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Research Perspective

Seeing for Understanding: Unlocking the Potential of Visual Research in Information Systems

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Abstract

In this paper, we argue that information researchers should use images as a source of data. The information systems field is overwhelmingly visual in nature. Not only is the Internet crammed with images, but also almost every detail observed during fieldwork in different research settings can be captured in the form of digital images. Yet, we rarely engage with those images. Except for sporadic video recordings in analyzing human-computer interaction and, more recently, neurophysiological imaging, using images in information systems research has been sparse and non-systematic. Where images are used, the purpose of using them has been largely restricted to visually representing the context of the research setting. This approach underuses the knowledge embedded in visual material, which needs to be unpacked in a systematic fashion. We discuss the theoretical underpinnings of visual research and illustrate via a three-step framework how images in information systems research can be collected, analyzed, and presented. We conclude with four considerations for researchers that can help them develop a visual research capacity in information systems and encourage researchers to engage with the images that are now a major feature of the information systems environment.

Keywords: *Research Methods, Visual Research, Images, Information Systems.*

* Gary Klein was the accepting senior editor. This article was submitted on 19th March 2014 and went through five revisions.

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1. Introduction

Our world is a universe of images. The physiology of vision allows humans, assuming they are not visually impaired, to see the world. Ferguson (1977) persuasively argues for the importance of images in technological advancement: "Pyramids, cathedrals, and rockets exist not because of geometry, theory of structures or thermodynamics, but because they were first a picture—literally a vision—in the minds of those who built them" (p. 835). Yet, most academic disciplines, some more than others, are still reluctant to incorporate images in their research (Silverman, 2011). While anthropology—and, to a lesser extent, sociology—have a well-established visual research tradition and areas of specialization around visual methods (Collier & Collier, 1986), the use of images in other disciplines, especially in information systems research, is still in its infancy, and clear methodological procedures have not yet been developed. Against this background, we argue for the use of images in information systems research—not just as contextual information to other data sources but also as a source of information in their own right. We also provide four methodological considerations to assist researchers who want to make images a part of their study.

Business studies have made inroads in using images in organizational research[1] since Meyer's (1991) early call to collect visual data and move beyond merely "verbal reporting and alphabetic writing" (p. 233). One can argue that the use of visual data has become to some extent accepted in qualitative research in different fields (Banks, 2001, 2007). For instance, management studies have emphasized the need to understand how vision technologies (e.g., screen monitors) influence organizational practices (Styhre, 201,0). The marketing field has developed guidelines for analyzing participant-generated images (Brace-Govan, 2007) and storyboards, as visual narrative analysis tools, to reveal consumers' personal introspections (Woodside, Megehee, & Sood, 2011). The tourism field has used photographs as stimuli to elicit participants' responses on the features of historical places (Naoi, Airey, Iijima, & Niininen, 2007). The use of images is also gaining acceptance in accounting research. Warren's (2005) photo-interviewing approach and Parker's (2009) explicit call to adopt photo-elicitation for historical research serve to illustrate this point. Likewise, information science researchers have advanced the use of photographs as a valid approach to conduct research (Hartel & Thomson, 2011). However, as we elaborate in this paper, few studies have used images in the information systems field. Consequently, we address two research questions:

RQ1*: Why should we consider the use of images in information systems throughout the research process?*

RQ2: *What considerations does the information systems researcher need to take into account when using images in research?*

In this paper, we argue for the usefulness of images as a source of data in information systems research. We propose an overarching methodological framework that enables information systems researchers to leverage images both as primary and secondary data sources for their analysis and subsequent presentation. Above all, we argue that images intrinsically contain data, and, as such, they need to be treated as any other source of data, which should be systematically collected, rigorously analyzed, and methodically presented.

This paper proceeds as follows. In Section 2, we describe how words and numbers dominate the expression of ideas at the expense of images in academic research, particularly in information systems, and present a conceptualization of images. In Section 3, we discuss how images have been used in the five main areas of information systems research. We argue for increasing their use and present a framework for collecting, analyzing, and presenting images. In Section 4, we discuss four considerations when conducting visual research in information systems. Finally, in Section 5, we conclude with a call for more visual research in information systems.

