovations that go beyond what is usual in a municipality.	0.850***		
Organisational Performance (Op)		**0.896**	**0.611**
(16) The amount of work and/or the number of products produced in your unit.	0.793***		
(17) The accuracy of work produced in your unit and/or the quality of the goods delivered.	0.826***		
(18) The number of innovations, process improvements, or new ideas implemented by your unit.	0.741***		
(19) The reputation for work excellence of your unit.	0.835***		
(20) The attainment of production or service level goals of your unit.	0.896***		
(21) The efficiency of operations without your unit.	0.767***		
(22) The morale of unit personnel.	0.674***		
Model fit indexes (Robust): χ^2=307.453; d.f.=190; CFI=0.980; TLI=0.976; RMSEA=0.045; SRMR=0.051			

***<.01, **<.05, and *<.10.

CFI: Comparative fit index; TLI: Tucker-Lewis index; RMSEA: Root mean square error of approximation; SRMR: Standardised root mean square residual.

Table 3. Descriptive statistics and correlations

Variable	Mean	Std.Dev.	Min	Max
Upward	0	1.225	-2.066	3.867
Inward	0	1.408	-2.275	3.702
Outward	0	1.249	-2.248	3.807
Exploitative	0	0.920	-2.871	2.652
Explorative	0	0.911	-2.177	2.985

OP	0	0.670	-3.107	2.546

Note: All variables have 378 observations.

Table 4 presents the correlations. As in the Spanish case, exploitative and explorative innovation exhibit a significant positive correlation (r = 0.799). Given that this correlation coefficient is substantially higher than that reported for Spain (r = 0.323), this preliminarily suggests that local governments in Japan tend to implement both types of innovation in combination to a greater extent (Barrutia & Echebarria, 2019).

Table 4. Correlation matrix

	Upward	Inward	Outward	Exploitative	Explorative	Op
Upward	1					
Inward	0.533***	1				
Outward	0.719***	0.574***	1			
Exploitative	0.467***	0.428***	0.450***	1		
Explorative	0.454***	0.400***	0.506***	0.799***	1	
Op	0.287***	0.265***	0.389***	0.441***	0.483***	1

Note: ***<.01, **<.05, *<.10.

5.3 Structural Model Estimation Results

A structural analysis of Hypotheses 1–4 was conducted to confirm the relationship between the latent variables. The results are shown in Table 5. Inward and outwards collaboration have indirect effects on organisational performance through exploratory innovation. Outwards collaboration also has an indirect impact on organisational performance. Thus, Hypotheses H3 and H4 were supported. However, the indirect effect of upward and inward collaboration on organisational performance through exploitative innovation was not supported.

Table 5. Core Model 1: Structural model estimation results

Hypothesis and other effects				Model		
	B			Estimate	Est./S.E.	p-Value
Direct effects						
a1	Upward Collaboration	→	Exploitative Innovation	0.166***	3.852	0.000
a2	Inward Collaboration	→	Exploitative Innovation	0.194***	4.303	0.000
b1	Inward Collaboration	→	Explorative Innovation	0.138***	3.447	0.001
b2	Outward Collaboration	→	Explorative Innovation	0.226***	5.333	0.000
c1	Exploitative Innovation	→	Organisational Performance	0.091	1.530	0.126

c2	Explorative Innovation	→	Organisational Performance	0.205***	3.367	0.001
c3	Outward Collaboration	→	Organisational Performance	0.094**	2.579	0.010
Indirect effects						
a1*c1	Up → Exploi	→	Op	0.015	1.401	0.161
a2*c1	In → Exploi	→	Op	0.018	1.395	0.163
b1*c2	In → Explora	→	Op	0.028***	2.660	0.008
b2*c2	Out →Explora	→	Op	0.046***	3.035	0.002
Total effects (Direct effects + Indirect effects)						
(a1*c1)	Total_Up	→	Op	0.015	1.401	0.161
(a2*c1)+(b1*c2)	Total_In	→	Op	0.046***	3.133	0.002
c3+(b2*c2)	Total_Out	→	Op	0.141***	3.854	0.000
R-Square						
Exploitative Innovation				0.194		
Explorative Innovation				0.211		
Organisational Performance				0.244		
Fit Indexes				χ^2=283.06; d.f.=192; CFI=0.984; TLI=0.981; RMSEA=0.040; SRMR=0.061		

***<.01, **<.05, and *<.10.

CFI: Comparative fit index; TLI: Tucker-Lewis index; RMSEA: Root mean square error of approximation.

