Seeking the 'Smart' in Cities: Managing the process of Innovating with IT

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Abstract

A smart city can be defined as a city seeking to address public issues via information technology solutions on the basis of a multi-stakeholder, municipally based partnership. Core to the smart city agenda is realizing a new innovation strategy for municipal governance based on high levels of cooperation among stakeholders to improve the efficiency and quality of public service delivery. Governments can enact an integrated digital platform to support high levels of cooperation among stakeholders with process management, and thereby align cooperative activities with public priorities. Drawing on punctuated equilibrium theory, we examine what know-how enables some city managers to manage implementation of an integrated digital platform for innovating with IT, and what know-how is lacking in city governments that fail to do so. We report evidence from case studies in eleven city governments to identify what know-how city managers require for the competence to manage such an implementation.

Keywords
IT governance, digital platform, knowledge management, smart cities, e-government.

Introduction

Conventionally, city services and resources such as water, waste, energy, and transportation have been governed by distinct public-sector entities with vertical IT systems architectures, which lead to application silos and raise boundaries within the public sector (Polak et al. 2014). This piecemeal architecture causes inefficiencies in asset planning and service delivery, which city governments can ill afford. Instead, as depicted in Figure 1, the conceptual architectural solution builds on massive real-time data gathered from technologies embedded throughout the sectors of public service delivery; i.e., the "Internet of Things" (IERC 2015). Integrating these data and applying modeling and predictive analytics can enable city managers to sense capacity problems, to predict future needs and the impact of IT-enabled innovations in public service delivery, and to fuse relevant information to manage these innovations; i.e., the "Internet of Services". However, the design or architecture of technology does not, on its own, determine how organizations use or "enact technology" in practice (Luna-Reyes and Gil-Garcia 2014; Orlikowski 2000). Therefore, we distinguish two aspects of IT implementation as (1) IT architecture, which is distinct from (2) enactment of technology, as follows.

While users can and do enact technologies in support of improved business processes, they also can and do circumvent designers' intended ways of using technologies by ignoring certain properties of the technology or working around them (Orlikowski 2000). It is users' *knowledge* of the technology and its relevance to improving their business processes that determines how organizations enact technology in practice. Pittaway et al. (2018) show that, for example, the know-how CIOs bring into public administrations is a causal factor in technology enactment for efficient and effective public service delivery. Research in the public-sector context finds, therefore, that we need to study what city governments learn that enables them to enact technology as an integrated digital platform to support high levels of cooperation among stakeholders with process management (Azad and Faraj 2008); i.e., "innovating with IT". This perspective raises fundamental questions about what know-how city managers require for innovating with IT.

Related to these questions, some scholars have examined the capacity of governments (i.e., know-how) to

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address public issues via IT solutions but focus primarily on financial rather than internal process outcomes (Carter 2015). As such, guidance for innovating with IT in "smart city research is at a relative early stage with respect to its conceptual development and empirical understanding. While the term has gained popular traction amongst academics, businesses, government and media, accounts tend to either be idealistic and/or technical, or critical but lacking in nuance and/or empirical evidence" (Kitchin (2015), p. 135). The resulting dearth of guidance is problematic because we still do not understand *what know-how do city managers require for innovating with IT?*
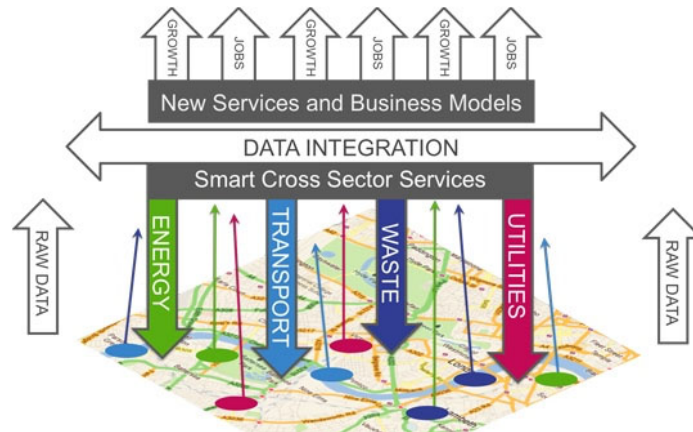

Figure 1. Integrated digital platform for innovating public services (Imperial 2014)

This article addresses this research question by advancing a perspective on organizational know-how to manage the disruptive "punctuated" organizational changes that are required to implement an integrated digital platform in support of innovating with IT. It then reports evidence from empirical case studies in eleven city governments to identify what know-how city managers require to manage such an implementation.