[1] InVisio (www.in-visio.org), launched in 2007, congregates a group of academics interested in examining the visual in organizational studies.

2. More Than Words and Numbers

Logocentrism—the assumption that the written language is the fundamental expression of external reality—has pervaded academic fields. On the whole, they are "disciplines of words" (Mead, 1995, p. 4). Oral communication in general and its different written systems in particular symbolize the pinnacle of human evolution (Hauser, Chomsky, & Fitch, 2002). Words and numbers are devices that facilitate the transmission of information based on the models we deem correct. The main merit of the written word and numeral system is that they make possible the transmission of assembled knowledge by using symbols. For example, a text on a bottle label describes the taste and aroma of wine in the same way as a number on an audiometer scale provides information about the device's frequency. Undeniably, written words and numbers are powerful vehicles for expressing ideas.

In analyzing the social effects of writing, Ong (1995) highlights the endurance of the text that makes it transcendent in time and accessible to an almost unlimited number of readers. However, he also recognizes that scripts can only represent objects partially: "The alphabet, though it probably derives from pictograms, has lost all connection with things as things" (p. 91). For instance, one can trace the origin of the letter "a" back to the ox's head hieroglyph that stood for ox, which later evolved into the Semitic letter aleph (א) and then into the Greek letter alpha (α).

While one cannot deny the representational power of words and numbers, the prevailing and almost exclusive logocentric approach ignores that humans perceive and interpret reality mainly through their visual sense (Prosser, 1998). Mitchell (1994) emphasizes the strength of images compared to words: "If writing is the medium of absence and artifice, the image is the medium of presence and nature, sometimes cozening us with illusion, sometimes with powerful recollection and sensory immediacy" (p. 114). The dominant logocentric approach has been challenged for many years—from early calls to bring visual material to the forefront that Collier and Collier (1986) made to the all-encompassing sensorial approach that Pink (2009) proposes. The term "ocularcentrism" underscores the significance of images in how we understand the world (Jay, 1993). We live in a pictorial world and perceive cultural symbols, social interactions, and individual actions through our vision. Computer-generated images have proved to be effective for transmitting scientific knowledge (Rowe, 2012) and conveying specialized knowledge to non-experts (Einsfeld, Ebert, Kerren, & Deller, 2009). Even images created simply for marketing purposes, such as the ones estate agents produce for advertising properties, trigger a cognitive process (e.g., the decision whether to buy the property or not). Unsurprisingly, Bourdieu (1984) treats images as symbolic goods in his persuasive examination of aesthetics as a tool for domination.

2.1. Images

Images overcome the alphabet's limitations. They are not merely depictions of objects; images are deeply rooted in the human mind with far more representational power than words (Banks, 2007). Paivio's (2007) dual coding theory postulates that images are "the engine of cognition" (p. 9) that engender a synergistic relation between the nonverbal mind and the verbal mind. An object (or a collection of objects) can be pegged to one word, but our mind does not see words. Our mind sees images. Temple Grandin (1995), the well-known autistic researcher, describes how her thinking strategy is image-based:

> *I think in pictures. Words are like a second language to me. I translate both spoken and written words into full-color movies, complete with sound, which I run like a VCR tape in my head. When someone speaks to me, his words are instantly translated into pictures* (p. 19).

Images are visual representations of reality (Scollon & Scollon, 2003). Although images are two-dimensional synoptic visual representations of the three-dimensional real world, they can easily convey information of a particular setting (e.g., an office, a boardroom, a production line, an operation room, an Internet café, an air traffic control area) with little distortion. Moreover, images have the distinctive capacity to encapsulate complex information from different quarters in a combinable fashion. For example, assume that rather dissimilar material as economic information in the form of

charts, engineering information in the form of technical drawings, transportation information in the form of color-coded plans depicting street-congestion levels, and architectural information in the form of photographs of historical monuments are all available in a local council office. Latour (1986) explains the connective quality and the sanctioning value of these images when "some power is given to an average mind just by looking at [the images]: domains which are far apart become literally inches apart; domains which are convoluted and hidden, become flat; *thousands of occurrences can be looked at synoptically*" (p. 25, emphasis added).

