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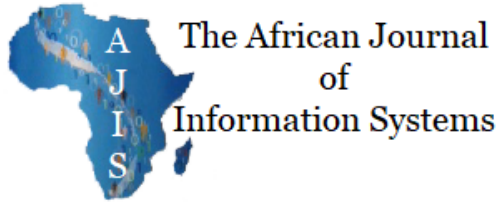
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# The Form, Function and Materiality of Portable IT in Inter-Organizational Control

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## ABSTRACT

Extant explanations of inter-organizational (IO) control are based on functional assumptions of information technology (IT) at the expense of structural assumptions. By focusing on structural assumptions, this paper explains how and why the formal and material properties of portable IT shape IO control. Based on analysis of portable IT mediation between a government agency and traders for tax administration, it was found that portable IT, with the support of the IO structure, reduces IO control. This occurs because portable IT invites users to subvert its connectivity and visibility with the support of the IO structure. Portable IT and IO structures are countervailing or generative depending on contingent conditions such as legislation, shared goals, and the imperative character of technology. The paper makes three main knowledge contributions: structural tensions between portable IT and IO relations; portable IT's structure and relation; technological, human and IO agencies. Research and practical implications are discussed.

## Keywords

Form, materiality, structure, portable IT, inter-organization, control, affordances.

## INTRODUCTION

Controlling organizational behavior is one of the key functions used to ensure appropriate productive behaviors and outcomes. To control an entity is to program its tasks in a manner that elicits behaviors and outcomes which conform with specified qualities and quantities (Etzioni, 1965). But because inter-organizational (IO) behaviors are structurally and relationally different from organizational ones (Ferguson, 2018; Radziwon & Bogers, 2019), general theories of control are inadequate to explain IO control. For instance, the control of transactions within an organization is significantly different from the control of transactions among two or more organizations (Davis, 2016). In the IO contexts, control is the governance of relations and transactions with organizational and technological mechanisms to address behavioral and outcome conditions which increase transaction costs.

One of the means of achieving IO control is deployment of information technology (IT) to mediate IO relations and to reduce transactions costs (Zhang, Sun, Yang, & Wang, 2018). Because the ontology of IT significantly shapes the structure and function of IO relations, information systems (IS) researchers have continuously aimed to explain the role of IT (Hernandez-Ortega, Serrano-Cinca, & Gomez-Meneses, 2014; Robey, Im, & Wareham, 2008; Reimers, Johnston, & Klein, 2014). But we are still faced with the question, *how and why do the form, function, and materiality of portable IT explain inter-organizational control?* Portable IT reflects a significant ontological breakaway from large IT, such as the desktop and laptop, but the implications for IO control have not yet been explained. Examples such as tablet computers, mobile phones, smartphones, and portable electronic cash registers are being deployed increasingly for electronic data transactions in sales tax administration systems, public electronic procurement systems, and mobile-commerce systems (e.g., Taresewich, Nickerson, & Warkentin, 2002; Varshney & Vetter, 2002; Rao & De, 2015).

While the ontology is evidenced by mobility in use, that mostly reflects the functional assumption. Before mobility, there is portability which reflects the structural assumption. The small size and even micro-mobility of portable IT generates IO control mechanisms which are different from desktop computers. This is especially true in cases where the controlling organization adopts and deploys the portable IT in the physical space of the organization in which activities are being controlled (the user). In the physical absence and only virtual presence of the controlling organization, the user organization has adequate discretion to manipulate the structure of the portable IT in order to undermine IO control. For example, it can reconfigure the technology, allow its battery to run out, move it about to avoid network coverage, move it to hide it from view, or just refuse to use it (Beaudry & Pinsonneault, 2005).

In existing explanations of IO control, the function of IT is emphasized at the expense of form and materiality. Form is the design entered by the material constitution of technology, and function is the purpose that a technology fulfills (Kallinikos, 2012). Emphasis on the IT function manifests in researchers' attention to its role in reducing IO transaction costs (e.g., Chatterje & Ravichandran, 2012). Thus, in these explanations, there is dominance of a transactional perspective on IT underpinned by a functional assumption of IT. Conversely, there is less emphasis of how and why the form and materiality of IT shape IO control, showing that formal and material perspectives are quite lacking. The formal and material aspects of an IT artifact are basically about "the ways that its physical and/or digital materials are arranged into particular forms that endure across differences in place and time" (Leonardi, 2012; p. 29). Formal and material perspectives reflect a structural assumption of IT, but researchers of IO control have not adopted it yet. But this research adopts it to provide a technological explanation of IO control. Empirically, the structural assumption deals with portable IT design properties, such as size, components, interface, links, and interfaces.

Practically, formal and material IT properties are important for designers and organizations interested in achieving high levels of IT functionality, usability, and ubiquity. For this reason, miniaturization of computers has been occurring since Babbage's computer, leading to contemporary smart phones. IT functionality, usability, and ubiquity are practical realities that designers and organizations draw upon to manage, plan, control, and coordinate human activities. Formal and material IT properties are also practically important because they are structures that complement or challenge IO structures. These structures are believed to generate control functions, and this explains why many organizations in Africa

and around the world are adopting and deploying portable ITs increasingly to control IO relations and transactions.

The paper analyzes how the form, functionality, and materiality of IT enhance or reduce IO control. It argues that portable IT generates reduced IO control by inviting users to subvert its connectivity and visibility with the support of the IO structure. It provides three main contributions: structural tensions between portable IT and IO relations; portable IT's structure and relation; and technological, human, and IO agencies.

In the next section, the literature on IO control and portable IT is reviewed, and the theoretical framework is discussed. This is followed by the presentation of the methodology and results from empirical data collection. Then the results are analyzed to provide explanations. After this, the contributions made by the explanations and implications are discussed in the last section.

## LITERATURE AND THEORY

This paper is premised on the argument that the function of IT is emphasized in existing explanations of IO control at the expense of form and materiality. In this section, the literature on IT in IO control is first reviewed to support the argument. Second, the literature on form, function, and materiality of portable IT is reviewed to show that it reflects the concepts of technical object, functional affordances, and symbolic expression. Then third, the concepts in the theory of technology affordances are discussed to show how and why they combine with the IT concepts to serve as the most suitable framework for analysis.

### IT and Inter-Organizational Control

The causal or determining role of IT as a conditioner of social forces in organizations has been discussed in terms of “technology as an occasion for structuring” (Barley, 1986). It has also been discussed in terms of its materiality and material agency (Leonardi et al., 2012).

IO control with IT has been researched extensively in domains such as collaborative work (González-Rojas, Correal, & Camargo, 2016), electronic markets (e.g. Malone, Yates, & Benjamin, 1987) (e.g., Malone et al., 1987), electronic commerce (e.g., Hart & Saunders, 1997; Johnston & Mak, 2000), customer-supplier relations (e.g., Son et al., 2005), strategic partnerships between organizations (e.g., Bensaou, 1997), inter-bank settlements (e.g., Boateng, 2009), and indirect control of individuals' or organizations' behavior (e.g., Schultze & Orlikowski, 2004). It also has attracted reviews and conceptual formulations by Robey and colleagues (2008), and Reimers and colleagues (2014). These reviews are notable because they discuss how the functions of IT shape users' actions and influence the restructuring of inter-organizational relationships. Thus, IO relationships are faced with IT as an additional mediating variable that undoubtedly will affect both reactive and proactive mechanisms of control. IO control mechanisms are determined by asset specificity, transaction frequency, complexity of product description, and market and environmental uncertainty (Robey et al., 2008).

