Going Back to Basics in Design Science: From the IT Artifact to the IS Artifact

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Abstract

The concept of the "IT artifact" plays a central role in the information systems research community's discourse on design science. We pose the alternative concept of the "IS artifact," unpacking what has been called the IT artifact into a separate "information artifact," "technology artifact," and "social artifact." Technology artifacts (such as hardware and software), information artifacts (such as a message), and social artifacts (such as a charitable act) are different kinds of artifacts that together interact in order to form the IS artifact. We illustrate the knowledge value of the IS artifact concept with material from three cases. The result is to restore the idea that the study of design in information systems needs to attend to the design of the entire IS artifact, not just the IT artifact. This result encourages an expansion in the use of design science research methodology to study broader kinds of artifacts.

Keywords

IS artifact, IT artifact, design research, design science, information artifact, technology artifact, social artifact

Introduction

In this essay, we evoke the difference in meaning between "information system" (IS) and "information technology" (IT). While both regard information, the former regards systems ("a set of entities with relations between them," Langefors, 1995, p. 55) and the latter regards technology ("a body of science-based technical knowledge," Bunge 1985, p. 220). Our purpose is to distinguish the concept of the "IS artifact" in the IS research community's discourse on design science – a dialogue that has been framed in terms of what it has called the "IT artifact," but not other artifacts (entities) that are also part of the overall formation of an IS. Indeed, an IS can even exist without an IT artifact. In this essay, we formulate a definition of "IS artifact" and demonstrate its value to design science by illustrating it in three cases.

In 2001, Orlikowski and Iacono published an article that explained how the IT artifact was largely missing from IS research. Before this event, we find only one refereed article (using a Proquest ABI/Inform Complete search) that responds to a search for "information systems" and "IT artifact" (or "IT artefact"). After this event, there are 360 refereed articles. Before this

article, technology like hardware or software was often a nearly unstated assumption in IS research: absent or nothing more than a possible source for the more interesting social or managerial effects under study. After this article, the surge of interest in technological artifacts was further accelerated by the publication of a seminal article by Hevner, March, Ram, and Park (2004). These works triggered a resurgence of *design* as a founding ideal in information-systems research. The resurgence, building on earlier design articles (e.g., Walls, Widmeyer, and El Sawy, 1992 and March and Smith, 1995), has focused mainly on design associated with the IT artifact. Any information system, however, involves an array of different artifacts, which can include but is not limited to the IT artifact.

This paper responds to the need to better define the IT artifact. For some, servicing this need means "incorporating more comprehensive and multi-faceted conceptualizations of the IT artifact" (Akhlaghpour et al., p. 151). For others, broadening the meaning of the concept (IT artifact) creates confusion. This definitional need calls for better distinctions between the IT artifact from its context, such as the environmental, social and organizational factors that precede and follow implementation (Currie, 2009). We are in concord with Currie's viewpoint. Our definition of a comprehensive IS artifact helps contextualize this technical artifact and better distinguish it from its context without necessarily diminishing the importance of this context.

We accept the position that the design of an information system may benefit by addressing the IT artifact but, just as importantly, we also take the position that the design of an information system may benefit no less by addressing the overall IS artifact. An examination of the larger system of which any IT artifact is necessarily a part quickly expands the focus from IT artifacts to include artifacts that are not IT and artifacts that are created by people who are not IT designers. We may conceptualize these different artifacts as enabling, interacting with, and even transforming one another where, in coming together as an information system, they ultimately serve to solve a problem or achieve a goal for individuals, groups, organizations, societies, or other social units.

We pursue two purposes in shifting attention from IT to IS in our way of conceptualizing "IS artifact." The first purpose is to liberate IS design from the IT artifact-centric perspective that has dominated scholarly discussions of IS design science since the publication of the seminal Hevner *et al*. article (where we are quick to acknowledge that the Hevner *et al*. article itself is not IT

artifact-centric). The second, and related, purpose is to expand the capability of design science methods in information systems (and rebalance the focus of our academic discipline) by enabling researchers, instead of focusing on the design of an IT, an information *technology*, to focus instead on the original IS focus: the design of an IS, an information *system*. As important as an IT artifact can be, it is just part of an IS; it is not the entire IS. A hallmark of systems thinking is that the whole comprising a system is greater than the sum of its parts.

With this in mind, we conceptualize "IS artifact" so that it refers to a system, itself consisting of subsystems that are (1) a technology artifact, (2) an information artifact, and (3) a social artifact, where the whole (the IS artifact) is greater than the sum of its parts (the three constituent artifacts as subsystems), where the IT artifact (if one exists at all) does not necessarily predominate in considerations of design, and where the IS itself is something that people create (i.e., an "artifact"). Regarding the last point, in the next and second section of this essay, we will present Herbert Simon's ideas on what an artifact (not just an IT artifact) is in general.