Innovating with IT in City Governments

A smart city can be defined as a city seeking to address public issues via IT-based solutions on the basis of a multi-stakeholder, municipally based partnership (Manville et al. 2014). Core to the smart city agenda is realizing a new *innovation strategy* for municipal governance based on high levels of cooperation among stakeholders to improve the efficiency and quality of public service delivery (Chourabi et al. 2012). Governments can enact IT as an integrated digital platform to support high levels of cooperation among stakeholders with process management, and thereby align cooperative activities with public priorities (Cordella and Iannacci 2010). Alternatively, governments can deploy new technologies without enacting an integrated digital platform for process management to avoid the costs of process change. However, the latter approach leads to problems such as: (1) inefficiencies and errors due to redundant search and re-entry of data in multiple incompatible systems; (2) lack of understanding among stakeholders regarding their role in business processes that span multiple departments; and (3) difficulty attaining consensus on priorities because of lack of collaboration and transparency among stakeholders (Nath 2012). Therefore, if city governments are to realize the full potential of a multi-stakeholder, municipally based partnership (i.e., innovating with IT), enacting an integrated digital platform is a prerequisite.

To this end, city governments can implement enterprise resource planning (ERP) systems as integrated digital platforms to manage improved business processes across the conventional boundaries of public service delivery (Weerakkody et al. 2011). Nonetheless, as few as 10% of city governments acquiring smart city technologies have implemented ERP as an integrated digital platform to support high levels of cooperation among stakeholders with process management (Manville et al. 2014). The focus of this article is on how city governments manage ERP implementation, and why few city governments achieve an integrated ERP implementation that supports innovating with IT.

We have long known that organizations' performance is related to aligning IT and business strategies, IT and business structures, and structure and strategy (Hirschheim and Sabherwal 2001). To that end, a rich

body of organizational dynamics literature examines how organizations manage change in these characteristics over time. By comparison, Kitchin (2015) finds that guidance for managing dynamic organizational change in support of innovating with IT is generally under-developed and lacking in nuance and/or empirical evidence. To ameliorate these shortcomings, we adopted a conceptual framing from organizational dynamics literature to examine what know-how enables some city managers to manage implementation of ERP as an integrated digital platform for innovating with IT, and what know-how is lacking in city governments that fail to do so.

Theoretical Framing

Punctuated equilibrium theory conceptualizes dynamic change in organizations as occurring over long periods of gradual evolution that are "punctuated" by revolutionary periods of change. This conceptualization fits the slow and heterogeneous changes observed in public-sector organizations better than alternatives such as the short cycles of structuration theory, and universalistic life-cycle theories (Silva and Hirschheim 2007). Because implementations of ERP vary in terms of organizational change that can take up to eleven years to complete (Phang et al. 2008), we conceptualize ERP implementation in terms of punctuated equilibrium.

Central to punctuated equilibrium theory is the notion that radical changes in an organization's services and technology require modifications in the underlying dimensions of its "deep structure" (Silva and Hirschheim 2007). In the context of IT-enabled change, organizational deep structure can be defined as the organization's choices in four dimensions: (1) business strategy, (2) IT strategy, (3) business structure, and (4) IT structure (Sabherwal et al. 2001). By accumulating a history of experience while embedded in an organization's deep structure, managers establish cognitive frameworks: a set of givens about the organization's situation and how it will behave that form a stable foundation from which they operate (Gersick 1991). Cognitive frameworks provide managers a sense of competence in knowing how to achieve the incumbent business strategy, so established cognitive frameworks can be profoundly functional when business strategy remains stable. However, when organizations pursue an innovative new IT-enabled business strategy, managers' established cognitive frameworks could become dysfunctional.