Earlier researchers argued that IT reduces external transaction costs, and therefore have suggested “electronic markets” as suitable control mechanisms (e.g., Malone, Yates, & Benjamin, 1987; Brynjolfsson *et al.*, 1994; Hitt, 1999; Zaheer & Venkatraman, 1994). Their argument is that technology

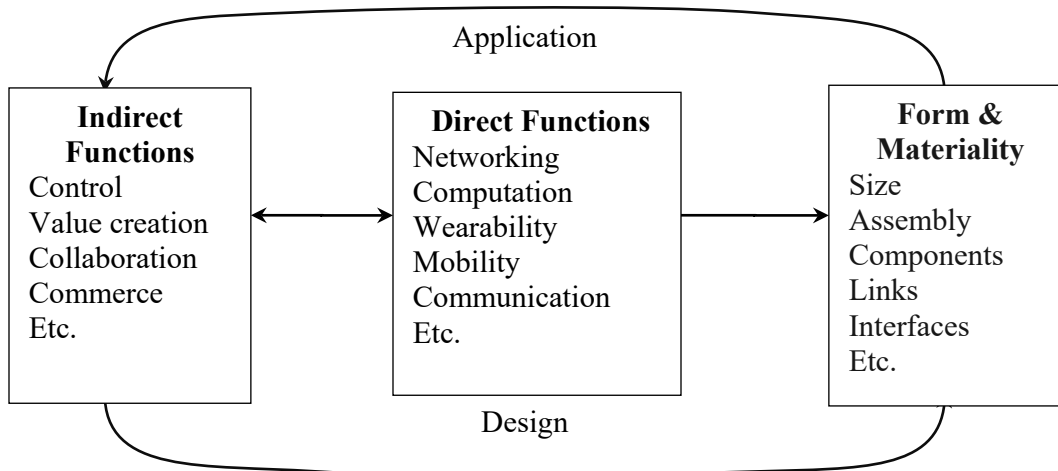
reduces external search costs, asset specificity, and uncertainties in transactions, making the electronic market control mechanism suitable. Some challenge this argument and suggest “electronic hierarchies” as suitable mechanisms because the market control mechanism may not result from IT (e.g., Holland, 1995; Clemons & Weber, 1996; Choudhury, Hartzel, & Kosynski, 1998). Others argue that IO control is not simply a choice between market and hierarchical control mechanisms. For instance, Klein (1995, 1996) argues that firms employ control strategies for multi-layer relationships with multiple trading partners. Similarly, Chatterje and Ravichandran (2012) explain IO control of transactions because of resource criticality, resource replaceability, and technology uncertainty.

Later researchers (e.g., Wareham, 2003) have transcended these arguments to suggest alternative control mechanisms that are influenced significantly by institutional arrangements and social embeddedness of the transaction (Granovetter, 1985; Griesinger, 1990). For instance, macro-level institutions, such as central or regional governments that define the legal rules and policies governing organizations, affect the control mechanism that cooperating organizations adopt to reduce transaction costs (Van der Meer-Kooistra & Vosselman, 2000). Similarly, Zaheer and Venkatraman (1995; p. 389) assert that “there exists a significant social component in exchange relationships which may be masked or missed in economic explanations of exchange.” The social context of inter-organizational transactions implies, therefore, that trust is an important additional mechanism for control (Gallivan and Depledge 2003; Nooteboom et al. 1997; Dekker 2004), especially of long-term transactions that are challenged by considerable uncertainties. The mechanism of trust resonates very much with Wareham’s (2003) social and procedural interdependence, which is traceable to Ouchi’s (1980) idea of clan relationships in which socialization, high degrees of inclusion, and immersion of individual organizations’ interests are typical.

In these diverse explanations of IO control, the function of IT is emphasized at the expense of form and materiality. Therefore, while they are replete with functional assumptions, they are quite bereft of structural assumptions. The structural assumptions would have problematized the formal and material aspects of portable IT in the explanation of IO control, but they are overlooked. Hence, existing theories of IO control are inadequate; and this paper takes up the problematization challenge.

### **Portable IT: Form, Function, and Materiality**

The form and materiality of IT (that is, combined hardware and software) usually follow its functions because its observable properties show the purpose that it is molded to serve. This principle applies to portable IT where its form and materiality are distinguished by size, elements, structure, physical components, programming, and interfaces. IT form and materiality reflect Markus and Silver’s (2008) concept of “technical object.” Markus and Silver argue that the “causal potential of technical objects lies not only in their functionality, but also in other properties as their packaging, arrangement and appearances” (p. 621). The form and materiality of portable IT as a technical object follow direct functions such as communication, networking, wearability, mobility, and computation (Wiredu, 2014). Markus and Silver (2008) call these “functional affordances” because they refer to potential uses of the technical object (Figure 1 and Table 1).



**Figure 1. Form, Materiality, and Functions of Portable IT**

Hence, in the first place, portable IT is understood in terms of the combination of its formal and material properties as well as its functional affordances. Although these properties and affordances are analytically distinct, they are practically inseparable when portable IT is in use. For instance, the mobile phone is “small and light enough to fit in a pocket or handbag, and is designed to be taken anywhere” (Arnold, 2003; p. 243). In this instance, the miniature size follows the direct function of mobility. At the same time, the miniature size follows the function of wearability because it is designed to be kept close to the bodies of users (Geisler, 2003). The structure and elements of the Long-Term Evolution or Fourth Generation smart phone are its formal and material properties that follow the direct and indirect functions. Smart phones, for example, are produced from a combination of computational and telecommunications networks within a continuous digital innovation process (Arthur, 2009; Tilson, Lyytinen, & Sørensen, 2010).

Functional affordances of Portable IT feature in Mathiassen and Sørensen’s (2008) networking services category of organizational information services (the other information services are computation, adaptation, and collaboration). Networking services “are organized as brief encounters in which actors are linked to sources to identify and access relevant information as needed” (p. 324). To achieve this, mobile phones, for instance, are supposed to provide a standardized connection that enables one actor to request information in a shared format from a distance. Ultimately, the shared format in the standardized connection helps to reduce task uncertainty. These functions are described in this paper as direct because they immediately inform the design of the form of portable IT (Figure 1).

Beyond these, there are indirect functional affordances, such as control (e.g., Leclercq-Vandelannoitte, Isaac, & Kalik, 2014), value creation (e.g., Li, Heck, & Vervest, 2009), commerce (e.g., Clarke, 2001), information management and collaboration (e.g., Bardram, 2005) that do not directly inform the formal design of the technology. They have indirect effects because organizational and personal applications of these technologies relate with the direct functions before form. Ciborra and Lanzara (1994) call the indirect effects of organizational dynamics as “formative contexts” that shape IT user behavior. The organizational and personal application domain is an instance of a formative context. This context is

more dynamic because organizational and personal circumstances are replete with more uncertain and equivocal conditions.

