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The unknown dynamism in the adoption of the incident command system

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Abstract

Several studies have been conducted about the incident command system (ICS), primarily because of its increasing significance to service delivery by government administrations. Majority of the studies conducted by both academia and business focus on the implementation, performance, and success of the technology. Critically, the factors that influence ICS's implementation, performance, or success remain unknown. The study sets out to examine and gain a better understanding of the factors that influence the adoption and use of ICS, from both technical and non-technical (business) perspectives. A wide range of literature from ten years, from 2012 to 2022 was gathered. A sociotechnical theory, moments of translation of actor-network theory (ANT) is employed as a lens to view why things happen in the way that they do, in the process of adoption and use of the ICS in organizations. From the analysis, five factors, ICS structure, power relationship, multiagency, system capability, and incident gauge are fundamental influences in the adoption and use of ICS in organizations. The study brings a fresh perspective in gaining a deeper understanding of why and how things happen in the adoption of ICS.

Keywords: Actor-network theory, Technology adoption, Influencing factors, Incident command system

Introduction

Many municipalities across the world experience emergencies due to a variety of incidents, which range from transport service, wildfires nature, housing, healthcare, and tourism-related events. These services require coordination, control, monitoring, and communication between the actors (stakeholders), which include community members, employees of the municipality, and information technology specialists. Thus, some municipalities adopt a technology, an Incident Command System (ICS), to enhance communication, improve response time, adequately monitor incidents, and improve the efficiency of incident workflow management. The ICS is an information technology (IT) solution designed to address challenges such as resource utilization, communication among multiple agencies as well as coordination of efforts during an incident of any magnitude (Estremera & Fruto, 2023; Jensen & Thompson, 2016). ICS is considered best used for standardization of on-scene, hazards incident management and allows responders to adopt an integrated organizational structure (Hogan & Foster, S2022; Djalali et al., 2012).

In addition, the ICS is intended to enforce seamless coordination and collaboration of efforts from multiple agencies such as Law Enforcement, Traffic Services, Fire Fighters, and Medical Services in an environment. These are crucial aspects in dealing with emergency-related events, through coordinated interaction among multiple agencies and to increase response time (Farcas et al., 2021). It is on this basis that some municipalities across the world adopt the ICS (Brown et al., 2022; Chiampas & Ibiebele, 2021).

Even though many municipalities have adopted the technology and extensive research has been conducted on ICS, there seems to be no study that examines the business or technical value to an organization (Chae & Bae, 2019; Chang, 2017). Nowell and Steelman (2019) suggest that one of the challenges of ICS is that it requires a hybrid governance structure, which many government administrations do not have. Also, this could be attributed to the fact that the municipalities have not been able to evaluate the technology and there seems to be no metrics to do so.

Thus, two main fundamental concerns are associated with the adoption of the ICS by organizations including municipalities. Firstly, there seems to be a limited reference point in many countries such as South Africa, in addressing its technical challenges and providing support to users. According to Alber et al. (2019), the lack of case reference point for implementations of technology often hurts the manageability and actualization of benefits, from both technical and business perspectives. Secondly, the technology has not been evaluated to ascertain its potential and value, in practice. Söllner et al. (2018) argue that lack of evaluation poses challenges to understanding the effects of synchronous and asynchronous technology performance.

The ICS is implemented in the Municipality, purposely to enhance the allocation of tasks, monitor response time, govern information flow, and manage workflow of incidents, which are fundamental to service delivery. However, the significance and value-add of the ICS, from both technology and business perspectives are not empirically known. In addition, there is no mechanism for determining the strategic direction of the ICS (Chang, 2017), towards improving service delivery. As a result, attributes of ICS, such as incidents' control and flows, management of functions, and response time have not been evaluated, to value its efficiency and effectiveness (Estremera & Fruto, 2023). Thus, the problem is twofold. First, the challenges are prohibitive and derail Municipality's service delivery. The second problem is that the return on investment (ROI) of the adoption and use of ICS, from both technical and non-technical perspectives, is not known.

From a technical perspective, compatibility and co-existence with existing systems are some of the problems that hinder service delivery. This is a major problem in that it is prohibitive and derails services primarily because of reasons such as (1) the automated system (ICS) that controls and monitors incidents for the municipality is not known (Farrag et al., 2021; Hambridge, Howitt & Giles, 2017); (2) how ICS processes and manages information about incidents are black-boxed (Samera, 2022;); and (3) these lagging knowledge poses a challenge for the integration of ICS with other systems (Lamb et al., 2021), which negatively affect service delivery because the systems depend on each other for information. This problem cuts both across technology and business units of the organization. The challenges identified above can only be addressed if the ICS is evaluated, which requires an understanding of the influencing factors.