In the third section, we will offer the first of three cases to illustrate our conception of "IS artifact." The case will offer our perspective on the coal mining technology that Emery and Trist made famous in their exposition of sociotechnical systems. It will involve nothing that today's research would consider to be an "IT artifact" but will still embody an artifact that is an information system. The absence of an IT artifact will serve to evoke what makes an information system an information system and, therefore, what it is that requires design. Following the coal mining case, in the essay's fourth section, we will illustrate our conception of the IS artifact in a case involving the appropriation of mobile-phone/conference-call technology in the design of an information system by immigrants (from China to the United States) seeking to fulfill their social and spiritual needs. This case will involve design by users, but not design of an IT artifact and not design by IT professionals or academics. In the fifth section, we will offer a third case in which an author of this essay, as part of a larger study, is implementing a model for participatory communication and information sharing to facilitate the reporting and tracking of health issues among women living in a particular rural, outlier community in a developing nation. To serve intentionally in contrast to the belief that a successful IS needs to be "high tech" and to engage in sophisticated data processing, this case will involve a "low tech" IT artifact and the processing of "small data."

Simon's Conception of "Artifact" and Our Conception of "IS Artifact"

Simon himself has stated (1996, p. 5):

> We have now identified four indicia that distinguish the artificial from the natural; hence we can set the boundaries for sciences of the artificial:
>
> 1. Artificial things ["artifacts"] are synthesized (though not always or usually with full forethought) by human beings.
>
> 2. Artificial things may imitate appearances in natural things while lacking, in one or many respects, the reality of the latter.
>
> 3. Artificial things can be characterized in terms of functions, goals, adaptation.
>
> 4. Artificial things are often discussed, particularly when they are being designed, in terms of imperatives as well as descriptives.

We find Simon's conception of "artificial thing" or artifact significant in three ways. First, there is nothing in Simon's conception that restricts artifacts to being only IT artifacts. Second, even something made without "full forethought" *and hence not made by designers* (whether IT designers or other designers) can be an artifact. Third, there is nothing in Simon's overall discussion that restricts an "artifact" to being something physical. Indeed, Simon includes law and journalism as sciences of the artificial (p. 112), where the artifacts created in law and journalism are nonphysical. These three aspects grant us considerable freedom in our effort to re-conceptualize "artifact" in IS design science from just the "IT artifact" to what we are calling the "IS artifact." We take advantage of this freedom to "unpack" what has been called the "IT artifact" into a separate "information artifact" and "technology artifact" that, together with a "social artifact," interact to form the "IS artifact." This parsimony relieves the need to overload the term "IT artifact" in order to extend the concept to encompass its surrounding context. Such extensions to the concept of "IT artifact" have reached far beyond its technical aspects to include "socio-technical artifacts" (Gregor and Hevner, 2013, fn2), "cultural properties" (Orlikowski and

Iacono, 2001, p. 121), and to encompass "IT, IS, and also related people, policies, and practices." (Currie, et al. 2014, p. 428). The "IS artifact" enables us to more exactly describe different kinds of artifacts in information systems instead of so overloading the term "IT artifact" that the original technical concept (such as that found in Walls, et al 1992; March and Smith, 1995; or Benbasat and Zmud, 2003) will soon go nameless.

Consistent with Simon's four indicia for what an "artificial thing" or artifact is, we now define "technology artifact," "information artifact," "social artifact," and "IS artifact."

First, we regard a **technology artifact** to be a human-created tool whose *raison d'être* is to be used to solve a problem, achieve a goal, or serve a purpose that is human-defined, human-perceived, or human-felt. This definition has four ramifications. First, IT artifacts can be regarded as special cases of technology artifacts in general. Second, technology artifacts may include not only those that are described as digital or electronic (such as a mobile phone, a FaceBook page, a memory stick, a pdf file, and a hardware-software-data-network system), but also those that are non-digital and non-electronic (such as a face-to-face meeting, a billboard, a person's memory, a book, and a library). Third, unlike in the first two ramifications, technology artifacts need not be about information *per se*; a tool such as a hammer, for instance, counts as a technology artifact. And fourth, a technology artifact need not be physical. Neither a strategy for winning a war nor a business strategy for gaining market share is a physical object, but each may nonetheless be considered a human-created tool whose *raison d'être* is to be used to solve a problem, achieve a goal, or serve a purpose that is human-defined, human-perceived, or human-felt.

Second, an **information artifact** is an instantiation of information, where the instantiation occurs through a human act either directly (as could happen through a person's verbal or written statement of a fact) or indirectly (as could happen through a person's running of a computer program to produce a quarterly report). We turn to McKinney and Yoos for their meanings of the term "information" (2010, p. 331). With an information artifact, the function or goal in instantiating information can be (1) to "process data" (the token view), (2) to "reduce entropy" (the syntax view), (3) to "form meaning" (the representation view), or (4) to "achieve viability" (the adaptation view). Examples of information artifacts in these four views are (1) numbers, letters, or other symbols that are themselves devoid of content (hence, "tokens"), but to which

content can be ascribed and with which the content can then be processed; (2) relationships among numbers, letters, or other symbols (literally, a "syntax"), of which a special case is the algebraic relationships among variables and constants in an equation and another special case is the grammatical relationships among words and punctuation marks in a sentence or paragraph; (3) accounting numbers which form the meaning of (and therefore are a "representation" of) a real-world financial situation, and (4) a perception or observation of a "difference that makes a difference" (Bateson, 1973, quoted in McKinney *et al.*, 2010, p. 336) in "a system [that] may be a mechanism, organism, or organization, such as a machine, mind, or a firm," where the difference that makes a difference refers to any "adaptation" made in the system towards, or away from, an intended or desired outcome.