**Table 1. Summary of Portable IT Form, Function, and Materiality**

	<b>Form and Materiality</b>	<b>Function</b>	<b>Interpretation</b>
<b>Concepts</b>	Technical Object	Functional Affordances	Symbolic Expressions
<b>Relational constructs</b>	Information and technology	IT and user actions	IT and user interpretations
<b>Analytical foci</b>	Design	Behavior	Signs

While functional affordance is a relational construct between IT and users, Markus and Silver also propose the concept of “symbolic expressions” as a “relational construct bridging IT artifacts and how users may interpret them” (2008; p. 623). The assumption is that symbolic expressions are not necessarily properties of IT artifacts; rather, they are users’ interpretations of their own values and goals as well as those of an artifact and/or its designers. Hence, users’ interpretations encompass their semiotic analyses of both intended and unintended outcomes. Therefore, symbolic expressions transcend mere user perceptions of properties of technical objects to incorporate signs that express messages to users.

### **Technology Affordance Theory**

The theory of affordance was originally concerned with the direct relationship between an organism and its environment. It assumes that the affordances of an environmental object (natural or artificial) are the perceptible properties it “offers the animal, what it provides or furnishes, either for good or ill” (Gibson, 1979; p. 127). This Gibsonian view of affordances lies in the interaction or relation between organisms and environmental objects.

An affordance cuts across the dichotomy of subjective-objective and helps us to understand its inadequacy. It is equally a fact of the environment and a fact of behaviour. It is both physical and psychical, yet neither. An affordance points both ways, to the environment and to the observer. (p. 129)

However, Gaver (1991) argues alternatively that “[affordances] per se are independent of perception. They exist whether the perceiver cares about them or not, whether they are perceived or not, and even whether there is perceptual information for them or not” (p. 80). Thus, the Gaverian view of affordances assumes independent existence of affordances. They exist “independently of the individual organism in the sense that as long as the possibility of a particular activity exists for a particular species in an environment, then the affordance can be said to exist” (Bærentsen & Trettvik, 2002; pp. 52-53). To argue for the independent existence of affordances beyond perception, Norman (1988, 1999) compared the complex character of IT with simplified objects, such as stones. While perception of a stone alone

may be enough to engender affordances, perception of IT alone does not offer adequate information needed to appreciate the other unperceived ones hidden or inside. Hence, the Gibsonian view breaks down when applied to ITs.

When IT is under consideration, “affordances result from the mental interpretation of things based on our past knowledge and experience applied to our perception of things about us” (Norman, 1988; p. 219). Hutchby (2001) suggests similarly that technology affordances are interpreted by humans according to a web of environmental constraints, such as organizational rules: “affordances are functional and relational aspects which frame, while not determining, the possibilities for agentic action in relation to an object” (p. 444). They are functional because they have material presence, and relational because they are available to and differ from one person or organization to another (Faraj & Azad, 2012).

The functional and relational understandings of technology affordances have had much influence on IT design. For ITs which have numerous hidden affordances for information capture, processing, and transmission, their ease of use is very dependent on design that enables users to perceive ease of use. Therefore, “[m]aking affordances perceptible is one approach to designing easily-used systems” (Gaver, 1991; cf. Draper, 1986). The perceived ease of use has to be derived from a revelation of the hidden affordances of the artifact through inferences from other sources and through its use to perform an action. Gaver uses the term inter-referential to describe perceptible affordances and to illuminate the fact that “attributes of the [tool] relevant for action are available for perception” (p. 81). However, hidden affordances of ITs lack inter-referential properties because their attributes do not avail themselves for immediate perception. Their affordances are revealed in a process that is mediated by perceptible affordances and other representations exemplified by screen icons, user-guides, instructions, experience, culture, and goals. Therefore, technology affordances are “action possibilities and opportunities that emerge from actors engaging with a focal technology” (Faraj & Azad, 2012; p. 238).

The import of the theory of technology affordances for IS research is an essentialist conception of IT – that its material and formal properties are “out there” and available for both perception and engagement by the user. For instance, Leonardi and Barley (2008), Markus and Silver (2008), and Faraj and Azad (2012) have drawn upon this conception to argue for the materiality of IT as a framework for analyzing the IT-organization nexus. They suggest that technology affordances are rooted in a relational ontology which gives equal play to the material as well as to the social. In line with their suggestion, Leonardi (2011), for example, has applied the framework to build a theory of imbrication of material and human agencies. Imbrication assumes that IT and organizational routines are distinct elements that overlap and yet function independently. Similarly, Zammuto and colleagues (2007), in the review of research on new organizational trends afforded by IT, premise their discussion of the trends on this claim: “An affordance perspective recognizes how the materiality of an object favors, shapes, or invites and at the same time constrains, a set of specific uses” (p. 752). In short, the materiality of IT both affords and constrains, depending on human and organizational engagement.

Given the usefulness of the theory of technology affordance for IS research that studies the materiality of IT, it is applied to this research. There are alternative theories that integrate materiality in analysis of society, but they assume non-structural or non-essentialist conceptions of technology. For instance, the theory of sociomateriality (Scott & Orlikowski, 2013) assumes that there is inseparability between



technology and organization. But this assumption is problematic because it does not specify the formal role of technology (Mutch, 2013). This research seeks to specify the formal role of portable IT, which is ontologically different from other types of IT. Likewise, socio-technical systems theory (Bostrom & Heinen, 1977) takes the social and technical seriously, but it “eschews simplifying rationales that seek a single or dominant cause of change” (Sawyer & Jarrahi, 2014). Actor-network theory (Latour, 2005) also facilitates the study of socio-technical processes by taking the social and technical seriously. But it also has a non-essentialist conception of IT because it assumes that IT is given substance, action, and intention only by the social and conceptual agents it associates with in a heterogeneous network. However, this research focuses on the formal and material roles of portable IT in IO control.

## **RESEARCH SETTING AND METHODOLOGY**

### **Empirical Research Background**

The value-added tax (VAT) Service of Ghana (now under Ghana Revenue Authority since 2010) was mandated by law to ensure efficient and effective tax administration. This necessitated an IO relationship with the trader. Interestingly, the Service and trader share very few common goals; and so the Service basically used the legislation, a traditional bureaucratic mechanism, to control the trader’s tax payments. However, the Service had not been able to wield the necessary control that would ensure that the trader pays the appropriate tax. Since its establishment in 1998, its tax revenue generation had been undermined significantly by leakages in tax receipts, cumbersome and inaccessible payment points, poor transaction monitoring and enforcement of tax regulations and sanctions.

In May 2008, an IT vendor (AlphaCom, a pseudonym) proposed an electronic cash register (ECR) to the government. The register was acquired for the Service to implement and enhance its control over the trader’s tax payments. The ECR was basically a portable wireless computer connected to a few servers and data transmission systems used by mobile telecommunications operators in Ghana (see Figure 1). It had a dual subscriber identity module (SIM) card slot, dual antenna, integrated thermo printer, sizeable display, a keypad, and an intuitive menu. It also promised sound battery management via a long-duration battery and charger. It was portable (length of 230mm, breadth of 95mm, and height of 70mm) and light (420g). The Service welcomed the ECR because it was hopeful that it would “significantly improve system administration, monitoring, auditing and enforcement; increase the overall payer base through easier and simplified installation of VAT terminals; and facilitate easier tax payment by increasing the number of payment points through the introduction of payment partners such as banks and other financial institutions.” Furthermore, it would support real-time as well as store-and-forward transmission of tax payment information; capture and confirm sales transactions; and issue duplicate receipts for the customer and the trader.