Visual representations require a referent (i.e., the entity they represent). We can broadly classify referents into two categories: concrete and abstract (Pauwels, 2006). Concrete referents are entities with recognizable physical properties (e.g., the shape, weight, volume, and color of a smartphone). In contrast, abstract referents are purely mental constructions with no corporeal existence but can still be represented (e.g., how perceived usefulness and perceived ease of use influence the intention to use technology depicted as a diagram). It follows that visual representations can be described as a continuum of reality with two distinctive ends (Kress & van Leeuwen, 1996). At one end of this continuum, naturalistic reality images capture or resemble the meaning of some concrete elements of reality (Rose, 2012). They are rich in details and exhibit, to a greater or lesser degree, fidelity between the visual representation and the physical characteristics of its referent, which makes the latter recognizable (e.g., the depiction of a tree evokes a real tree). Naturalistic realism encompasses a wide range of images that goes from videos and photographs—both photo-mechanical and digital ones (which are faithful records of actual entities)—to paintings that truthfully capture elements of the real world (e.g., Courbet's depictions of everyday life events) and to unrefined reality drawings that incompletely depict concrete components of reality (e.g., sketches). In addition, technological developments have increased the options available for creating and reproducing naturalistic reality images, including infrared imaging, radiography, ultrasonography, functional magnetic resonance imaging, and radar imaging, among others. Avatars constitute a distinctive case of naturalistic images. Since avatars are incarnations representing users' expressive or utilitarian values in a virtual world, they derive their existence from and resemble real individuals (Cui, Aghajan, Lacroix, van Halteren, & Aghajan, 2009). For the same reason, we also treat representations of objects in a virtual environment as naturalistic images.

At the other end of the reality continuum, scientific realism uses general, highly abstract, schematized, and somewhat arbitrary images to represent mental constructions of the real world rather than details that can be seen with the naked eye. Tufte (1990, 1997, 2001) presents a compelling argument of the necessity and benefits of presenting information resulting from statistical analysis in a visual format. Diagrams (e.g., boxes and arrows representing hypothesized relationships among objects or ideas), graphs (e.g., time series), maps (e.g., maps of poverty), and tables (among others) are images produced to graphically represent some abstract elements of reality. Using these scientific reality images has been facilitated to a great deal due to the easy availability of semiotic software (e.g., MS PowerPoint®, MS Visio®), semiotic functionalities embedded in some software packages (e.g., charts in MS Excel®, plots in IBM's SPSS®), and mash-up applications with geographic references (e.g., local attractions on GoogleMaps). Unlike naturalistic ones, scientific reality images are typically the output of prior analysis.

Table 1 shows the main characteristics of both naturalistic reality and scientific reality images along with examples of their referents. It also includes some of the imaging resources available.

Table 1. Naturalistic Reality Images and Scientific Reality Images			
	Characteristics	**Examples of referents**	**Imaging resources**
Naturalistic reality images	• Represent concrete elements of reality • Are rich in details and more or less truthful representations of the actual physical characteristics of reality • Can be the input for subsequent analysis	Individuals, spatial environments, cultural artifacts, brain activity, IT-mediated activities, websites	Videos, sketches, photographs, paintings, avatars, functional resonance magnetic images
Scientific reality images	• Represent mental constructions of reality • Use general symbols, highly abstract depictions and schematized representations of reality • Are usually the output of prior analysis	Relationship among concepts, occurrence of processes, patterns of production and consumption of cultural expressions	Diagrams, graphs, maps, flowcharts, tables

Both naturalistic and scientific reality images offer a superior representational power compared to only words (Kress & van Leeuwen, 1996). The fact that we cannot read aloud, say, a box-and-whisker plot in the same way we read a text does not diminish the power of this plot to convey meaning. Similarly, literally "reading" naturalistic reality images is not possible; however, it does not lessen their representational power. For instance, any attempt to list the entities contained in a photograph of an office (e.g., computers, users, cubicles, desks, pencils, telephones) along with a description of this environment (e.g., natural light, crowded with people, uncluttered shelves and new furniture) will simply remove the holistic understanding that just seeing the picture affords.