Third, we define a **social artifact** as an artifact that consists of, or incorporates, *relationships or interactions between or among individuals* through which an individual attempts to solve one of his or her problems, achieve one of his or her goals, or serve one of his or her purposes. We describe this artifact as social because relationships and interactions involve more than just one person; hence, they involve *the social*, not just *the individual*. Defined in this way, social artifacts can include persistent social objects that involve already established relationships (such as kinship structures, institutions, roles, cultures, and laws) as well as one-off ephemera in one-off interactions (such as an utterance in a conversation, a decision made in a committee meeting, a purchase made in a retail transaction, and a charitable act).

Fourth, when the three artifacts, just defined, are brought together and interact, they can come to form what we call an **IS artifact**. We define it as more than just the side-by-side concatenation of a technology artifact, an information artifact, and a social artifact. Much as, in chemistry, a compound has properties different from those of a mere mixture of the elements from whose interactions the compound emerges, an IS artifact likewise has properties different from those of the constituent artifacts from whose interactions the IS artifact emerges. An IS artifact is itself a system, in which the whole (the IS artifact) is greater than the sum of its parts (the IT artifact, the social artifact, and the information artifact), where the constituents are not separate, but interactive, as are any subsystems that form a larger system. Hence we name it an **information systems artifact** or **IS artifact**.

A venerable literature recognizes that technology aspects, information aspects and social aspects are among those that serve as definitional in information systems. Alter (2008) details 21 published definitions of the term "information systems" with contrasting emphasis on social versus technical concerns in which all three aspects above are found in the most common views. These are information systems aspects that also share a common perspective from socio-technical theory (Mumford, 2006), systems science (Checkland, 1998), and information science (Debons, 2008). While we aim to be consistent with this broad body of work on information systems, we particularly seek to bring identity to the nature of IS as an artifact, in Simon's terms, which may include among its components the IT artifact, the social artifact and the information artifact. Formulating the IS as an artifact better clarifies how the range of methodology and paradigmatic thought from the design science perspective can be brought to bear in studying the IS artifact along with its three constituent kinds of artifacts.

Our three case illustrations below will show how the information artifact, the technology artifact, and the social artifact can all interact and combine into a whole that is greater than the sum of its parts – where the whole is the IS artifact.

A Case of an Information System without an IT Artifact

Emery and Trist's (1969) classic exposition of a sociotechnical system predates the IS discipline and, of course, need not be viewed as a case of an information system; however, for illustrative purposes, it is instructive for throwing light on our concepts of "technology artifact," "information artifact," "social artifact" and, ultimately, "IS artifact." It is also instructive for showing how an information system can exist without an IT artifact.

Emery and Trist's coal mining case involved the technology of longwall mining, which can be described as follows (*Encyclopaedia Britannica*, 2012):

> In the longwall mining method, mine development is carried out in such a manner that large blocks of coal, usually 100 to 300 metres wide and 1,000 to 3,000 metres long, are available for complete extraction... A block of coal is extracted in slices, the dimensions of which are fixed by the height of coal extracted, the width of the longwall face, and the thickness of the slice (ranging from 0.6 to 1.2 metres). In manual or semimechanized operations, the coal is undercut along the width of the panel to the depth of the intended

> slice. It is then drilled and blasted, and the broken coal is loaded onto a conveyor at the face. The sequence of operations continues with support of the roof at the face and shifting of the conveyor forward. The cycle of cutting, drilling, blasting, loading, roof supporting, and conveyor shifting is repeated until the entire block is mined out.

As such, longwall mining qualifies as a sophisticated and complex tool for achieving the goal of coal production. The instantiations of this technology at the two different coal mining sites observed by Emery and Trist is each a **technology artifact**.

Whereas both field sites employed the same number of people and used what Emery and Trist called "the identical technology," each had a different way of organizing its division of labor. One site employed the "conventional system" (1969, pp. 285-286):

> The conventional system combines a complex formal structure with simple work roles [where] the miner has a commitment to only a single part task and enters into only a very limited number of unvarying social relations that are sharply divided between those within his particular task group and those who are outside. With those "outside" he shares no sense of belongingness and he recognizes no responsibility to them for the consequences of this actions.

The other site employed the "composite system" (p. 286):

> In the composite system the miner has a commitment to the whole group task and consequently finds himself drawn into a variety of tasks in co-operation with different members of the total group; he may be drawn into any task on the coal-face with any member of the total group.

The instantiation of the conventional division of labor at one coal mining site and the instantiation of the composite division of labor at the other coal mining site can each be considered a **social artifact**. Each incorporated a social structure, created differently from each other; each created a different set of specified roles (where each role had tasks assigned to it) and different relationships among the roles through which coal miners were expected to, and did, interact with each other in order to complete their tasks.

The information requirements, as it were, of a coal miner were different, depending on the site. On the one hand, for a coal miner at the site who found himself working in a conventional

division of labor, the **information artifacts** – that is, the data that the coal miner processed and the meanings that he formed – pertained only to his "single part task" and his "very limited number of unvarying social relations." On the other hand, for a coal miner at the other site who found himself working in a composite division of labor, the **information artifacts** (again, data that the coal miner processed and the meanings that he formed) spanned a wider range, associated not with a "single part task," but rather with "a variety of tasks in co-operation with different members of the total group."