Thus, it was possible for the Service to have real-time awareness of all of a trader’s transactions (gross sales, net sales, VAT due, etc.). The perceived advantage of the technology to the trader was its provision of a more transparent view of VAT transactions by showing updated schedules of payments, amounts owed, dates due, and other relevant payment information. The deployment of the ECR was expected to enhance IO control by the VAT Service, leading to increased tax revenue and decreased cost of collection. It was designed originally for one system of control; and then eventually configured by the Service for another system.

This IO relationship was selected conveniently because it was the only project of portable IT implementation in IO transactions during the period of the study. It was one of the many projects across African countries sponsored by the World Bank to enable governments to achieve better tax administration within their jurisdictions. Portable IT deployment and use among governments, businesses, and individuals in Africa have experienced phenomenal growth since the beginning of this century. One of the reasons for this is that portable ITs take advantage of wireless networks to overcome infrastructure deficiencies. These realities appear to have informed the deployment of portable IT for tax administration. They provided the opportunity to gather relevant data about how the technology is implicated in IO control.



Figure 2. The Portable Electronic Cash Register

## Research Approach

This research assumes that the form of portable IT has real, essential, and material agency (Leonardi, 2011) that can generate increased or reduced IO control. In order to trace the phenomenology of control in the empirical case to this agency and explain its materiality, the assumptions of critical realism were drawn upon. Critical realism informs interpretive knowledge claims, but those claims are grounded in real structures that have causal potential (Mingers, 2004). Causal potential refers to an explanation that “is not about deterministic or stochastic association of patterns or events, not about experiences, but the ascription of causal powers to objects” (Tsoukas, 1989; p. 553). The case explanations from this study are argued to be generalizable to theory (Lee & Baskerville, 2003; Yin, 2003; Walsham, 2006) because the explained materiality of portable IT does not belong to the empirical and actual domains, but to the real domain (Bhaskar, 1978; Tsoukas, 1989). The real domain of portable IT is understood by properties, such as its structure, size, ports, and interface components. Generalization to theory refers to “explanations of particular phenomena derived from empirical interpretive research in specific IS settings, which may be valuable in the future in other organizations and contexts” (Walsham, 1995; p. 79).

## Data Collection

Data collection and data analysis were informed by three main assumptions. First, the paper focuses on transactions of electronic data only, and so the analysis precludes transactions of physical or material products that are typical of buyer-supplier relationships in electronic commerce. Second, IO relations are understood in the context of only dyadic relationships. This scope can be extended to relationships between an organization and others in multiple dyads, as it is between a tax revenue organization and enterprises in a country. Third, traditional bureaucracy (Weber, 1947) is the underlying governance mechanism in the transactions between these IO dyads. Traditional bureaucracy is sustained by mechanisms such as rules, regulations, and routines used for IO control.

Data were collected from the following multiple sources on the Service's preferred system of control over the period leading to its eventual abandonment for IO control: meetings, training sessions, interviews, and documents. These multiple sources of data are important for ensuring a systematic data collection in case studies. Much of the data were collected from the researcher's attendance at meetings of the technology implementation committee that was instituted by the Service. The committee was composed of representatives from the Service and Ghana Union of Traders Association (GUTA); the Director of the Information Systems Support Unit of the Service was the chairman. The researcher attended twenty-two meetings from September 2009 when the committee was instituted to May 2010 when the technology was abandoned. He combined voice recording with note-taking during the meetings. The meetings were useful sources for data because they were platforms for branch managers of the Service to report the technology's implementation issues to the committee.

He also collected data from eight out of the ten ECR training sessions at the Service's headquarters; each of the sessions lasted about three hours. He sought to understand the dynamics of IO relations as the Service tried to get traders to learn how to use the technology. For instance, he studied and noted the amount of time, information, and courtesy given to the trainee traders. He also looked for the traders' apparent responses to the trainers as they searched for implications of the technology on the existing relationship between the two parties.

Finally, he interviewed ten traders who were using the ECR individually at their shops to both observe and note their reactions to the Service's control inscribed into the technology. Only ten interviews were obtained or sustained because many of the traders suspected that he was an agent of the Service. Each of these interviews, mixed with observations at the shops, lasted for fifteen to thirty minutes, depending on the number of transactions during the researcher's interaction with the trader.

Alongside the primary data collection, he obtained reports written by VAT Service on the challenges and benefits pertaining to the technology and its origins. He wanted to understand the control motives in the government's adoption of the technology that had not been clearly communicated to the traders in their negotiations.

## Data Analysis

Data were analyzed by listing the following pre-set codes that were drawn from the research question, literature, and theory: form and materiality; functional affordances; appropriation; symbolic expressions; opportunistic behavior; and behavior control (Appendix A). Then, through thematic analysis, themes

(phrases and keywords that reflected these codes) were identified and underlined in the field notes. In addition, themes based on emergent codes (for example, negotiation and rejection) were identified in the field notes. The themes were interpreted and reduced by classifying them into the following key issues of this research: formal and material properties of portable IT, functional affordances, symbolic expressions, and IO control. These classifications were related to each other by proceeding from the symbolic expressions (experiences and phenomena), to the functional affordances (events and conditions), and to the material properties (generative mechanisms). Thus, this order of analysis, from user interpretations to material properties, was informed by critical realism, which suggests explanations with generative mechanisms in the real domain (Table 2). The formal and material properties of portable IT were in the real domain, and so it was necessary to explain IO control by the form and materiality of the technology in this domain.

**Table 2. Relations between Critical Realism and Theoretical Background**

<b>Technology</b>	<b>Form and Materiality</b>	<b>Function</b>	<b>Interpretation</b>
<b>Concepts</b>	Technical Object	Functional Affordances	Symbolic Expressions
<b>Relational constructs</b>	Information and technology	IT and user actions	IT and user interpretations
<b>Analytical foci</b>	Design	Behavior	Signs
<b>Critical realist domains</b>	Real (generative mechanisms)	Actual (events and conditions)	Empirical (experiences and phenomena)

## RESULTS

The ECR was designed by AlphaCom to allow for use by the trader for its private organizational purposes. For instance, its size, networking, and programming were envisaged by the Service to enable flexible placement and use of the technology in the shop by the trader. However, the trader realized that her use of the technology was also a means for the Service to monitor her activities more closely. Therefore, she often moved and kept the device from the view of the buyer who could demand its use in the transaction. Similarly, she often placed the device in locations that kept it out of the mobile operators' network coverage area. This implies that the trader managed to derive self-centered benefits from the locational aspect of technology use, and increased the Service's difficulty to control the trader's behavior on a daily basis.

Furthermore, the device had an RJ-45 network port which the trader could use for an Ethernet or serial connection to her personal computer. If that connection could be made, then the use of the ECR would enhance the trader's management of transactions. The connection would capture digital data about transactions, send the data to the trader's personal computer for processing, and store and secure the resultant information to help the trader achieve enhanced record keeping. Thus, a GUTA representative

told a meeting that: “A few foreign companies want to connect the devices to their computers to help them with stock control.”