In closing the gap identified above, this study sets out to examine the factors that influence the adoption of ICS, which can guide the evaluation of the technology in a government administration such as a municipality. This entails gaining an understanding of how ICS is adopted and used, to enable and support service delivery, from both business and technology perspectives. The objective translates to the research question: what are the factors that influence ICS adoption and how do the factors manifest towards evaluation, from both business and technology perspectives in an environment? This can be achieved by following the translation of involving actors. Thus, actor-network theory (ANT) is considered most suitable for the study as it is the only sociotechnical theory that focuses on the conscious and unconscious formation of the network and shifting negotiation, which are required to gain insight into the factors that influence the adoption and use of the ICS in an organization.

The remainder of this paper is organized as follows: The first section introduces the study and its focus.

The review of literature in the context of the study is presented in the second section. This is followed by the theory, ANT, which underpins the study and the methodology that is applied in the study sections. Next, an analysis and discussion of the findings are presented. Finally, the paper is drawn to a conclusion.

Literature Review

This section presents a review of the literature designed to provide an in-depth understanding of the gap that this study intends to close. Thus, the review focuses on the core aspects of the study, which are implementing and evaluating IT solutions.

Implementing Information Technology Solution

Information technology (IT) solutions offer an organization's computing capability to deliver services through data, information, governance, and management of events (Ghobakhloo et al., 2011). Gabriel et al. (2014) suggest that the immense contribution of IT solutions has increased the reliance on it by organizations. According to Iyamu (2022), IT solutions are increasingly employed for efficiency and effectiveness, to improve service delivery. The implementation of IT solutions refers to the stage at which an organization selects a particular technology for use (Lai, 2017). When organizations adopt such technologies, it is with the premise of improvement in business processes and operations. The adopted technology can be used as a tool to either guide activity or be the activity itself (Govender & Pretorius, 2015). Also, organizations adopt technologies for several reasons that are of operational or strategic intent. According to Naseer, Rehman and Saeed (2013), technology adoption varies and depends on several factors such as geographical location. The adoption of technology is often guided by requirements that are gathered from units within an organization (Ullah et al., 2021; Ali et al., 2020).

Due to its significance, several studies have been conducted on the ICS (George-Ufot et al., 2022; Shamsi et al., 2020; Yao et al., 2017. However, the studies extensively focus on the implementation of ICS, and not the factors that influence the adoption and use, thereof (Clark-Ginsberg et al., 2023; Lavrov et al., 2020). Technologies such as the ICS enable organizations to standardize their approach and execution when emergencies occur (Jensen & Thompson, 2016), in times, such as dangerous multi-agency emergencies (Bigley & Roberts, 2001). More so, the management of an incident, emergency, or disaster not only entails response but also the management of resources such as people, vehicles, procedures, and technology, which could be considered influencing entities.

Although the adoption of technology varies from one organization to another, it brings benefits. Oliveira and Martins (2011) highlight the benefits of technology adoption in an organization. Despite the benefits of the ICS, challenges exist. Ejiaku (2014) identifies some of the challenges as policies, technology infrastructure, training, and environmental culture. Batubara, Ubacht and Janssen (2018) argue that the main challenges in the adoption come from a technical perspective, which includes security and flexibility. Mustafa and Yaakub (2018) explain how challenges of adoption hinder the use of technology for innovation, which affects responsiveness, efficiency, and effectiveness. Even though studies have been conducted on the technology's adoption, challenges persist (Chouki et al., 2022; Toufaily, Zalan & Dhaou, 2021; Jewer, Compeau & Besworth, 2017). This can be attributed to a lack of understanding of how the challenges come to exist and how they manifest.