When organizations shift to an innovative new IT-enabled business strategy, organizational performance depends on attaining the appropriate IT strategy, business structure and IT structure to execute the new strategy (Hirschheim and Sabherwal 2001).   However, managers tend to interpret novel shifts within the limits of their old cognitive frameworks, thereby preserving their old cognitive frameworks (Gersick 1991). Consequently, they tend not to change their fundamental approach to business processes, strategies and organizational structures. That is, managers tend to preserve deep structure despite the need for change. Therefore, if organizations are to attain the appropriate IT strategy, business structure and IT structure to execute an innovative new IT-enabled business strategy, they must break managers' established cognitive frameworks in order to make way for new ones. Best practices for managing this frame-breaking change call for a revolutionary period of discontinuous change (Tushman et al. 1986).

Discontinuous change is frame-breaking change. During revolutionary periods of discontinuous change, top managers rapidly change all four dimensions of deep structure concurrently. This concurrent break from past strategies and structures serves to break managers' old cognitive frameworks to make way for new ones. Managing concurrent change in strategy and structure, such as a fresh mission with revised norms and values (i.e., strategy) backed up with power and status (i.e., structure), provides strong reinforcement of change. Short-term detrimental effects on organizational performance, which stem from the disruption of organizational attributes during concurrent change, stress the need to complete these changes rapidly. To that end, managers should exploit political changes, public demand for services, new technologies, crises induced by poor performance and looming deadlines, and visionary new leadership as opportunities to trigger rapid and concurrent change (Silva and Hirschheim 2007). Management should exploit these *trigger events* to usher in a new cognitive framework by championing a new vision for the organization's future that raises aspirations, by generating enthusiasm for a new approach to achieve the vision, and by highlighting the gaps between existing organizational arrangements and those necessary to achieve the new vision. For example, a city seeking to address public issues via IT-based solutions on the basis of a multi-stakeholder, municipally based partnership can be considered a radical change in business strategy from using IT in cutting costs of present operations to innovative use of technology to bring about new means of operational efficiency. Radical change in *business strategy* requires change in IT strategy,

business structure and IT structure. It is expected that ERP implementation will bring about tightly coupled task interdependence, as it will have to run across different organizational units (i.e., *business structure*). This implies a profound transformation of the targeted business processes as well as redistribution in the allocation of resources (Sharma and Yetton 2007). To this end, all functional and process strategies are encompassed under the umbrella of *IT strategy* with digital resources serving as the connective tissue. Implementation of IT strategy is achieved through the supporting IT structure dimension of deep structure.