The ECR’s software could be configured in such a manner that could allow the trader to enter her preferred units (called “codes” by the implementation committee) of measurement and names as the identifiers of each item she sold. Different traders use different units and names even for the same item, such as an electricity cable. This cable may have one scientific name but more than one street or market name; it may also have one scientific unit of measurement, but sold according to a street unit. If the software had been configured in this manner, then its use would be more flexible to allow the trader a higher degree of behavioral discretion. The following data from field notes are paraphrases of statements made by different stakeholders of the ECR project implementation. They reflect the actual and anticipated frustrations associated with the standardized codes, and show why the trader desired procedural flexibility.

- *The codes are not extensive enough; for example OMO [a detergent] is common in the market but [only] ‘soap’ is coded. (GUTA representative)*
- *The machine will delay transactions and cause traders to desist from inputting sales data into it. Therefore, VAT Service will be losing revenue instead of maintaining or improving it. (trainee)*

These accounts show that VAT Service wanted to provide an incentive for easy handling, user satisfaction, and technology acceptance. It also reflects its ceding of part of its control over the use and benefits of the technology to the trader. Consequently, the use of the ECR would be serving the interests of both the Service and trader at the same time. It would be serving the trader’s interest because her use of processes and procedures in unacceptable or unpredictable ways would undermine the Service’s control. It would also be serving the Service’s interest because the trader’s tax payments would be normalized in the long run.

During AlphaCom’s presentation of the technology to representatives of the Service and GUTA, the activation of the network port and related potential benefits to the trader were suggested. This suggestion was made because the trader was in favor of configuring the device to enable her to enter preferred item names and units of measurement in each transaction. She agitated for this through her representative in the implementation committee and in her participation in the training sessions. However, the Service dreaded this scenario, and the dread is traceable mainly to the history of mistrust between the Service and the trader.

- *Flexible use will compromise data integrity and traders may manipulate the device. Therefore it should be standalone (AlphaCom representative)*
- *Additional facilities of the terminals are not yet activated for traders because of security reasons (GUTA representative)*

The trader did not trust the Service because she believed the Service taxed her unfairly. Thus, there were violent protests held against the government’s introduction of VAT to replace the sales tax in May 1995. There was suspicion that VAT was the government’s tactic to collect more taxes. The government then withdrew the VAT, revised it slightly, and re-introduced it in 1998 without demonstrations. Conversely, the Service did not trust the trader because it believed she under-declares or avoids paying

taxes. The mistrust between the parties was so strong that the traditional bureaucratic mechanism could not guarantee the kind of technology use by the trader that would keep the Service in control of VAT administration. This was sufficient to dissuade the Service from opting for a system of control that would allow for the trader's uncontrolled use of the ECR.

The Service opted instead for a configuration of the ECR that would cause the trader to conform to the technology use procedures. It worked with AlphaCom to program the device in such a manner that discretionary use by the trader was negligible. Apart from disabling the network port, it also pre-programmed the device to receive manual entries of some standard measurement units and names of traders' items. The Service developed these standards and included them in the last pages of the device's user manual. However, the range of units and names were very limited. This is because each measurement unit of an item actually had multiple sub-units on the ground, and multiple names were sometimes used in the market for the same item. Besides, new items and names that had not been anticipated by the Service were introduced in the market after the deployment of the register. The following paraphrases are also from field notes:

- *One of the problems is with the codes in the user manual – exemption codes are needed and should be activated in the network.* (from a field officer's report)
- *Prices should not be inputted because we bargain with customers* (a GUTA representative)
- *Fabrics are bought in fractions of units but the machine only allows whole numbers of units to be entered* (trader)
- *Instead of a separate/side list of codes, the codes should be inputted in the device so that the trader can scroll down and pick an item or can type in the first letter of the item to access it* (trainee)

In spite of these problems, the Service claimed the standardized procedures engendered by the pre-programming would at the same time ensure simpler transaction data entry for the trader. But the ECR had limited private benefits for the trader who used it according to the standardized procedures and purposes. This evidence reflects the standardization of technology use procedures that proved to be a disincentive for easy handling, user satisfaction, and technology acceptance by the trader. It also reflects a concentration of power and control over the use and benefits of the technology in the Service. Therefore, the use of the ECR served the interest of the Service predominantly at the expense of the trader. It undermined the trader's interest because she was forced to acquiesce to technological control of use processes and procedures.

Although the Service acknowledged the restricted use of the ECR to control the trader's use of the technology, it looked forward to a point where this would become institutionalized. At this point, the Service anticipated that the trader would have gotten used to the restricted use and accept the collective outcome of easier and simpler tax returns submission. Indeed, some of the traders reported during interviews that they found the device to be easier for submission of tax returns at the end of the month. Some of them found it easier to use than writing and found calculation of VAT returns less difficult. One expressed optimism even after he had found that the device was going off more frequently than he expected: "it may be because we are in early days."

However, the researcher also observed different behaviors quite contrary to the expectations of the Service. It was observed that some of the traders did not keep the device on the desks from which they transacted with buyers. The devices were kept in places in the stores where it would take a more careful observer to find them. They were not completely hidden from view, but placed at locations which were few feet away from the desks from which they transacted with buyers. Related to this was the fact that the traders knew that the service was highly interested in “monitoring” traders’ use of the device for transactions. For instance, one GUTA representative in a meeting asked “what are the mechanisms for monitoring the use of the terminals?” The response from a VAT Service official was “the [field] officers have been given access to the server [e-core] to monitor which machines are active and which are not.”

The researcher asked traders about how their placement of the devices (at locations that did not make them easily observable) could possibly take them out of the Internet network coverage area. However, they seemed not to be concerned about using the device for transactions. For instance, it was observed during the researcher’s engagement with the traders that they continued to transact with buyers without the device. It also was found from the empirical study that because of this behavior by traders, the Service made public announcements using newspaper, radio, and television which informed buyers that they should demand ECR-generated receipts from traders who had been given the device to use. All the traders who were given the device were identified with conspicuous paper notices which were stuck on walls or doors at eye level to make them easily visible to buyers.

Furthermore, reports from field officers of the Service indicated that traders were finding all sorts of reasons to avoid using the device.

- *334 given out, 6 returned = 340 distributed; some traders are actually lobbying others not to accept the ECRs* (a field officer)
- *“The rate of return of the machines by the traders is very high. Very frequent returns. The slightest problems cause them to return them”* (a field officer)
- *“Those who are using them are not doing so as they used to do a few months back”* (a field officer)

Many of the terminals were not used at all, or were used only occasionally, or returned with the slightest excuse. Throughout the empirical study period, the researcher found that the general frequency of use of the device was decreasing. Other officers who were monitoring the use of the device online also reported that many terminals were “inactive.”

All these issues combined with mistrust – the historical problem – to undermine outcome control in the ECR use leading to its disuse by the trader and eventual suspension by the VAT Service. The Service returned to the previous mode of tax administration after the suspension, and it did not restore the ECR, or its revised version.