Evaluating IT solution in an organization

Organizations implement IT solutions on the premise that it adds value, through the enhancement of the business processes, operations, and strategic intentions (Kitsios & Kamariotou, 2019; Ilmudeen, Bao &

Alharbi, 2019). Hence understanding both the efficiency and deficiency of implemented IT solutions is crucial. Iyamu (2022), explain how IT solutions are getting more sophisticated, at the same time, increasing in complexity. Thus, makes evaluation more critical. Mthethwa and Jili (2016) define evaluation as an applied inquiry process for collecting and compiling evidence that highlights the effectiveness, efficiency, and value of an artefact. The concept of evaluation entails a systematic assessment of an adopted system's performance towards a specific criterion within an organization (Patsioura, 2014). Goldkuhl and Lagsten (2012) emphasize the need for evaluation from the perspectives of assessment of goals and participatory association. Also, evaluation helps to identify factors of influence, towards enhancement of a system (Krmac & Djordjević, 2019; Srisawasdi, Pondee & Bunterm, 2018).

Evaluation of ICS seems complex which is the reason for less attention. Bahrami et al. (2020) explain that ICS evaluation is important, to gain a better understanding of factors that influence its adoption. However, the evaluation must be concise, universal, and commonly understood. Different evaluations of ICS are a derailing factor in the use of the system (Chang, 2017). Some of the rationales for evaluating ICS are to generate knowledge and improve the system (Visser, Biljon & Herselman, 2013). It is critical for organizations to embark on the evaluation process because knowledge is gained from both the process and results (Goldkuhl & Lagsten, 2012). The outcome of an evaluation helps to gain more knowledge and understanding of the system in an organization (Quinn et al., 2018).

An organization must evaluate the ICS because of its significance to both business and IT units (Bailey, 2021; Moynihan, 2008). Without evaluation, an organization concludes based only on theoretical rather than a practical endorsement. According to Venable, Pries-Heje and Baskerville (2017), the evaluation process is of value to an organization primarily because it aids in determining how an adopted system fulfils its intended purpose. The ICS has been adopted in municipalities or government agencies or administrations for many years, yet it is rarely evaluated, to attest to its efficiency and effectiveness organization (Brown et al., 2022; Holtzclaw et al., 2022; Farcas et al., 2021; Powell, 2020). This is primarily because it works, which results in fewer concerns.

Actor-Network Theory

The purpose of this study is to understand the factors that influence the adoption of ICS towards its evaluation. ANT is selected to underpin this study primarily because of its network distinctive approach (Birke & Knierim, 2020), shifting negotiation that entails in-depth interactions between actors (Iyamu, 2021), and translation at various stages or moments (Law & Callon, 1997). These factors are fundamental to the study in that they can assist in achieving the objectives of the study, from three main perspectives, gaining an understanding of (1) the ICS functions through problematization, how things came to be; (2) different translations of events that are associated with the system; and (3) why the system is mobilized by both business and technology units or agencies, separately. Other socio-technical theories that were explored such as Activity Theory (Dennehy & Conboy, 2017) and Diffusion of Innovation (Rogers, 2003); do not focus on the areas mentioned above.

ANT refers to humans and non-humans as actors and focuses on shifting negotiation (Iyamu, 2021; Latour, 1992). In ANT, an entity is considered an actor if it has the capacity to make a difference (Callon, 1986), such as influencing the development or adoption of a system (Dwiartama & Rosin, 2014). Heeks and Stanforth (2015) view ANT as a pragmatic recursive sociological process that focuses on the way actors build and maintains networks. According to Islam, Mantymaki and Turunen (2019), ANT is often used to explore how actor-networks are assembled, to achieve a common goal. One core aspect and strength of ANT is translation. From ANT's perspective, translation is transformative in that it allows different meanings to be associated with materials (such as technology) from one point to another (Latour, 2005).

Thus, conceptually, ANT's translation helps to understand how technologies are created and why actors associated certain meanings to them (Iyamu, 2021; Birke & Knierim, 2020). As shown in Figure 1, there are four stages of the moments of translation (Law, 1992; Callon, 1986).