Moreover, in the composite division of labor but not in the conventional division of labor, a coal miner shared a "sense of belongingness" and recognized "responsibility to [others] for the consequences of his actions." This indicates the need for us to recognize yet another category of information artifacts – namely, those that were used in establishing, sustaining, and calling upon personal relationships, apart from those that were used in carrying out directly work-related tasks, such as operating a piece of machinery.

Emery and Trist reported that the coal production at the site with the composite division of labor was significantly greater than at the site with the conventional division of labor and the former's costs were lower than the latter's. The greater productivity and lower costs cannot be explained in terms of the technology alone because the technology artifact was the same ("identical," in Emery and Trist's description) at both sites. Apparently the social artifact involving the composite division of labor enabled the technology artifact (the instantiation of the longwall mining method) to function more efficiently, whereas the social artifact involving the conventional divisional of labor constrained the technology artifact from functioning as efficiently.

Although the differences in productivity and costs between the two sites cannot be explained in terms of the technology artifact alone, the technology artifact did mediate or moderate the differing social artifacts through the differing demands it placed on them: Longwall mining involves "changing conditions" to which the rigidity of the conventional division of labor was unable to respond, whereupon the overall social system reacted "by increasing the stress on its members, sacrificing smooth cycle progress or drawing heavily upon the negligible labour reserves of the pit" (p. 287). Thus, at the site with the conventional division of labor, the technology artifact interacted with the social artifact to hurt production and increase costs.

In addition to interacting with each other, the technology artifact and the social artifact also interacted with the information artifacts. This can be seen through the impact that the "changing conditions" would have on the information artifacts that a coal miner would use to sustain and to call upon personal relationships. The presence or absence of these information artifacts (e.g., information about personal relationships) would then enable or constrain the social artifact (the given division of labor) from functioning efficiently, which in turn would enable or constrain the technology artifact (the site's implementation of the longwall mining method) from functioning efficiently. Indeed, one could say that, without these information artifacts, the social artifact and the technology artifact could not have functioned at all.

Depending on the extent to which one believes that information played an indispensable role in the production of coal and the costs incurred, one may describe the resulting configuration of artifacts as either a sociotechnical system (as Emery and Trist do, with their focus on the social artifact and the technology artifact) or an information system (where one attributes, to the information artifacts, importance equal to or greater than the importance that one attributes to the social artifact and the technology artifact). If the latter, then the resulting system that was formed, being (in Simon's words) "synthesized … by human beings," can be conceptualized as not only an artifact, but an **IS artifact**. In any case, there would be no contradiction in positing the simultaneous existence of both a sociotechnical system serving the business purpose of producing coal and an information system serving the purpose of supporting the given sociotechnical system.

Note that we are able to conceptualize our artifact as being an IS artifact *even though it contains no electronic, digital IT artifact*. We conceptualize it instead with (1) an information artifact and a technology artifact that are differentiated from each other and (2) a social artifact, forming a triumvirate whose interactions result in a whole (the IS artifact) that is greater than the sum of its parts (the technology artifact, the information artifact, and the social artifact).

A Case of an Information System with an IT Artifact, but without IT Designers

An information system can emerge without the participation of IT designers. Such information systems may or may not be typical, but a case of such an information system can be instructive for highlighting our concept of an "IS artifact" in contrast to an "IT artifact." To illustrate our points, we turn to a *New York Times* article (Luo, 2006) on the use of mobile-phone/conference-

call technology to serve the spiritual and social needs of immigrants from China to the United States.

Luo writes about "illegal immigrants from the Fuzhou region of Fujian province, coming off bone-wearying 12-hour shifts as stir-fry cooks, dishwashers, deliverymen and waiters at Chinese restaurants, buffets and takeout places." These small, inexpensive Chinese restaurants, often located in strip malls or modest storefronts, are familiar fixtures on the American landscape. These Fujianese restaurant workers speak little or no English and are "often isolated in small towns across the country." Consider this illustration involving Mr. Chen Yingjie (Luo, 2006):

> Dowagiac [a town of 6,000 people], which sits in the heart of the largest hog-producing county in Michigan, might seem an unlikely place for a Chinese restaurant. But located on the town's main thoroughfare, a few doors down from Bill's Vac Shop and Marci's Variety Store, China Garden draws a steady line of customers. General Tso's chicken is the most popular dish. On the wall, a framed certificate from a local newspaper honors the restaurant as having the best buffet in town.
>
> Upon his arrival in Dowagiac in late April [2006], Mr. Chen was assigned a 9-by-12 [foot] room upstairs from the restaurant. The restaurant's owners lived in an adjoining room; other employees camped out in the living room.
>
> But Mr. Chen quickly soured on life in Dowagiac. (He left last weekend to go back to Chicago.) The restaurant owners locked the doors every night, making it impossible to leave. Even on his days off, without a car, he had few options other than walking to the public library down the street.
>
> "It's like I'm living in a cage," he said.

Providing additional context to this case is the role of a cleric, Pastor Paul Chen, whom Luo describes as:

> a minister at Church of Grace [located in Manhattan's Chinatown] and himself an emigrant from the Fuzhou region, which has become China's leading source of illegal immigrants smuggled into the United States. Three years ago, he said, he had been praying about how to tend to the thousands of Fujianese working in Chinese restaurants across the country.