As for Hypotheses H5-H8, in Core Models 2 and 1, the relationships between each form of collaboration and innovation are statistically significant (See Table 6). The indirect effects of inward and upward collaboration on per capita administrative costs are also negative at the 5% level, thereby supporting Hypotheses H5 and H6.

Table 6. Core Model 2: Structural model estimation results

Hypothesis and other effects				Model		
B				Estimate	Est./S.E.	p-Value
Direct effects						
a1	Upward Collaboration	→	Exploitative Innovation	0.166***	3.845	0.000
a2	Inward Collaboration	→	Exploitative Innovation	0.190***	4.221	0.000
b1	Inward Collaboration	→	Explorative Innovation	0.140***	3.486	0.000

b2	Outward Collaboration	→	Explorative Innovation	0.226***	5.294	0.000
c1	Exploitative Innovation	→	ACperPop	-0.061***	-2.620	0.009
c2	Explorative Innovation	→	ACperPop	0.042*	1.776	0.076
c3	Outward Collaboration	→	ACperPop	-0.019	-1.487	0.137
Indirect effects						
a1*c1	Up → Exploi	→	ACperPop	-0.010**	-2.137	0.033
a2*c1	In → Exploi	→	ACperPop	-0.012**	-2.395	0.017
b1*c2	In → Explora	→	ACperPop	0.006	1.607	0.108
b2*c2	Out → Explora	→	ACperPop	0.010*	1.688	0.091
Total effects (Direct effects + Indirect effects)						
(a1*c1)	Total_Up	→	ACperPop	-0.010**	-2.137	0.033
(a2*c1)+(b1*c2)	Total_In	→	ACperPop	-0.006	-1.509	0.131
c3+(b2*c2)	Total_Out	→	ACperPop	-0.009	-0.742	0.458
R-Square						
log_ACperPop				0.029		
Exploitative Innovation				0.191		
Explorative Innovation				0.211		
Fit Indexes				χ^2=260.96; d.f.=122; CFI=0.972; TLI=0.965; RMSEA=0.059; SRMR=0.127		

***<.01, **<.05, and *<.10.

CFI: Comparative fit index; TLI: Tucker-Lewis index; RMSEA: Root mean square error of approximation.

5 Discussion

This study extends the model developed by Barrutia and Echebarria (2019), and demonstrates the impact of CI on organisational performance and per capita administrative cost. Differing from prior works, besides examining the direct effects of exploitative and explorative innovation, this study also identifies the indirect effects of different forms of collaboration on outcomes through innovation. Given that the impact of CI has remained unclear in extant studies (Barrutia & Echebarria, 2019; Torfing, 2016), the finding that explorative innovation contributes to improvements in organisational performance and that exploitative innovation helps reduce administrative costs represents a key contribution of this research.

Moreover, while Barrutia and Echebarria (2019) rejected the direct effect of

inward collaboration on exploitative innovation in their study of Spanish local governments, this study incorporates inward collaboration into the model, considering Japan's long-standing practices of collaboration with citizens and non-profit organisations. Moreover, differing from the Spanish case, this study shows that inward collaboration significantly contributes to reducing administrative costs through exploitative innovation.

Finally, this study has some limitations. First, its approach is not consistent with extant research as it uses survey-based methods (eg. Speklé & Verbeeten, 2014), which has may introduce bias as it records the perceptions of managerial staff in charge of administrative reform in city governments. Nonetheless, using per capita administrative cost as a dependent variable allows the study to alternately capture innovation outcomes through a robust indicator. This is key strength compared to prior research.

Further, as noted by Barrutia and Echebarria (2019), the present study simplifies collaboration into three forms: upward, inward, and outward. However, in practice, a wider range of collaborative efforts may take place. As such, the inability to capture this wider variety of collaborations remains a limitation.

Despite these limitations, this study's demonstration of the relationship between CI, and outcomes such as organisational performance and administrative cost contributes to the growing body of knowledge on collaboration and innovation in the public sector.

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Appendix 1

Table A1: Constructs and Questions

Upward Collaboration (Up)

	Item	Scale	Mean	Std
1	The frequency of interaction with HTG is high. (Note) any type of interaction, such as a conference call, a meeting, and so on.	1–7	3.06	1.32
2	The intensity of interaction with HTG is high. (Note) degrees of detailed information exchange and cooperation.	1–7	3.04	1.34
3	We have a fluid relationship with HTG representatives.	1–7	3.33	1.32

(Cronbach's alpha = 0.94)

Inward Collaboration (In)

	Item	Scale	Mean	Std
4	The frequency of meetings with local stakeholders is high.	1–7	3.23	1.47
5	The variety of local stakeholders with whom we interact is high. (Note) any type of interaction, such as telephone calls, meetings, and so on.	1–7	3.41	1.55