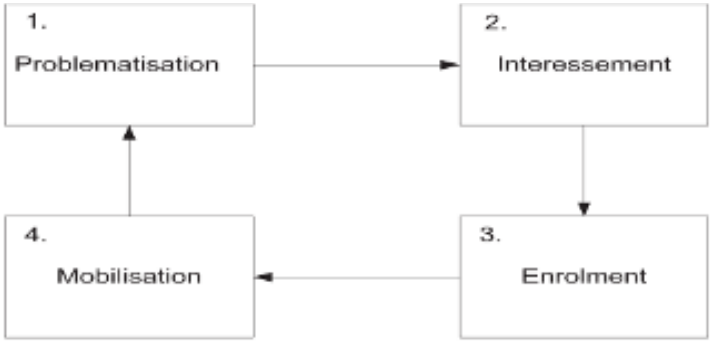

Figure 1: Moments of translation (Callon, 1986*)*

The four moments of translation: (1) Problematization - is the first step where actors define their interests around a common problem and solution (Sage, Vitry & Dainty, 2020); (2) Interessement - refers to the moment when an actor succeeds in capturing the interest of other actors regarding the problematized issue (Rivera & Cox, 2016); (3) Enrolment - during this stage, actors with a common interest gather to solve the problematized issue (Heeks & Stanforth, 2015); and (4) Mobilization - is the last stage of the moment of translation. It refers to when a group of actors with a common goal has successfully gathered to form a network (Nehemia-Maletzky, Iyamu & Shaanika, 2018).

Methodology

Evident from the literature, the realities that motivate this study include that ICS does exist; the technology is adopted and used in governments' administration (municipalities) to improve services delivery; and business and technology units view the technology from different perspectives including its efficiency and effectiveness; and despite the growing significance, it is difficult to find studies that focus on the factors that influence the adoption. Epistemologically, the factors that influence the adoption and use of ICS are unknown. Epistemology as a theory of knowledge (Hussain et al., 2013) is followed to assist in gaining a fathoming of reality about ICS adoption, and evaluation (Kivunja & Kuyini, 2017). Thus, from our subjective position, what can be known or learned about this study includes the factors that influence the adoption of the technology and how the factors manifest from both business and technology perspectives. This is to understand why things happen in the way that they do (Iyamu, 2021) from different perspectives. Subjectivism allows associating meanings with actions and activities (Nehemia-Maletzky et al., 2018).

The bibliographic approach was employed, using criteria to search and gather the most relevant literature for the study. The academic databases that were consulted are Google Scholar, Scopus, and Web of Science. The criteria used in the search for the most relevant literature are keywords and year of publication. The keywords include incident command systems adoption; challenging of incident command systems; and incident command system management. Articles published within the last ten years, between 2012 and 2022 were considered most appropriate. It helps to gain an understanding of the challenges, approach, and meaning that have been associated with the adoption of ICS, from historical perspectives (Iyamu, Nehemia-Maletzky & Shaanika, 2016). From our search through the databases, 177 peer-reviewed articles were gathered. Most of the literature focuses on the adoption, and benefits of the system (Clark-Ginsberg et al.,

2023; George-Ufot et al., 2022; Lavrov et al., 2020; Yao et al., 2017). The papers were streamlined, guided by the objective of the study, which is to examine the factors that influence the adoption and use of ICS. A total of 54 papers were gathered.

Analysis and Discussion

Despite the publicized benefits, it is important to determine the influencing factors and how they manifest (Jensen & Thompson, 2016). This improves our understanding of what is known about the system and how this is known. Research suggests that ICS is limited in its usefulness (Jensen & Thompson, 2016), this can be attributed to a lack of understanding of the influencing factors (Kaye et al., 2021). Some of the challenges of ICS persist because the influencing factors are not known (Samera, 2022). This triggers the research question, which this study attempts to address: 'What are the factors that influence the adoption of the ICS in an organization?

Actor-network theory underpins the study, meaning, it is employed as a lens to guide the data analysis of the data. Primarily, the analysis focuses on three aspects, towards achieving the objective of the study, which is to understand the factors that influence ICS evaluation. First, ANT was used to gain an understanding of how various actor-networks are formed, in the use, support, and management of ICS in the organization. This helps to shed light on how roles and expertise align with the adoption and use of the technology. Second, the relationship and interaction between actors, to determine the differences in views of business and technology units, in the areas of efficiency and effectiveness in the adoption and use of ICS, to improve service delivery. Third, how the negotiations between the business and IT units shift in understanding the efficiency, effectiveness, and ROI, in the adoption and use of ICS, to improve service delivery. in the organization.