Luo continues:

> New York City is the central node of a vast ethnic economy that provides labor to the country's Chinese restaurants, of which there are more than 36,000 – more than the number of McDonald's, Burger King and Wendy's outlets combined – says the Chinese Restaurant News, an industry publication.
>
> Fujianese workers line up at dozens of ramshackle employment agencies under the Manhattan Bridge [in New York City's Chinatown]. On the wall are postings advertising jobs available at restaurants across the country, generally paying $1,800 to $2,600 a month. After short telephone interviews, the workers are trundled off on van lines that drop them off at their new jobs.
>
> "We've got this little diaspora in formation," Dr. Guest [an anthropologist at the City University of New York] said. "The workers are not settling in these places. The restaurant owners are going and establishing these outposts. The workers are still moving back and forth. It's really a working-class internal migration between New York and other parts of the country."
>
> But the migration has a high cost for many workers, who often find themselves stranded in places with few other people like them and little ability to interact with the English-speaking world.
>
> "They're particularly vulnerable and lonely," Dr. Guest said.

The spiritual needs (in the eyes of Pastor Paul Chen) and overall social needs (in the eyes of isolated restaurant workers such as Mr. Chen Yingjie) are obvious. Against this backdrop and serving both sets of needs, an innovation emerged. It began with an isolated restaurant worker located somewhere in America using his or her mobile phone to connect to a parishioner at Pastor Chen's church so as to be able to participate, at least via audio, in a church activity. According to Luo (2006):

> Early on, the gatherings over the telephone were organized haphazardly, with one restaurant worker calling into the church and then conferencing in a friend; the friend would in turn conference in another friend. The chain expanded, growing to 20 or 30

> people on the line at once. Sometimes it would take 20 minutes just to get everyone together.
>
> Different parts of the Bible are studied on different nights: Psalms on Tuesday; New Testament on Wednesday; Old Testament on Thursday. On Mondays, there is a short devotional and then a time of prayer.
>
> Eventually, the church bought conference call lines able to handle 40 callers at a time. When that proved too few, they expanded to 100 lines.

The result can be considered to be an information system, emerging from the mutually enabling interactions of a technology artifact, an information artifact, and a social artifact.

The Pastor and the restaurant workers encountered mobile phones and their conference-call features as already created, ready-to-use tools that they could appropriate to achieve the immediate goal of real-time communication and the longer-range goal of addressing their spiritual and social needs. As such, these tools constitute the **technology artifact** in this system.

The **information artifact** consists not so much of words that are printed in Bibles and hymnals, but rather, of words from the Bible and hymnals (and other sources) that were spoken or "instantiated" in the mobile-phone/conference-call sessions and that the restaurant workers "process" as "data" and otherwise form meanings from.

The **social artifact** refers to the relationships newly emerging among restaurant workers (where, through these relationships, they pursue the goals of ending their isolation and forming a community) as well as relationships already existing among them as members of the Fujianese community (where, through these relationships, they practice their culture and pursue their goals of mutual self-help in general, as do members of any other American immigrant group). The **social artifact** may also be construed to include those relationships already existing in the "vast ethnic economy that provides labor to the country's Chinese restaurants" (quoted above). These relationships do not exist apart from pre-established culture and institutions: persistent cultural objects, such as the shared knowledge accompanying the Fujianese kinship structure, that enable the co-construction of Fujianese community living together as a colony in a foreign land, and persistent institutions, such as a church, that can facilitate such co-construction (Kyle and Liang, 2001).

It is clear that the technology artifact, information artifact, and social artifact interacted with and enhanced each other's functioning. We give three examples. First, the technology artifact (the instantiation of the conference-call features of mobile phones) had the effects of (1) making possible the existence of the information artifact in the first place (the sharing and processing of "data" and the formation of meanings among people who otherwise would not be communicating) and (2) further developing the social artifact (establishing and strengthening relationships among individual restaurant workers scattered across remote locations). Second, the information artifact imposed requirements on the technology artifact, thereby changing and strengthening it (involving, for instance, the technology artifact's expansion to 100 lines). Third, the social artifact, through its already established relationships in the Fujianese community and the "vast ethnic economy," allowed the restaurant workers (and the Pastor) to meet one another in the first place and, then, to place demands on both the technology artifact and the information artifact to better connect the restaurant workers (and the Pastor) to each other. Emerging from these interactions were the forms eventually taken by the technology artifact, information artifact, and social artifact, all culminating in the creation of an information system or **IS artifact** through which the restaurant workers could address their spiritual and overall social needs.

The significance of what we mean by the "IS artifact" in contrast to the "IT artifact" can be seen in the following. On the one hand, IT designers and IT artifacts certainly had a role in the creation of mobile phones and their conference call features. On the other hand, the information system or IS artifact in this case was itself not the product of IT designers. The innovative use of mobile phones, conference-call features and, presumably, free evening and weekend minutes occurred spontaneously and haphazardly among "users," *without the participation of IT designers using design science to design new IT artifacts*. Instead, these design acts emerged as a sort of improvisational bricolage intensely driven by a social artifact: the intense importance to be part of a specific cultural community. The formation of the information system or IS artifact in this case is better explained by the roles played by a technology artifact and an information artifact that are differentiated from each other and that interact with a social artifact, than by the role played by any sort of "IT artifact" newly created through "design science."