As we elaborate further in this paper, different types of naturalistic reality images may serve different purposes in information systems research. Sketches can be particularly useful for producing a quick graphical representation of what one observes in the field (e.g., physical location of computing devices on a floor) in a rather unobtrusive way. Photographing subjects can be a more intrusive technique compared to sketching but offers the possibility of capturing instances of real life with a high degree of fidelity as long as the observer and the object are in sightline (e.g., a photograph representing actual user work practices of the coexistence of new technology and legacy systems) (see Figure 2). Videos are exceptionally well suited for capturing the actions, including sound, of information technology users (e.g., blind individuals using text-to-speech technology for "reading" documents while producing text-processed reports). Functional neuroimaging techniques can offer insights into consumer preferences in online environments. The advent of avatars has brought research opportunities in new forms of interaction in different domains (e.g., e-business, customer service, online gaming, and teamwork).

3. Opportunities for Using Images in Information Systems Research

Using images in academic research is not new. Images have been used regularly in anthropological research from the outset. Alfred C. Haddon conducted the first recorded anthropological fieldwork during his expedition to Torres Island, Australia, in 1898. A few years later, Bronislaw K. Malinowski's research in the Trobriand Islands, Papua New Guinea, in 1914 granted full scholarly credentials to ethnography in terms of both a data collection technique and a research product. Haddon and Malinowski, however, were not only precursors of fieldwork and ethnography; they pioneered the collection and use of visual data through using film and photographs. They set the foundations for what would become a visual research tradition.

In information systems research, the use of scientific reality images (e.g., charts, diagrams, tables) is abundant. However, the same cannot be said about the use of naturalistic reality images. A systematic review of the papers published in *Management Information Systems Quarterly*, a highly regarded journal in the field (Lowry et al., 2013), showed that naturalistic reality images were rarely,

yet increasingly, used in the journal, from no papers containing this type of image in 2002 to ten papers in 2013. Moreover, whenever naturalistic reality images were included, they were often not analyzed in their own right. They were essentially used, with few notable exceptions, either to enrich the description of the explanation given in the text or to pictorially represent the contextual background. Thus, the rich data contained in those images was ignored—in our view, an opportunity missed. The lack of primary analysis of these images is even more surprising when one considers the increasing number of studies by information systems researchers in the social media domain, where visual material is a key feature.

This observation corroborates the assumption that naturalistic reality images, in spite of being always available and the opportunities they afford, have been somewhat sidelined in some areas of information systems research. The areas of human-computer interaction and design science, specialized areas in information systems, constitute an exception. The use of naturalistic reality images in these areas is a well-established practice; unsurprisingly, most of the papers published in the *Human-Computer Interaction* journal contain naturalistic reality images. This field widely uses video technology for capturing and analyzing IT-mediated complex activities in the workplace; for example, see the works of Bødker (1995) and Ruhleder and Jordan (1997). Design science has also embraced images in a wide range of activities that range from using video analysis for system design (see Suchman & Trigg, 1991) to cooperative prototyping (see Bødker & Grønbæk, 1998). Moreover, a recent call for integrating elements of visual aesthetics into information systems design explicitly recognizes the importance of images in design research because "virtually all users now use visual interfaces" (Peak, Prybutok, Wu, & Xu, 2011, p. 170).

The explosion of images available on online social networking services (e.g., Facebook[2]), video-sharing websites (e.g., YouTube), location-based Web services (e.g., NearMe), online image sharing services (e.g., Pinterest), and mash-ups of geographic information systems (GIS), just to name a few, offer an unparalleled opportunity to enhance different areas of information systems research. Researchers can now use images to investigate a range of topics from different perspectives. For instance, Susarla, Oh, and Tan (2012) examine the influence of social networks on the popularity of visual content, and Schultze (2012) studies how individual identities are created on virtual worlds. Taking a cultural perspective, Pauwels (2011) makes a call for analyzing websites as tangible expressions of culture, and Burgess and Green (2009), by studying YouTube content, scrutinize patterns of online cultural production and consumption. Ibrahim (2012) adopts a political approach and discusses how user-generated images can be either relayed to circumvent government restrictions or used by governments to create new mechanisms of surveillance. Images also allow researchers to emulate how customers experience products in an online context (Jiang & Benbasat, 2005).