Factors Influencing Incident Command System Adoption

More comprehensive knowledge of ICS will lead to effective productivity (Matear, 2023), which can only be achieved through an understanding of the influencing factors. Bahrami et al. (2020) suggest that several factors influence ICS's performance and reduce its effectiveness. In gaining an understanding of the influencing factors, the moments of translations (MOT) of ANT are employed. ANT helps to gain deeper insight into how an activity transforms through shifting negotiation (Iyamu, 2021). As tabulated in Table 1, the MOT is applied to view the factors that influence the adoption and use of ICS. Using MOT, it clarifies actors' roles and influence, and they are influenced including the manifestation of the influences. As presented in the Table, each moment of translation is used in analysis-describing the activities involved in the adoption and use of ICS in an organization. From the analysis-describing, factors influencing the activities were extracted, as shown in the third column of the Table. The factors are further discussed below.

Table 1: Factors Influencing Incident Command System Adoption

MOT	Translation of ICS	Extraction
Problematization	Requests a common goal and understanding of the ICS, to deliver service and gain new insights. This helps to comb controversies and directs attention to the heterogenous strategic relations in the adoption and use of ICS in organizations. Also, it shapes the relationships between the business and IT units. Thus, ICS cannot be problematized at one level or unit because it is multiplex. Consequently, the system must be problematized at various levels.	Power relationship Multiagency

MOT	Translation of ICS	Extraction
Interessement	Actors are interested in the adoption and use of ICS. However, many of them change their affiliation to distinct groups within or between the management structure and ICS structures. This type of behavior interrupts associations to construct a system of alliances' (Callon, 1986). Change of affiliation causes friction and invokes obligatory passage point, which results in a power relationship.	ICS structure Power relationship
Enrolment	Focal actors employ several methods to define roles, and allocation of tasks and use different tactics to interrelate with each other, individually or in groups including the multiagency, in the use of the ICS. Local multiagency (business and IT units') participation in the adoption and use of ICS are based on associated value, from understanding, which requires determination and assessment of features of the system, for a common goal among the agencies.	Multiagency Systems' Compatibility Incident gauge
Mobilization	The size of the organization and the involved agencies should determine the mobilization of the adoption and use of ICS. Each unit (or agency) is bound to have a spokesperson, which results in a multitude of spokespersons. Consequently, lack of uniformity is highly likely, as each spokesperson defines his/her own ICS identity in their mobilization of activity. A spokesperson is a translator on behalf of a network (organization). The translator must be knowledgeable and comprehend ICS and its activities. Another challenge is that the involved units might not have the same insight into the incidents inventory.	Multiagency Incident gauge

In ANT, successful enrolment confirms and indorses interessement, which validates problematisation. Also, actors are influenced by the network (units or agency), and, in turn, the network influence the actors as negotiations continue to shift toward determining a common goal. Interaction and relationship are the key components of negotiations, which manifest to influence activities and incidents, as revealed in Table 1: ICS structure, power relationship, multiagency, system capability, and incident gauge. The influencing factors are further discussed.

The ICS structure

Activities of the ICS are within its structure and begin with the incident command (Chang & Trainor, 2020), which is a challenge in organizational structures because of non-alignment. According to Bailey (2021), the ICS focuses on coordinating on-scene operations, which is only part-role of the function of the system. Kaye et al. (2021) suggested that through coordination, ICS plays a crucial role in effective and timely response during disasters and emergencies. According to Chang (2017), the ICS hierarchy conflict with the management structure of an organization by putting more emphasis on certain units or departments.

The hierarchical structural nature of the ICS is a barrier to its alignment with organizational vision and derails buy-in, which affects the comprehensive approach and strategy. (Quinn et al., 2018). Chang and Trainor (2020) gave an example, that when there are rapidly changing situations and require quick adjustments and improvisations, a large ICS structure is highly likely to delay or prolong the response time. Since the ICS is hierarchically structured, it should be aligned with the organizational structure, to form a

single channel of commanders, unified to coordinate cohesion, collaboration, and collectiveness. Structure manifests to shape power relationships, in turn, defines task allocations and execution.

Power relationship

The power relationship is asymmetrical, and it defines the ability to exercise control and relation between actors. Cutolo and Kenney (2021) suggest that power asymmetry is intrinsic to relationships and activities within the structure. Quinn et al. (2018) suggest that the evaluation of the adoption and use of ICS is more effective if the power relationship between the stakeholders (actors) is clearly defined and understood. Holtzclaw et al. (2022) highlight an approach of applying the ICS in an environment where power could have been exerted to change the course of unpopular action. Each unit (or agency) in the heterogeneous networks often defines its approach. It is influenced by power relationship, which emanates from the diverse structures.