In other words, the power of the resulting information system or IS artifact did not stem from any IT or technology artifact. Indeed, the technology artifact – consisting of mobile phones and their conference call features – was rather mundane. It was not any IT or technology artifact *per se*,

but rather the technology artifact in combination with both the information artifacts and the social artifact, that ended up creating a conceptually simple but impressively effective IS artifact.

A Case of Small Data, Low Tech, and Information Systems Success

The two preceding cases did not involve data of the kind that an IS is typically considered to handle – namely, numerical data. In this third case, numerical data are processed by an IS, but again, it fits the pattern where no sophisticated IT artifact created by advanced IT design science is required for an IS to come into existence and to be successful. Furthermore, the main data processing performed by the IS does not process huge amounts of complicated data, but primarily just data in the form of simple single or double digits.

This case uses material from an ongoing field project that one of the authors of this essay has been conducting. The author has been collecting data in the Elamkunnappuzha village of Ernakulam District in the State of Kerala in India. The field project involves the use of mobile phones to track and promote the health of women in a community characterized by minimal levels of literacy and low socioeconomic welfare (the average annual income ranges from 200 to 450 USD). The village is bounded by the backwaters of Kochi on three sides and is typical of outlier communities. It is home to 510 families. Seventy-nine percent of the men are employed in the fisheries sector. Due to the seasonal nature of such employment and the small scale of operations, the men work for a maximum of just 5 months in a year. Women (approximately 200) work as contract laborers in fish processing jobs. In the ongoing field project, IT is deployed to help achieve the immediate goal of facilitating the reporting and tracking of reproductive health issues among the women and the longer-range goal of improving their overall health.

The **technology artifacts** include mobile phones and their associated text-messaging features, which the author conducting the field study configured to allow women of low literacy to self-report their health symptoms easily, confidentially, and at minimal cost. The women are taught to use text messaging by simply inputting and sending certain single and double digit numerical codes to report their health situations and health needs. For instance, this would involve a woman's using her mobile phone to enter a phone number, the pound sign, and then a single or double digit code (see Figure 1) indicating the symptom she is reporting. An additional **technology artifact**, for use by medical officers, is an electronic dashboard with archiving and

drill-down features that allow determining the level of seriousness of a patient's health issue at a syndromic level, as well as evaluating the illness history of a patient.

The **social artifacts** in this case consist of certain already existing roles and relationships. One set of relationships is between women in the village and community health workers (CHW's, who can be thought of as similar to social workers in a western context), where the former regard the latter with trust. Indeed, the CHW's know all the women individually, visit them on a regular basis, and trained them in the use of their mobile phones for this purpose. Another set of relationships is between the CHW's and medical officers in government operated health centers. The former set of relationships enables the women to express, in ways that they consider safe, certain of their health care needs. The latter set of relationships enables the communication of information from the CHW's to the medical officers. Apart from these relationships, the **social artifacts** also include one-off ephemera in one-off social interactions, such as inquiries made concerning one's health status, the identifying of illness incidents, and acts of reaching out to those who require clinical attention. Associated with the CHW role is the function of collecting primary data in the field, consolidating the information, and offering health awareness sessions. Associated with the medical-officer role is the function of reaching out to the women identified by CHW's as requiring immediate assistance. These interactions and communication among the women, the CHW's, and the medical officers did not occur prior to the introduction of the mobile-phone/text-messaging **technology artifact**.

The **information artifacts** pertain to the information requirements of the women in the village, the CHW's, and the medical officers in the government health centers. The **information artifacts** for the women are synonymous with data on the reporting and detection of illness symptoms, preventive care, and consumable health services, where the data can be either external to and independent of the CHW (e.g., data reported by the women) or internal to and dependent on the CHW (e.g., assessing the degree of disease severity). The **information artifacts** for the medical officer are data describing the objective reality of the women's health situations, where the data are reconciled through communication with the CHW and are made to reflect information from the CHW (e.g., data suggesting immediate treatment for a patient with symptoms of fever and urinary infection).

The technology artifacts, social artifacts, and information artifacts all support each other's functioning where, together, they come to form an information system or **IS artifact**. Two related examples demonstrate the interactions among them. First, the technology artifact (a simple text messaging service on the mobile phones) (1) engages the information artifact for disease surveillance among the women living in the underserved location, and (2) reinforces the social artifact in the form of social relations by improving the provider-client interaction among the patients, CHW's and the health professionals – relations that can otherwise be problematic to establish and nurture in this geographically isolated area. Second, the information artifact places requirements on the technology artifact to enable the women to report their symptoms in a confidential and culturally sensitive manner, but is itself required to acknowledge, as imposed by the social artifact, a stigma attached to sharing information about gender-sensitive reproductive health symptoms between certain roles (women patients and medical officers). By ensuring information flow using mobile phones and their associated text-messaging features (the technology artifact), credible and reliable data directly from the source (the information artifact) are communicated in confidential ways allowed among the women, the CHW's, and the medical officers (the social artifact). The solution (the IS artifact) thus brings the socially excluded segment of the society within the folds of the broader public health care system (thereby resulting in a whole that is greater than the sum of its parts).