The *IT structure* dimension refers to the structure of decision rights and accountability for IT management decisions (Sabherwal et al. 2001), which has come to define the structure of IT governance (Xue et al. 2008). Best practices call for a mindful approach to IT governance involving five practices: deference to expertise, commitment to resilience, performance monitoring, sensitivity to operations, and complexity seeking (Plotnick et al. 2009; Weick et al. 1999). A mindful approach to IT governance *defers to expertise* by placing individuals possessing the most relevant knowledge in direct control of key decisions. Because the chief information officer (CIO) should possess a unique mixture of IT and business knowledge, he/she should be empowered to identify and interpret the potential of ERP to the organization (Guillemette and Paré 2012). *Commitment to resilience* requires that one expects there will be errors and develops techniques to recover quickly from them while they are still small and manageable (Plotnick et al. 2009; Weick et al. 1999). To do so, all experts must be on-board and actively collaborating in strategic IT decisions. The city of Chicago, for example, found that implementing smart city technologies requires mayors leading task forces that make policy to leverage technology and drive innovation wherever possible (Mathis 2014). Closely *monitoring performance* highlights gaps between existing organizational arrangements and those necessary to achieve new strategic objectives. *Sensitivity to operations* helps to mitigate oversimplified interpretations of the need for change. It is a collective accomplishment that requires knowing how to promulgate a shared vision for possible future states for the organization. *Complexity seeking* involves cycles of renewal and revision of business processes such that they encapsulate new experience-based know-how over time. In this way, business processes become increasingly complex, which increases the repertoire of possible responses to trigger events. Based on the preceding literature, we can conceptualize implementing ERP as an integrated digital platform for innovating with IT in terms of managing discontinuous change in all four dimensions of deep structures from one time period to another, as depicted in Figure 2.
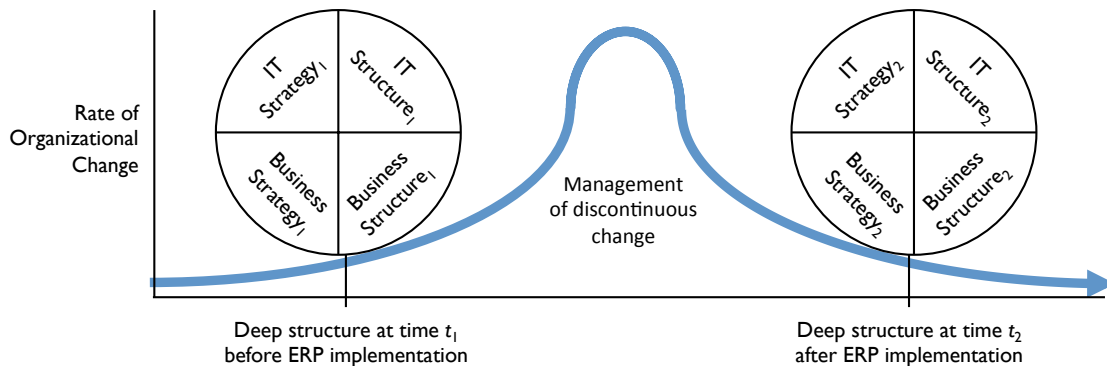

Figure 2. Conceptual framing: implementing ERP as a digital platform for innovating with IT

The problem arises when top managers avoid initiating significant changes to strategy and structure in response to trigger events. In this case, they adhere to the old strategies and structures despite the need for significant change (McDonald and Westphal 2003). As a result, they tend to pursue *convergent* change (Tushman et al. 1986). During convergent change, managers can implement new IT systems that can change horizontal integration of business processes (i.e., business structure), but they attempt piecemeal changes in support of old business strategy. Considering that even piecemeal change in business structure imply shifts in the balance of power and status, some managers would lose in the shift while others gain. Consequently, this slow piecemeal approach to change gets bogged down in politics as pockets of resistance have a chance to grow, develop, and undermine change. Thus, organizations can emerge from slow piecemeal change initiatives weakened by discord without having accomplished necessary revisions in deep structure (Gersick 1991). Hence, we should expect that city governments fail to implement ERP as an integrated digital platform for innovating with IT because management lacks the know-how to exploit trigger events and manage discontinuous change in all four dimensions of deep structures.

Research Design

We selected eleven Canadian city governments cases to assess *what know-how do city managers require for innovating with IT* for three reasons. First, United Nations reports for 2001-2010 consistently ranked Canada among the top ten e-Government initiatives. Thus, we would expect enriched know-how by city managers for innovating with IT to be well-represented in Canadian city governments. Second, the eleven cities selected for our empirical research had acquired ERP systems in 1999. This enabled us to assess their comparative ERP implementation progress through time. Third, ERP systems are expected to be well-implemented within eleven years (Phang et al. 2008). Nonetheless, a report showed that these eleven cities were at different stages of ERP implementation eleven years after adoption of ERP systems (MMAH 2010). Thus, the eleven cases provide an enriched variation of *know-how by the city managers for innovating IT*.

To assess our research question, we examined the discursive and material realities of existing smart city developments illuminated through comparative studies that contrast the experiences of different city governments (Kitchin 2015). This approach contributes substantive insight into how specific initiatives are formulated, gain (or fail to gain) political and financial backing, and roll out in the messy reality of established city governments (Kitchin 2015). To that end, and consistent with prior case studies in the public sector (Kamal et al. 2011), our research methodology consisted of three phases – (1) research design, (2) data collection and (3) data analysis and synthesis, which are highlighted as follows.