The power relationship is dimensional, it describes interrelationship and group correlation (Wang et al., 2022). Quinn et al. (2018) explained the significance of the power relationship between the actors in the use and management of ICS in an organization. Thus, power relationships between responsive (or involving) agencies are critical because they foster trust and support structure and response strategies. This includes unified coordination and cooperation of the local multiagency.

Multiagency

Multiagency refers to diverse types within a network (organization or ecosystem). It allows multiplexity of agencies in a unified manner, in addressing challenges and providing services to the community (Bailey, 2021). Hu, Sadiq and Kapucu (2022) suggest that multiagency is essential and relevant in managing incidents within a community. It facilitates the optimization of safety, and healthcare, and enabling of law enforcement agencies' efficiency (Holtzclaw et al., 2022; Chiampas & Ibiebele, 2021; Kaye et al., 2021). This must be understood, to improve the interconnection among the involved agencies.

Multiagency coordination can be effective for ICS strategies (Rahman et al., 2015). Also, it can hinder collaborative efforts and activities undertaken by both intra-sector and cross-sector in managing incidents (Lin, Hsieh & Chen, 2023). According to Quinn et al. (2018), little is known and documented about the use of ICS for multiagency or multiplexity. This means that the local multiagency is challenged with allocation and tasks, associate roles, and division of responsibilities, which are attributing influence the success or failure of the system. Although the need for ICS is always justified, the issue of command remains a major impediment that consequently causes disjointed operations and weakens coordination among the different agencies including the capability of the system.

Systems' Compatibility

For efficiency and effectiveness purposes, the capability of ICS must be adaptable in providing improved services. ICS evolves therefore, its evaluation can lead to the optimization of its efficiency and effectiveness (Matear, 2023). Bahrami et al. (2020) argued that evaluating ICS can improve the effective use and efficiency of this system. The ICS has been applied to identify lapses in areas such as healthcare, law enforcement, and transport (Brown, 2022; Chiampas & Ibiebele, 2021) in various situations and events by many agencies (Cook, 2020). Thus, ICS helps to mitigate lapses (Farcas et al., 2021), through its capability that allows interaction and translation of incidents and activities, to meaningful use.

The ICS capability enables an organization in performing its function, in providing service to the community. Thus, personnel are instrumental to the structural effect, for managing efficiency, and the capability of ICS in an organization (Chang, 2017). The lack of ICS compatibility with structure is a barrier to its effectiveness and efficient use in providing services in many environments (Shooshtari, Tofighi & Abbasi, 2017). The capability of ICS to execute action depends on people's ability and interest, in various conditions including organizational structure.

Incident Gauge

Another factor that influences the adoption of the ICS is the lack of, or limited incident gauge in its use. According to Chang (2017), the nature of the system and its controlling scale need to be understood, for appropriate allocation of tasks and roles. Alignment between business and IT units is improved and compatibility is enhanced, if activities are gauged, accordingly. Incompatibility with management structure is one of the main challenges of the ICS, Shooshtari, et al. (2017) argued.

The limit in incident gauge has a constraining impact on ICS adoption and use. This manifests and influences the use of the system for service delivery. According to Chang and Trainor (2020), the bigger the ICS structure is, the more time it takes to transmit information and respond to incidents.

Conclusion

The research question was: what are the factors influencing ICS adoption from both business and technology perspectives in an environment? From the rigor and comprehensive study in which ANT was employed, the factors influencing the adoption of ICS in organizations were revealed. In the process, the paper helps to gain a better understanding of the influencing factors, as discussed. ANT was employed to follow the interactions among the actors, which bring profound insights to the adoption and use of ICS, towards achieving the objective of the study. The factors can be used to guide the development of policy that aligns with the structures of an organization, to reduce challenges and complexities in the adoption of the ICS.

The contributions of this study come from two main standpoints, theoretical and practical. Theoretically, the study provides a reference point for municipalities. From the academic front, the study provides factors based on which ICS adoption can be measured. Also, it adds to advancing the use of ANT in IS research. Practically, the influencing factors can be used to guide practices, including evaluation of the system, for value-add purposes. These factors can be used by other organizations as a guide to examine how the ICS is assessed, from both technical and non-technical perspectives.

The paper lays the foundation for further studies, to develop a metrics model that can be used as a reference point for municipalities' adoption of the ICS. The model aims to guide how an ICS can be evaluated to determine its value to both IT and business operations and strategies, to fortify service delivery.

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