Significantly, the heart of this information system is not an "IT artifact." In this case (as in the previous cases), the technology artifact (the mobile phones with text-messaging features) came already designed and already built. Rather, the heart of the new information system in this rural healthcare case consisted of the social artifact in the form of firmly established relationships and roles of the women, CHW's, and medical officers. Without the social artifact, the new information flows using the technology artifact could not have come into existence to improve the health of the women. Furthermore, rather than require the processing of "big data," the successful functioning of the overall IS artifact depended on the communication and processing of simple single or double digit data through the use of a rather mundane IT artifact (text messaging on mobile phones) that, already in existence, required no design. We may therefore characterize the successful information system in this case as being "low tech" rather than calling for new efforts to design an advanced IT artifact, and as processing "small data" rather than "big data."

Similar to the information systems in the previous two cases, it was not any IT artifacts *per se* or their design, but rather the technology artifact in interacting with both the information artifacts and the social artifacts that ended up forming a conceptually straightforward but nonetheless effective and therefore successful IS artifact.

Discussion

Our return to some basics – Simon's concept of "artifact" and the systems concept in which a whole is greater than the sum of its parts – provided the basis on which we "unpacked" the well known concept of the "IT artifact" into a separate "information artifact" and "technology artifact" that, together with a "social artifact," interact to form the "IS artifact." However, in introducing and illustrating these new terms, we have only scratched the surface.

We have, for example, utilized only two of the four categories of information defined by McKinney and Yoos. (We have utilized the token view and representation view. There remain the syntax view and adaptation view.) For another example, we have also examined only the technology artifact, information artifact, and social artifact as the components that form an information system. There is no reason that other artifacts, whether in addition to or in place of any of our three components, may not be conceptualized and then theorized as other components in an information system. Other components might include communication, processes, control, work; one often-identified IS component is "people" (Alter, 2008). People may not be artifacts, but their behavior (Tromp and Hekkert, 2013), their avatars and cyborgs (Schultze and Mason, 2012), and their constructed online self-representations (Lam, 2000) can be designed. For a third example, just as the design of technology artifacts has already benefitted from the vast body of knowledge already accumulated in computer science and engineering, the design of social artifacts awaits benefitting from the vast body of knowledge already accumulated in sociology and phenomenology.

Further development of the differing kinds of artifacts that can make up an IS artifact can further deepen our understanding of design and IS. For example, our conceptualization of social artifacts is silent on political aspects of the social. A political component in an IS artifact might be represented by the interaction of a citizen with online government systems, such as a tax system. While we have recognized that artifacts can be embedded with politics (Winner 1980), our work

suggests that political kinds artifacts can exist independently of other kinds and may be an artifact of information systems available for further study through design science.

One may choose to pursue the above suggested avenues in order to delve more deeply under the surface that we, in this essay, have only scratched. However, our examination in this essay has been sufficient to introduce the significance of the new term, "IS artifact."

We believe the emergence of the design science research paradigm and design science methodologies holds a broad future promise for the IS field. Much of the current research in this paradigm has been limited to the IT artifact. By providing a better understanding of the nature of the IS artifact, we seek to open up a clearer path for broader development of design science in IS. This development could extend this exciting research paradigm toward developing our knowledge about other important kinds of artifacts in IS. Opening awareness of these other kinds of artifacts helps us to perceive differing kinds of design unfolding in IS, such as the improvisational design work that engulfs many kinds of social artifacts.

Our examination also helps to restore value and meaning to the term, "artifact." Alter (2014) argues that a good course of action is to "retire the IT artifact and its cousins" owing to the overuse and ambiguous usage of the term "IT artifact"; however, he does not argue against using the term "artifact" as long as it is specifically defined. We have specifically defined "IS artifact," "information artifact," "social artifact," and "technical artifact," and demonstrated their overall value in three cases. As long as this term remains useful, it should not be retired.

Conclusion

The three cases offered in this essay hardly deny the importance of the concept of the IT artifact or the importance of IT design. Instead, the three cases are useful for highlighting the possibility of situations where the IT artifact and its design are not problematic, but other artifacts and their design remain a challenge and therefore need to be tended to.

Emery and Trist's coal mining case, which predates the era of electronic computing, is instructive for reminding us about what technology is in general, as well as for reminding us that technology is subsidiary to the larger overall system of which it is a part and whose functioning (not the technology's) should be our main concern.

Luo's case of a system serving social and spiritual purposes for Chinese immigrants in the United States is useful for revealing that even when electronic information technology is present, there need not be the participation of any IT designers using design science to design IT artifacts. This is because the IT artifact (in this case, the mobile-phone/conference-call technology) can be already designed, already built, and therefore already available. This shifts the focus away from the design of the technology artifact and towards the design of the information artifact and the social artifact.

Along similar lines, the case about a field project promoting women's health in a rural village in India shows that an information artifact in the form of "small data" and a technology artifact that is "low tech," if supported by a solidly established social artifact in the form of well defined roles and relationships among the roles, can still lead to a successful information system, without any need for a "sophisticated" IT artifact.

Together, these cases illustrate how IS research and IS design may differ from IT research and IT design. There is a rich array of differing kinds of artifacts in the realm of IS that include technology artifacts. Among such kinds of artifacts are also the information artifact and the social artifact.