(Cronbach's alpha = 0.94)

Outward Collaboration (Out)

	Item	Scale	Mean	Std
6	The frequency of meetings with other municipality representatives is high.	1–7	3.11	1.38
7	The number of municipalities with which we interact is high. (Note) any type of interaction, such as telephone calls, meetings, and so on.	1–7	3.2	1.39
8	The intensity of our interaction with other municipalities is high. (Note) degrees of detailed information exchange and cooperation.	1–7	3.21	1.38
9	We have a fluid relationship with other municipality representatives.	1–7	3.65	1.36

(Cronbach's alpha = 0.95)

Exploitative Innovation (Exploi)

	Item	Scale	Mean	Std
10	We regularly implement small adaptations to our existing service.	1–7	4.63	1.14
11	We frequently refine the provision of existing services.	1–7	4.27	1.24

12	We are well known for regularly improving the provision efficiency of our existing services.	1–7	3.45	1.21

(Cronbach's alpha = 0.86)

Explorative Innovation (Explora)

	Item	Scale	Mean	Std
13	We are well known for experimenting with new services and operations.	1–7	3.44	1.24
14	We lead the way in introducing innovations that require brand-new competencies.	1–7	3.32	1.33
15	We constantly consider introducing innovations that go beyond what is usual in a municipality.	1–7	3.47	1.32

(Cronbach's alpha = 0.87)

Organisational Performance (Op)

	Item	Scale	Mean	Std
16	The amount of work and/or the number of products produced in your unit.	1–7	4.37	0.86
17	The accuracy of work produced in your unit and/or the quality of the goods delivered.	1–7	4.43	0.83
18	The number of innovations, process improvements, or new ideas implemented by your unit	1–7	4.3	1.03
19	The reputation for work excellence of your unit	1–7	4.15	0.80
20	The attainment of production or service level goals of your unit	1–7	4.31	0.80
21	The efficiency of operations without your unit	1–7	4.3	0.89
22	The morale of unit personnel	1–7	4.53	0.99

(Cronbach's alpha = 0.92)

Upward Machine-to-Machine Interactions (UpM2M)

	Item	Scale	Mean	Std
23	Systems in use are jointly cloud-based with HTG	1 – 7	1.97	1.27
24	The system in use is standardised with HTG	1 – 7	1.83	1.12
25	The system has been improved through customisation in a joint cloud with HTG	1 – 7	1.76	1.13

(Cronbach's alpha = 0.89)

Outward Machine-to-Machine Interactions (OutM2M)

	Item	Scale	Mean	Std
26	The system in use is jointly cloud computing system with other municipalities.	1 – 7	3.04	2.02
27	The system in use is standardised with other municipalities.	1 – 7	2.43	1.66

28	The system has been improved through customisation in a joint cloud with other municipalities.	1 – 7	2.35	1.59

(Cronbach's alpha = 0.85)

Information Systems Infrastructure Capability (ISIC)

	Item	Scale	Mean	Std
29	Our information systems (IS) infrastructure is suitable for developing customised software applications when needed.	1 – 7	2.94	1.36
30	Our IS infrastructure can respond quickly to requests from internal and external customers.	1 – 7	3.41	1.39
31	The capacity of our network infrastructure is fully competent to meet our organisation's needs.	1 – 7	3.99	1.32
32	Our organisation's data can be shared with internal and external units of the organisation.	1 – 7	2.90	1.42
33	Our IS infrastructure is highly secure to protect our company from intruders and hackers.	1 – 7	5.67	1.06
34	Our IS infrastructure provides fast and flexible operations for internet-based systems.	1 – 7	3.81	1.48

(Cronbach's alpha = 0.70)

Information Systems Human Resources Capability (ISHRC)

	Item	Scale	Mean	Std
35	Our IS staff has adequate knowledge of computer-based systems.	1 – 7	4.24	1.24
36	Our company seeks a high degree of computer-based technical expertise from the IS department/unit employees.	1 – 7	4.31	1.39
37	Our IS staff can learn quickly and apply new technologies as they become available.	1 – 7	4.27	1.18
38	Our IS staff has the skills and knowledge to manage projects in our current business environment.	1 – 7	4.13	1.21
39	Our IS staff can work closely and efficiently with our employees and customers.	1 – 7	4.56	1.13
40	Our IS staff is capable of rapidly discovering potential problems in the systems.	1 – 7	3.96	1.29
41	Our IS staff is capable of quickly maintaining the system whenever a failure occurs.	1 – 7	4.29	1.28

(Cronbach's alpha = 0.90)

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