## **PORTABLE IT AND INTER-ORGANIZATIONAL CONTROL**

The analysis of how the form, function, and materiality of portable IT are implicated in IO control begins with explanations of the symbolic expressions at the planned and actual stages of implementation. The actual symbolic expressions are analyzed further to explain the functional

affordances; and the functional affordances are also analyzed further to explain how the form and materiality of portable IT generate mechanisms that cause reduced IO control.

### Symbolic Expressions of Facilitator and Surveillance

Initially, VAT Service and GUTA representatives were considering how the device could be programed to allow traders to configure it to suit their business needs. Trader configuration would lead to user appropriation. Appropriation of portable IT is normally a negotiation about power and control over the configuration, uses, and benefits of portable IT (Wiredu, 2007; Waycott, 2002). Although VAT Service was quite apprehensive about appropriation, they considered it in the implementation meetings because it was a way of achieving traders’ acceptance and use of the device. Thus, VAT Service thought the size, network, and interface of the technology would afford traders the configuration and connection of the device with their own computers. The size in particular was meant to allow its movement in the shop by the trader to achieve network connectivity. The interface would also allow traders to relay transaction data to their own computers.

However, these functional affordances generated positive and negative symbolic expressions for VAT Service and traders in different ways. Symbolic expression is a “relational concept bridging IT artifacts and how users may interpret them” (Markus & Silver, 2008; p. 623). Positively, the symbolic expressions drawn from the size and interface by VAT Service were surveillance and control over traders’ activities. The positive expression drawn by the trader was facilitation. The trader believed that the interface would bring them low transaction costs because it would facilitate sales of their products and payments of VAT at the same time. Negatively, however, VAT Service thought that the functional affordances would give traders the opportunity to configure the device beyond acceptable limits and subvert its ability to control behavior on a daily basis. This is a scenario of reduced behavioral control generated by the formal and material properties of the ECR. It induced the Service to suspend the programing of the device for user configuration and appropriation.

**Table 3. Summary of Analysis of the Two Stages**

Stage	Portable IT Form and Material (Design by VAT)		User Experience	Control
Planned	FA1	Could be moved, networked, and configured significantly	Appropriation	Reduced
	SE1	Surveillance and control	Facilitator	
Actual	FA2	Moved slightly or insignificantly but repeatedly, and configured slightly	Subversion	Reduced
	SE2	Surveillance and control	Threat and burden	

FM: Form and Materiality  
 FA: Functional Affordance  
 SE: Symbolic Expression



## Symbolic Expressions of Threat and Burden

The device was *actually* programed to standardize use procedures in order to reduce ambiguity in the traders' use of it. Thus, VAT Service did not allow traders to use the physical network port in the shop. Moreover, it asked AlphaCom, the vendor, to inscribe standard procedures into the device to compel traders to behave according those rules. This decision, at the same time, was meant to increase VAT Service's control over user behavior because it was not interested in the traders' appropriation of the device. It was also meant to coerce traders to acquiesce to appropriate use of the device; and they did acquiesce. Acquiescence is understood as the outcome of construction of a standardized operational domain of technology according to the strategies of functional closure and simplification (Kallinikos, 2005; Luhmann, 1993). Users acquiesce to technology when they are forced to use devices according to a standardized "layout of steps that have to be followed in order to accomplish a task or series of tasks" (Kallinikos, 2005; p. 191).

The traders' acquiescence reflects their perception of the technology as threat and burden which are symbolic expressions. The symbolic expression of threat was witnessed in how traders often exploited the size and wireless network interface components of the device to move it out of the mobile telecommunications network coverage areas. This happened when VAT Service announced that shoppers should demand ECR-generated receipts. Expression of threat is also witnessed in how VAT Service sought to increase surveillance over traders' transactions remotely through the device. The symbolic expression of burden was witnessed in how the traders labored both in the implementation meetings and in their use of the device to achieve flexible use; this contrasted with the Service's desire for and implementation of standardized procedures at the same time. According to Beaudry and Pinsonneault (2005), when users interpret IT negatively in senses such as threat and burden due to their low control over it, they minimize perceived negative consequences through self-preservation strategies such as avoidance, selective attention, and distancing.

The symbolic expressions of facilitator, burden, and threat mediate the nexus between portable ITs and how they are interpreted by users (Markus & Silver, 2008). Symbolic expressions mediate, and so they are generated not only by users' values and intents, but also by formal and material properties of portable IT. The size, limited programing, and limited interface of the ECR are the combined formal and material properties that were sensed and interpreted as threatening and burdening signs to the traders. Because symbolic expressions are relational concepts mediating IT and user groups, these interpretations also derive from traders' interests. The size of portable IT has mobile possibilities, and the limited programing and interface have communication possibilities. Communication creates remote visibility every time, everywhere. Therefore, traders' sensing and interpretation of threatening and burdening signs were due to their dislike for being visible every time, everywhere to VAT Service.

## Functional Affordances of Subversion through Micro-Mobility

By virtue of the symbolic expression of threat and burden, the traders generated a functional affordance of micro-mobility from the device in order to subvert the Service's control of their transactions. Micro-mobility is limited movement of the device by the trader within a shop. The functional affordance of micro-mobility was generated by the traders not just because it is a perceptible property of portable IT. Rather, it was generated because of their engagement with the device, and their interpretation of its size,

programming, and interface. How their engagement generated the functional affordance of micro-mobility can be understood by the formal and material properties of the device in relation to the IO rules between VAT and traders, the rules of which Hutchby (2001) calls environmental constraints. The empirical case suggests that these constraints are particularly IO in nature because they reflect the limited shared goals between two organizations. Limited shared goals, apart from portable IT, provide motives for opportunistic behavior by the controlled party (the user) to subvert IO control of transactions. When portable IT enters the relationship, this motive constrains or undermines control by driving the controlled party to interpret and generate a functional affordance of micro-mobility from their engagement with the device.

When VAT Service announced publicly that shoppers should demand ECR-generated receipts from traders that had the device, traders often kept the device from the view of shoppers. At this stage, the functional affordance of surveillance generated by VAT Service at the outset was undermined by the affordance of micro-mobility generated by traders. The announcement signifies further limitation of the shared goals in the IO relationship because it tends towards antipathy rather than empathy. Further limitation of shared goals reflects a worse experience in the mind of the controlled organization. Gaver's (1996) assumption of technology affordance is that such experience mediates users' interpretation of technology upon their engagement with it. It also mediates their subsequent generation of affordances. In the empirical case, a worse experience induced the traders to generate an affordance of another form of micro-mobility – moving the device away from the view of shoppers. This form of mobility reflects a negative user interpretation of portable IT. In sum, the functional affordance of this other form of mobility is induced by worse experience in an IO relationship that mediates users' engagement with portable IT. It mediates by providing greater motives for negative user interpretations from the engagement.

### **Portable IT and Reduced Control**

The upshot of the analysis above is that IO control was supplanted by the expected or actual handling of the ECR by traders. The experiences of reduced control by VAT Service over traders' transactions are traceable to the functional affordances of portable IT: movement, connectivity, visibility, and concealment. Transaction control was dependent on the extent to which the traders thought of or practically moved, connected, and/or concealed the device. However, while these user behaviors point to functional affordances, they go beyond affordances to point to the formal and material properties of portable IT. Although the behaviors are actual experiences that occurred, users in other contexts may not reproduce them. Affordances are socio-technical conditions that must be further traced to the form and materiality of portable IT that generates them (Hutchby, 2001). Therefore, this paper explains how and why reduced IO control is generated by the formal and material properties of portable IT.