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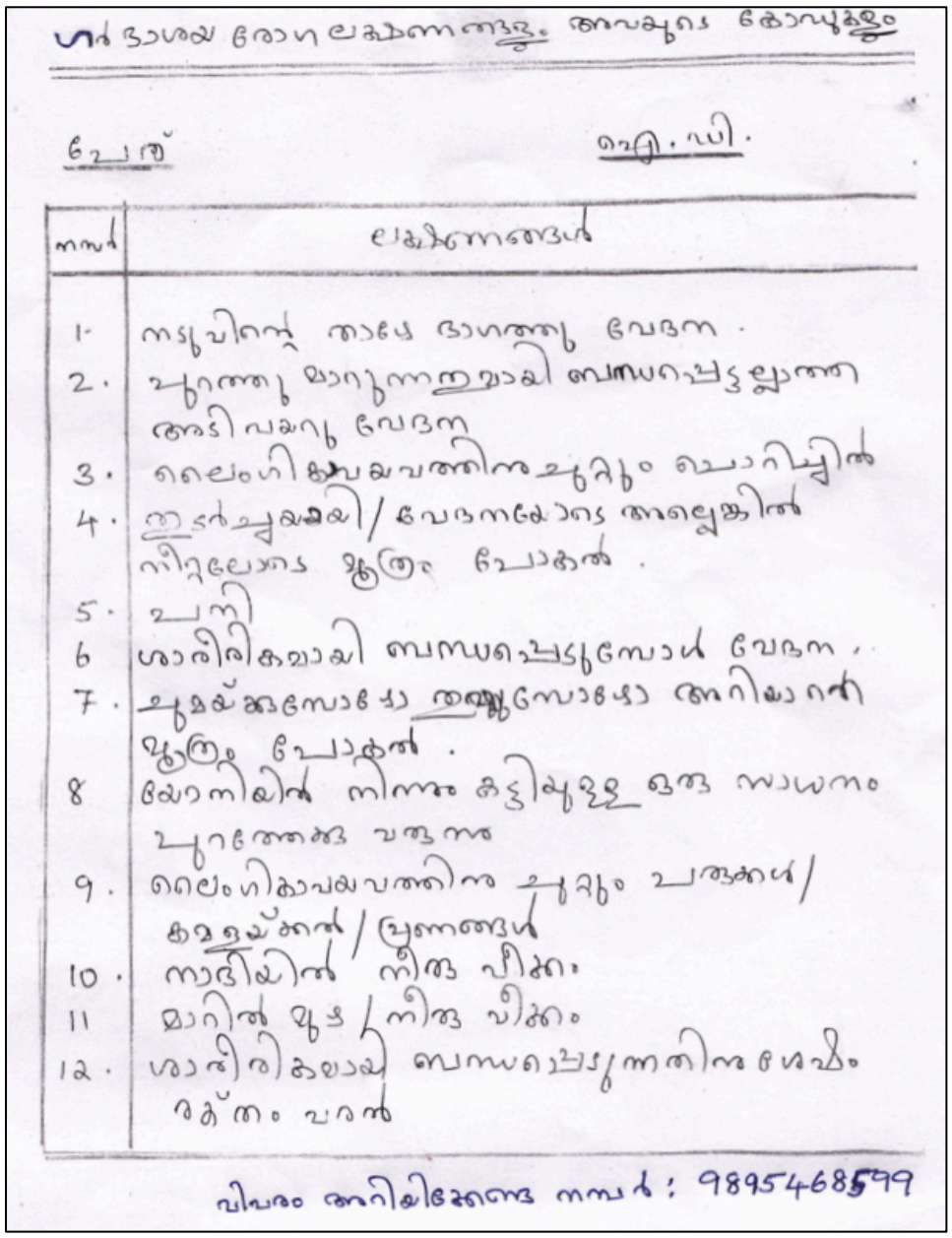

നമ്പർ	ലക്ഷണങ്ങൾ
1.	നടുവിന്റെ താഴെ ഭാഗത്തു വേദന.
2.	പുറത്തു മാറുന്നതായി ബന്ധപ്പെട്ടല്ലാത്ത അടിവയറു വേദന
3.	ലൈംഗികബന്ധത്തിനു മുമ്പും പ്രോഗ്രസ്സിൽ
4.	ആർത്തവമായി / വേദനയോടെ അല്ലെങ്കിൽ നിറയോടെ മൂത്രം പോകൽ.
5.	പനി
6	ശാരീരികബന്ധത്തിനു ശേഷം വേദന.
7.	മൂത്രമൊഴിക്കുമ്പോഴും തുമ്മുമ്പോഴും അറിയാതെ മൂത്രം പോകൽ.
8	യോനിയിൽ നിന്നും കട്ടിയുള്ള ഒരു സ്രവം പുറത്തേക്കു വരുന്നു
9.	ലൈംഗികബന്ധത്തിനു മുമ്പും പ്രശ്നങ്ങൾ / കുളിയ്ക്കൽ / ചൂണ്ടുക
10.	നാഭിയിൽ നീരു പിടിക്കൽ
11	മാറിൽ മുഴ / നീരു പിടിക്കൽ
12.	ശാരീരികബന്ധത്തിനു ശേഷം രക്തം പോകൽ

വിശദാംശങ്ങൾക്കായി സമ്പർക്കം : 9895468599

Figure 1. Codes used in a “small data,” “low tech” IS artifact