The preferred research design was based on an exploratory case studies methodology because extant theory of dynamic organizational change in support of efficient innovating with IT is generally under-developed and lacking in nuance and/or empirical evidence (Yin 2003). Our case studies concerned eleven city governments' implementations of ERP over time. This type of case study can also be labeled as revelatory (ibid.) since researchers have the opportunity to investigate situations and phenomena of which little is known. Through semi-structured interviews with CIOs in each of the city governments, we gained access to the experiences of the top managers possessing a unique mixture of IT and business knowledge in the organization (Guillemette and Paré 2012). This presented us the opportunity to explore how city governments manage discontinuous change in deep structure. CIOs' responses to our semi-structured interview questions resulted in 19 hours of transcripts, which we used to code key events, interpretations and organization-level factors. In the interest of parsimony, the semi-structured questions and coding matrix are incorporated with our findings into Table 1 in the next section.

We took steps to naturally control political, service and technology triggers for public-sector organizations (Silva and Hirschheim 2007) by selecting eleven city governments in a single jurisdiction in Canada that: (1) experienced the same regulatory changes and four-year election cycles, (2) provided the same 12 basic public services, and (3) had all acquired ERP technology in 1999. We then coded their ERP implementations according to: (1) IT architecture, which can be used to classify technology deployments into qualitative profiles (Ross 2003), and (2) their technology enactment, using the proxy of city governments' investments in user education to support ERP enactment, consistent with prior public-sector research (Azad and Faraj 2008). We obtained IT budgets for each city government from annual budget documents, and IT budget benchmarks for private sectors from Gartner (Guevara et al. 2012). Business strategy was coded in terms of the established typology of 'defenders' (which emphasize efficiency in existing operations), 'prospectors' (which explore for innovative opportunities), or 'analyzers' (a hybrid of both types) (Sabherwal et al. 2001). IT strategy was coded in terms of the established typology of low-cost (i.e., efficiency), differentiation, innovation, growth, or alliances (Sabherwal et al. 2001). Business structure was coded in terms of vertical and horizontal integration arrangements (Silva and Hirschheim 2007). IT structure was coded in terms of whether or not an organization followed five best practices for mindful IT governance: deference to expertise, commitment to resilience, performance monitoring, sensitivity to operations, and complexity seeking (Plotnick et al. 2009; Weick et al. 1999). Data triangulation was used by comparing and contrasting the interview findings with document reviews as it was necessary to validate and verify the findings of the primary data with secondary information (Kamal et al. 2011),

Comparative Analyses

Analysis of innovating with IT over time necessitates a comparison of implementations in different time periods. The logical initial time period for comparison should coincide with the initial change trigger. Because new technology is a change trigger (Gersick 1991), our comparison begins with 1999 when all eleven

city governments acquired ERP systems. Empirical data are summarized in Table 1, with exemplar quotes from CIOs in Table 2, and comparative findings are elaborated next.

Concepts	Dimensions	Semi-structured questions *To what extent does your city practice/have...*	Supporting Literature	Data Sources	Findings for city governments in...			
					1999	2012		
					All 11	7	3	1
ERP implementation	■ Enactment of ERP	...benchmark-level investments in user education to enact ERP?	(Azad and Faraj 2008; Devadoss et al. 2002; Guevara et al. 2012)	I,D	×	×	×	✔
	■ IT architecture	...integrated architecture profile?	(Ross 2003; Weerakkody et al. 2011)	I,D	×	×	✔	✔
Trigger events	■ External	...4-year election cycles?	(Hanna 2010; MMAH 2010; Silva and Hirschheim 2007)	D		✔	✔	✔
		...experienced regulatory changes?		D		✔	✔	✔
		...12 basic public services?		D		✔	✔	✔
		...ERP technology acquired in 1999?		I,D		✔	✔	✔
	■ Internal	...experienced performance crisis?	(MMAH 2010; Silva and Hirschheim 2007)	I,D		×	×	✔
		...visionary new leadership?		I,D		×	×	✔
Best practices for managing discontinuous change	■ Business Strategy	...analyzer/prospector business strategy?	(Sabherwal et al. 2001; Tushman et al. 1986)	I,D	×	×	×	✔
	■ IT Strategy	...innovator type IT strategy?	(ibid.)	I,D	×	×	×	✔
	■ Business Structure	...vertical+horizontal process integration?	(ibid.)	I,D	×	×	✔	✔
	■ IT Structure	...deference to CIO expertise?	(Plotnick et al. 2009; Tushman et al. 1986; Weick et al. 1999)	I,D	×	×	✔	✔
		...collaborative executive decision-making (commitment to resilience)?		I,D	×	×	✔	✔
		...new performance monitoring?		I,D	×	×	×	✔
		...shared vision (sensitivity to operations)?		I,D	✔	✔	✔	✔
		...change (complexity) seeking?		I,D	×	×	×	✔