Reduced IO control is traceable to two main properties of portable IT. One is the size that enables affordances of micro-mobility and concealment. The others are limited programming and interface that enables affordances of connectivity and visibility. Size, programming, and interface are key formal and material properties of portable IT that determine reduced or increased control from the perspectives of both controller and user. A careful look at the trajectory of the ECR (in terms of its design, redesign, and handling in the empirical case) shows that the behaviors of VAT Service and traders were not the real or

essential factors for control. This is because VAT Service had high control over traders before the deployment of the device and after its abandonment. When the technology was introduced, its formal and material properties (size, programing, and interface) were the specific instruments used by the controller to pursue its control agenda, and by the user parties to pursue its subversion agenda.

Reduced IO control occurs because the formal and material properties of portable IT have real structures that invite users to activate those properties. Invitation and user activation are occasioned by their deployment for IO control. Until they enter IO relations, invitation is meaningless because users are only probable, and the technology's form and materiality lie latent. The observation of traders' exploitation of the formal properties of the ECR and functional affordances to exercise subversion or counter-control, at the expense of VAT Service's control, point to the device's invitation and users' activation of these properties. To wit, size, programing, and interface serve as mechanisms that generate technological agencies. This is because they render portable IT as a generative mechanism of reduced control or more subversive user behavior in IO relations.

The realization of portable IT as a generative mechanism is nonetheless contingent upon other non-technological generative mechanisms in the IO domain. According to Tsoukas (1989), "[w]hether a particular causal power is exercised, or whether it manifests itself in the actual and/or empirical domain depends on the ambient *contingent* conditions" (p. 553; emphasis in the original). Prominent contingent generative mechanisms in IO relations are the IO structure, accompanying legislation, spatial distance, and history. If these mechanisms are activated, they can countervail the form and materiality of portable IT. The empirical data suggests that these non-technological mechanisms were not activated to the degree that they would countervail the generative reality of portable IT; this is because of three reasons. First, the IO structure is essentially a relationship with limited shared goals between the organizations. By itself, it does not carry a strong generative mechanism that is sufficient to control the other party. Hence, second, legislation is required to guard the shared goals to control the other party and avert opportunistic behavior. Legislation carries a greater generative mechanism than the IO structure. But it is quite inappropriate to legislate portable IT use, especially when user acceptance and satisfaction are to be achieved (Waycott, Jones, & Scanlon, 2005). Thus, VAT Service approached the ECR deployment by using more negotiations with traders' representatives and less legislation to coerce its acceptance and use. Third, there is wisdom in the negotiation approach if spatial distance and history have powerful tendencies to generate more subversive behavior and reduced control of the other party.

Therefore, portable IT as a mechanism that generates reduced IO control is not absolute. The portable IT does not necessarily determine reduced control, but it is nonetheless forceful in terms of its generative reality. Its forcefulness is facilitated and sustained by the IO structure and spatial distance; but this is only a tendency because it may or may not lead to low reduced transaction control. For instance, a non-technological contingency may activate a countervailing generative mechanism that may weaken the reduced-control generated by portable IT. In this instance, the tendency of portable IT to reduce IO control will weaken or even lie latent to the extent that the technology will be deemed to have only a generative reality. But this tendency will never be destroyed completely because users may manipulate the technology in other unpredictable ways that can restore its generation of reduced IO control. Therefore, to answer the research question, *the materiality of portable IT, with the support of the inter-*

*organizational structure, generates reduced IO control by inviting users to subvert its micro-mobility, connectivity, and visibility.*

## **CONTRIBUTIONS AND IMPLICATIONS**

This paper has analyzed how the formal, functional, and material aspects of portable IT are implicated in IO control. This has led to the identification of the limited size, programing, and interface, as the properties of the technology that have materiality to generate reduced control. The study of materiality of portable IT is about “the ways that its physical and/or digital materials are arranged into particular forms that endure across differences in place and time” (Leonardi, Nardi, & Kallinikos, 2012; p. 29). Thus, the paper has provided portable technological explanation of IO control, labeled as portable technology control. This explanation provides three main contributions: structural tensions between portable IT and IO relations; portable IT’s structure and relation; technological, human and IO agencies.

### **Structural Tensions between Portable IT and Inter-Organizational Relations**

First, control through size, programing, and network interface of portable IT is a specific explanation of portable technology control in the context of IO relations. It is specific in terms of both technology and social contexts. In terms of technology context specificity, portable IT’s small size, programing, and interface together constitute its core material components. These have been analyzed as generative mechanisms of functional affordances and aberrant behaviors in the previous section. Among these, size has emerged as a core form of portable IT that directly affects IO control. Previous theories of technology control (Beniger, 1986; Ciborra, 2000; Kallinikos, 2005; and Luhmann, 1993), arguing for the non-deterministic character of technology, are in harmony with this paper. However, they are derived from analysis of control in terms of the Internet and/or corporate information infrastructure.

In terms of social context specificity, the IO structure has been shown in this paper to be a generative mechanism that facilitates and sustains the reduced control generated by the materiality of portable IT. The IO structure is substantive and distinct from the organizational, national, and global structures that characterize previous studies. Consequently, previous theories of technology control are so generic that they are incapable of explaining control in terms of the specific particular portable IT and IO structures. In this paper, control has not just been ascribed to portable IT but to its particular component parts which lie beneath the undivided level of the artifact. It also has been ascribed to the IO structure as a generative mechanism that can countervail and diminish the form and materiality of portable IT. This ascription extends our understanding of control by pointing to the particular and distinctive generative mechanisms in portable IT, to their specific constraints and affordances, and to their likely control effects.

### **Portable IT’s Structure and Relation**

The second contribution is an explanation of technology control in terms of both structural and relational understandings of portable IT. The proposed explanation of portable technology control is founded ultimately on the formal and material properties of portable IT, yet only in its relations with other generative mechanisms is the explanation fully understandable. The idea that portable IT, as a generative mechanism, is facilitated and sustained by the IO relations suggests both a structural and relational

understanding of its materiality. This dual understanding means that portable IT control is objective and subjective at the same time. It is objective in the sense that our knowledge of IO control ultimately rests on portable IT, but its generation of IO control is subject to the IO relations. This understanding resonates with Faraj and Azad's (2012) idea of technology affordances which "come about from the confluence between an actor's line of action and the generative action possibilities in the technology" (p. 254).

Thus, technology affordance is rightly a relational construct, but the relationship is located between technology and user. This location characterizes other previous models, such as sociomateriality (Orlikowski, 2007; Scott & Orlikowski, 2013) and imbrication of human and technological agencies (Leonardi, 2011). However, when such models are applied to this paper's research problem, they will locate only the relational explanation between portable IT and control, and strip the technology of structural role. This paper's explanation rather locates the relational explanation between portable IT and the IO structure in the real domain; and it specifies the structural role of portable IT at the same time. Therefore, while Leonardi espouses an imbrication of human and technological agencies as the relational explanation underlying organizational routines, this paper espouses a complementary imbrication of formal, material, and IO agencies that generate reduced control because they lie at the real domain.