Notes: Data sources (D=documents, I=interviews); Findings (✔=attribute present; ×=attribute not present)

Table 1. Comparison of ERP implementations and innovating with IT over time

CIO of Alpha	CIOs of other ten cities
On Business Strategy "Think of economic development, we are actually competing with cities all over the world. IT can play a role in that. For example, the mayor wanted our website to become the best in the world. So we developed in 2002 a view to the future as an enabled city with local government anytime, anywhere."	"We have a vision that information technology will enable departments to deliver cost-effective, quality programs to the population and businesses."
On IT Strategy "In 2002 we developed a smart city vision. We created three strategic groups led by executive management. By getting these smart city committees in place we feel that we were really starting to connect with those business players and ultimately the council and public. We also understood what the IT and business opportunities were for the next 2 to 3 years, and that helped us to get a better understanding and strategic view of IT."	"IT is viewed as a cost center. I want to shift this total cost of ownership focus to total value, but my problem is how do you change IT from a cost center to an opportunity center?"
On Business Structure "We implemented a central call center to improve access to all city programs. To accomplish that we did a complete business process re-engineering of the services in all programs so they could take maximum advantage of the central center and also feed information into it."	"We have a long-term vision and supplementing this vision is a number of master plans for roads, waste, social services, and so on, which are supposed to answer how each division is going to implement the vision of the organization."
On IT Structure "One thing we've done as a strategic piece is the IT group questions the business impacts of IT in business units. What are we getting out of this portfolio investment in IT? How good is it? How much does it align back to the strategic outcomes of the mayor, council, the public themselves, our programs? How well does this alignment work? What is the overall risk profile in managing this and what value are we getting out of it?"	"I have BSAs [business systems analysts] assigned to each department. Their job is to work with the department in using and fine-tuning some of the applications and support them as the subject matter expert. So, IT resources are to be managed in each group."

Table 2. Exemplar quotes from city CIOs

Pre-implementation

In 1999, all eleven city governments were beginning to implement ERP in a context characterized by an 'application silos' *IT architecture*, which is based on multiple incompatible legacy systems. In no case did managers have prior knowledge of how to *enact ERP* when they acquired ERP systems in 1999. The four dimensions of organizational deep structure – business strategy, IT strategy, business structure, and IT structure (Sabherwal et al. 2001) – were the same for all eleven city governments. Their *business strategies* focused on efficiency in existing operations (i.e., defender type), and their *IT strategies* focused on low-cost operational efficiency. Their *business structures* consisted of vertical business silos without horizontal integration among business processes. Their *IT structures* deviated from recommended best practices: deference to expertise, commitment to resilience, performance monitoring, sensitivity to operations, and complexity seeking. Specifically, business unit managers did not *defer to the expertise* of the CIO for IT acquisition decisions, and top management did not practice a *commitment to resilience* by collaborating with each other in strategic decisions, as recommended. Managers did not *monitor performance* for potential failures before they occurred, as recommended. While managers did share a vision to lower operating costs (i.e., *sensitivity to operations*), as recommended, they did not *seek complexity* by renewing old business processes. Next, we compare these 1999 findings to 2012 findings.

Implementation

Selecting 2012 as the comparison period allowed the city governments more than the standard eleven years to complete their ERP implementations (Phang et al. 2008). In 2012, only one city, which we call Alpha, was *enacting ERP* as an integrated digital platform to support high levels of cooperation among stakeholders with process management. Evidence from business unit budgets showed that Alpha made systematic business unit-level investments in educating its employees about the new integrated business processes and use of technology to achieve this level of technology enactment. For instance, the fire services business unit at Alpha explicitly identified education as a budgeted component in the rollout of new IT-enabled business processes, and explicitly recognized education as necessary to help its employees to understand how to use IT to improve the cost and quality of fire services. Alpha's investments in user education to enact ERP reflected in per-employee investments that were consistent with mean private-sector benchmarks (Guevara et al. 2012) (mean difference=-0.0098, not significant) and significantly higher than the other ten city governments ($F=759.813$, $p<0.001$). Enacting ERP as an integrated digital platform was key to Alpha's timely and efficient implementation of an innovative single-point contact center for all public services, and to Alpha's international award as one of the world's best smart city governments. Alpha's *IT architecture* provided an integrated architecture of standardized business processes across the conventional boundaries of public service delivery. Three other city governments also exhibited integrated architectures. They did not, however, make benchmark-level investments in user education to achieve the same level of ERP enactment as Alpha, and consequently users at all three city governments were not enacting IT as an integrated digital platform to support high levels of cooperation among stakeholders with process management. None of the remaining seven city governments made benchmark-level investments in user education to achieve the same level of ERP enactment as Alpha, and none of them exhibited an integrated IT architecture. Instead, they had implemented isolated modules of ERP alongside legacy systems and manual workarounds as application silos to support local business processes. Hence, implementations at ten city governments stalled short of enacting ERP as an integrated digital platform to support high levels of cooperation among stakeholders with process management. Next, we examine how Alpha managed change in deep structures from 1999-2012 in order to implement ERP, followed by a comparative analysis of how the other ten city governments managed change in the same period.

What Know-how do City Managers require for Innovating with IT?

Alpha experienced the external *trigger events* of four-year election cycles, rising demand for public services, and implementing ERP technology. However, these external trigger events alone cannot explain differences between ERP implementations at Alpha versus the other ten city governments, which all experienced the same three external triggers. Instead it was top management know-how to exploit internal trigger events of crisis and visionary newcomers as opportunities to break managers' old cognitive frameworks that, we found, distinguished Alpha from the other ten city governments.

A newly elected mayor at Alpha prescribed a new business strategy to address public issues via IT-based solutions on the basis of a multi-stakeholder, municipally based partnership. At the same time, top management also initiated frame-breaking change by exploiting a political crisis that called into question the established controls for IT investments and brought in a new CIO with visionary ideas from outside the organization. As a result, Alpha adopted a new 'analyzer' type *business strategy* (i.e., a hybrid of innovation and efficiency types) and a new 'innovation' type *IT strategy*. In order to execute the innovative new business strategy, top management at Alpha knew how to use ERP implementation to change *business structure* by adopting the horizontally and vertically integrated best-practiced business processes embedded in ERP. The IT-enabled change in business structure was supported with a new *IT structure* that shifted the balance of IT investment power and status from business unit managers to the CIO and an IT group led by top management, who directed IT investments toward integrated ERP. Given the high power and status of the new CIO, business unit managers *deferred to expertise* of the CIO to identify and interpret the potential of ERP to the organization. Furthermore, top executives learned to actively collaborate on strategic IT decisions in order to combine their expertise (i.e., *commitment to resilience*). As expected, the shift in power raised resistance from business unit managers at first. However, Alpha knew how to counteract resistance by closely *monitoring performance* and using evidence of substandard operational performance to highlight gaps between existing organizational arrangements and those necessary to support high levels of cooperation among stakeholders. Once managers' old cognitive frameworks were disconfirmed, top management knew how to promulgate a new shared vision among business units (i.e., *sensitivity to operations*) to innovate the business processes of public service delivery by adopting the integrated best-practiced business processes embedded in ERP (i.e., *complexity seeking*). In sum, the know-how to exploit internal trigger events and manage discontinuous change in all four dimensions of deep structure enabled Alpha to implement ERP as an integrated digital platform to support high levels of cooperation among stakeholders with process management.