### **Technological, Human, and Inter-Organizational Agencies**

The third contribution is an explanation of how technological, human, and IO agencies combine to shape IO control. IO agency is the ability of the IO structure to realize certain conditions that increase the costs and control of transactions. Portable IT as a mechanism that is actually implicated in control underscores its technological agency. But knowledge of the role of technological agency in technology control is incomplete without knowledge of how it combines with human and IO agencies to shape control. Human agency is enacted when users generate functional affordance from the size and network interface of portable IT. But technology features are not the only things that induce this enactment; it is also induced by motives to manage conditions that increase IO transaction costs in order to reduce the costs.

This research highlights and integrates the role of IO agency into previous explanations of how technological and human agencies shape an organizational routine like control. If the IO structure is a substantive generative mechanism that can countervail the generative capacity of portable IT, then it is an agent in its own right. Therefore, it is also a theoretical, not just contextual issue for technology control. The integration enhances previous theories of technology control because IO agency enhances our understanding of how transactions, their costs, and cost reduction serve as incentives for technological and human agencies. By combining technological, human, and IO agencies to explain IO control, the paper also enlivens previous theories of human and material agencies (Constantinides & Barret, 2005; Lapointe & Rivard, 2005; Chu & Robey, 2008) that are spearheaded by Leonardi's (2011) theory of imbrication of these agencies. The paper enlivens these theories because its contribution leads researchers to consider the technological, human, and IO agencies in their analysis of how these agencies affect IO control.

## Implications

This research has taken the lead in developing an explanation of portable IT control. This is a step beyond existing theories of technology control because it represents a specific explanation of this broad issue. Although this research is limited to the IO level of analysis, the explanation of portable technology control opens up a new area of research into control through portable IT. Given that portable ITs have been deployed and used at personal, organizational, national, and global levels, these different levels of analysis of portable technology control represent fertile research grounds. For example, the question “how is the materiality of portable IT implicated in government control of citizens?” is yet unexplored in current efforts at developing theories of technology control. Another substantive research question can be posed if “government control of citizens” in the question is replaced with “organizational control of employees.” Addressing such questions will lead to more elaborate theorization of technology control in IS research.

The issue of how much or less materiality of portable IT may reduce control at any level is also brought forth by the explanation of portable technology control. This is a very relevant research issue because the current phenomenon of ubiquitous computing is linked intrinsically with portability or miniaturization of IT (Tilson et al., 2010). Ubiquitous computing, which is evidenced by more portable IT, represents an increasing density of these devices among individuals, organizations, and nations around the world. The density of devices is tantamount to density of materiality, which may have manifold implications for portable technology control. For instance, it is very plausible that material properties of smartphones, such as Near Field Communication protocol and Long Term Evolution technology, which are becoming commonplace, may shape the degree of control reduction at any analytical level (personal, organizational, national, or global). As the uptake of smartphones is increasing at all these levels, it will be interesting to explore how employees and citizens are gaining more control with them at the expense of organizational and governmental control, respectively.

The exploration of how much materiality of portable IT implicates reduced control has further implications for design science research on this technology. Gregor and Hevner (2013), in outlining positioning and presentation schema for design science research, encourage IS researchers to develop more design theories. Researchers who would embark on design of portable IT for control can be informed reliably by theories of portable technology to produce novel design insights and artifacts. Hence, more elaborate theorization of portable technology control will provide more kernel theories to be drawn upon by design science researchers for developing theories of portable IT design and action (Gregor, 2006; Walls, Widmeyer, & El Sawy, 1992).

This explanation of portable technology control also has implications for future research on inter-organizational information systems (IOS). This paper has shown that the IO structure is not just a contextual issue but a theoretical one without which one cannot understand this explanation of portable technology control completely. IO agency can countervail the material agency of portable IT. Each of these types of agency is generative, and which of them prevails depends on contingent conditions (Tsoukas, 1989) such as legislation, shared goals, and the imperative character of technology. This research has not been able to explore such contingent conditions on IO agency because of the primary focus on exploring the material agency of portable IT. Therefore, it will be interesting for researchers to

explore how IO agency is conditioned by such contingent conditions in IOS research in general or in IOS control research in particular.

This proposed explanation provides organizations with greater understanding of how to use portable IT to regulate IO control. If portable IT is assumed to reduce IO control, then the assumption can be applied by organizations to a wide range of actions pertaining to control. Actions such as acquisition, design, implementation, and management of portable IT can be undertaken with greater understanding drawn from this research. As this paper has shown how portable IT reduces IO control, organizations can use them to create and activate generative mechanisms that countervail this reduction in order to maintain high control. However, the creation and activation of countervailing mechanisms can guarantee success if organizations understand the importance of IO agency. This understanding is especially necessary when organizations face the imperative character of technology, and must therefore adopt portable IT. The understanding will help organizations to use IO agency for regulation.

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## APPENDIX

Pre-set codes	Keywords	Descriptions	Interpretation & Reduction	Categories
Form and materiality	Network port	Pre-programed the device	Limited programing	Generative mechanisms
	Ethernet	Codes are not extensive enough	Limited programing	
	Portable	Flexible placement and use in the shop	Small size	
	Software	If the software had been configured; software could be configured	Limited programing	
	Terminal	Additional facilities of the terminals are not yet activated	Limited interface Limited programing	
Opportunistic behavior	Kept	Avoid using the device	Subversion	Functional affordance
	Placed	Keep the device from view of the buyer	Appropriation	
	Desist	Placed the device in locations that kept it out of mobile operators' network	Mobility and subversion	
	Manipulate	...traders may manipulate the device	Appropriation and subversion	
Symbolic expressions	Monitor	...technology was a means for the Service to monitor	Surveillance	Symbolic expression
	Enhance	Limited private benefits for the trader	Threat	
	Frustrations	Frustrations associated with the standardized codes	Burden	
Appropriation	Connect	...want to connect the devices to their computers	Appropriation	Functional affordance
	Configuring	If the software had been configured; software could be configured	Acquiescence	
	Flexible use	Flexible placement and use in the shop	Appropriation	

	Conform	Flexible use will compromise data integrity ...traders may manipulate the device	Subversion	
Functional affordances	Flexible placement	Keep the device from view Keep the device from view of the buyer	Appropriation Subversion	
	Kept	Placed the device in locations that kept it out of mobile operators' network	Mobility and subversion	Functional affordance
	Placed			
	Delay transactions	The machine will delay transactions and cause traders to desist from inputting sales data into it	Limited programing and subversion	Generative mechanism and functional affordance
Behavior control	Standardized procedures	Discretionary use was negligible Restricted use of the ECR	Restricted programing and acquiescence	
<b>Emergent codes</b>	<b>Keywords</b>	<b>Descriptions</b>	<b>Reduction</b>	<b>Categories</b>
Negotiation	Meetings	Exemption codes are needed The codes should be inputted in the device	Limited programing Limited shared goals	Inter-organizational form and agency
		Implementation committee meetings	Limited shared goals	
Rejection	Return	Return of the machines by the traders Very frequent returns	Subversion	Functional affordance
	Avoid	Traders are actually lobbying others not to accept the ECRs		