What Gaps in Know-how lead to Stalled Implementations?

As previously discussed, three city governments had implemented ERP systems within an integrated IT architecture while seven had implemented ERP systems in application silos (i.e., islands of automation). Implementations at all ten of these city governments stalled short of enacting ERP as an integrated digital platform to support high levels of cooperation among stakeholders with process management. These stalled implementations were problematic because all ten city governments had experienced external *trigger events* that signaled the need for innovation in public service delivery – four-year election cycles, rising demand for twelve core public services, and implementing ERP technology – as did Alpha. Unlike at Alpha however, top management at the ten city governments did not exploit internal triggers of performance crisis and visionary new leadership as opportunities to initiate discontinuous change in deep structure. Instead, top management in all ten cases pursued convergent change that kept some or all dimensions of deep structure largely unchanged and failed to break managers' old cognitive frameworks as follows.

Consistent with convergent change, CIOs at all ten city governments justified ERP implementation in terms of support for the pre-existing 'defender' type *business strategy* (i.e., which emphasize efficiency in existing operations), rather than an opportunity for innovating with IT. Their approach to *IT strategy* also remained unchanged, adhering to the old low-cost (i.e., efficiency) strategy type rather than adopting an innovation strategy. Seven of the city governments exhibited no change from a *business structure* of vertical business silos, whereas three city governments exhibited some horizontal integration of business processes (i.e., business structure). None of the ten city governments adopted all best practices for *IT structure*. In seven city governments, top management did not *defer to the expertise* of the CIO in IT acquisition decisions, nor did they collaborate on strategic IT decisions to combine their expertise (i.e., *commitment to resilience*). In consequence, business unit managers acted as powerful gatekeepers that actively resisted change in their business units to maintain "their own kingdoms," in the words of one CIO. In the remaining three city governments, top management learned to defer to the expertise of the CIO in IT acquisition decisions and collaborate on strategic IT decisions. This enabled the three city governments to achieve an integrated IT architecture when the seven city governments did not. In none of the ten city governments, however, did managers learn to closely *monitor performance* and use evidence of substandard operational performance to highlight gaps between existing organizational arrangements and those necessary to support high levels of cooperation among stakeholders. Top management failed, therefore, to disconfirm managers' old cognitive frameworks, as evidenced by the fact that they still shared the old vision to reduce operational

costs (i.e., *sensitivity to operations*) and did not envision the need to innovate their old business processes by adopting the best-practiced business processes embedded in ERP (i.e., *complexity seeking*). Hence, a lack of know-how to manage discontinuous change in all four dimensions of deep structure can explain the failure to implement ERP as an integrated digital platform to support innovating with IT.

Conclusions

This article informs implementations of integrated digital platforms in the form of ERP systems towards innovating with IT in smart cities. Our findings show that top management requires the know-how to exploit trigger events for discontinuous organizational change by (1) promulgating an analyzer type business strategy entwined with an innovation type IT strategy, *and* (2) implementing the integrated core business processes embedded in ERP, *and* (3) restructuring the organization around those integrated business processes, *and* (4) restructuring IT governance by vesting IT investment power in the CIO and a collaborative IT group led by top management, by closely monitoring gaps in performance to focus on achieving high levels of cooperation among stakeholders, and by promulgating a new shared 'smart city' vision among business units. City managers should therefore exploit internal triggers to promote rapid and concurrent organizational change in four dimensions – business strategy, IT strategy, business structure, and IT structure – if they are to realize the full potential of integrated digital platforms for innovating with IT, which is core to the smart city agenda. For scholarship, prior literature examining organizational capacity has examined independent effects of know-how on financial outcomes (Carter 2015). Our findings contribute to the literature by elaborating (1) the configurational (rather than independent) effects of know-how (2) on innovating the internal processes of public service delivery with IT. While we isolated the effects of heterogeneous know-how configurations between cities by controlling for exogenous factors, future research could relax this constraint in other jurisdictions to hypothesize the interaction effects of different types of trigger events, and thereby inform potential interventions that can further the smart city agenda.

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