Equally important is the visual richness of many IT-enabled everyday activities that have a concrete designation in the physical world. For instance, Salvador, Sherry, and Urrutia (2005) use photographs to help explain how individuals engage in IT-mediated activities in public spaces purposefully designed to be evocative of familiar places (e.g., bars in Spain as an extension of one's living room) or to resonate with clients' interests (e.g., PC bangs in Korea resembling spaceships). Pirini, Norris, Geenen, and Matelau (2014) use multi-modal analysis to understand how family interactions enfold through and around video-chat technology. From an anthropological perspective, Sorenson (1995) advocates using images to document the transformations that interaction between individuals and computer technology may produce on society.

In order to map particular opportunities for using images, we draw on the extant literature that classifies the research areas that have regularly dominated the information systems field. We admit that any attempt to produce a taxonomy of research areas is influenced by the level of granularity chosen for the classification (from a finely grained categorization of specific research topics to a more aggregated level of research areas) and the period of analysis, which reflects the field's intrinsically dynamic nature (Taylor, Dillon, & Van Wingen, 2010). However, by recognizing that information

[2] Facebook users upload 350 million photos daily. By September 2013, a total of 250 billion photos had been uploaded to it (Balolong, 2013).

systems is a polycentric research field, it is still possible to identify the different areas that various themes gravitate to. Sidorova, Evangelopoulos, Valacich, and Ramakrishnan (2008), through latent semantic analysis, group the various themes into five core areas that constitute the essence of information systems as a research field: information technology and organizations, information systems development, information technology and individuals, information technology and markets, and information technology and groups.

In Table 2, we briefly explain each of these core areas, the themes they cover, and provide examples of visual material used in selected information systems papers. This selection only includes papers that purposely use images as part of the research design or include images to support the argument explained in the text.

Table 2. Information Systems Research Areas and Themes Along with Selected Papers Using Naturalistic Images

Research areas (Sidorova et al., 2008)	Research themes (Sidorova et al., 2008) and how visual data has been used in published information systems research
1. Information technology and organizations: examines the consequences of information technology on organizational performance and business processes	• ERP implementation: content analysis of 126 customer presentations from SAP conferences on organizational benefits and/or project success factors from enterprise systems (Seddon, Clavert, & Yang, 2010) • Supply chain management: screenshots of an intelligent-agent system developed for procurement processes in enterprise supply chains for showing the environment in which buyer and seller agents interact (Nissen & Sengupta, 2006) • Work coordination: a set of diagrams showing the physical arrangement and photographs depicting work practices in technology-intensive work environments (Goodwin & Goodwin, 1998; Suchman, 1998)
2. Information systems development: examines information technology itself and its development	• Collaborative design: a quad chart of NASA's solar sail project for illustrating how design boundary objects can promote shared representations, alter design knowledge, organize design action, and legitimize design knowledge (Bergman, Lyytinen, & Mark, 2007) • Training: using technology's multi-media capabilities, including video, to enhance the authenticity of and develop a technology-mediated learning system in project-based organizations (Hardless, Lindgren, & Schultze, 2007) • Prototyping: virtual video for communication, experimentation, and reflection in the design of digital three-dimensional environments along with physical objects in the context of pervasive computing (Halskow & Nielsen, 2006)

Table 2. Information Systems Research Areas and Themes Along with Selected Papers Using Naturalistic Images (cont.)

Research areas (Sidorova et al., 2008)	Research themes (Sidorova et al., 2008) and how visual data has been used in published information systems research
3. Information technology and individuals: examines the psychological aspects of human-computer interaction	• Virtual worlds: user photographs and their corresponding avatar faces along with low-similarity avatar faces for examining to what extent the degree of resemblance between avatars and users affects the users' attitudes towards their avatars (Suh, Kim, & Suh, 2011) • Impression formation: a fictitious female character's social network site with her profile and photo, a mix of positive and negative friends' messages, and photos of her friends with different levels of physical attractiveness for investigating the effects of self- and other-generated cues on forming impression among teenagers (Antheunis & Schouten, 2011) • User and job satisfaction: sketches and screenshots of a proof-of-concept prototype email and task management system that gives users a sense of their upcoming deadlines and generates messages to relevant collaborators (Bellotti, Ducheneaut, Howard, Smith, & Grinter, 2005)
4. Information technology and markets: examines the influence of information technology on buyers, sellers, and interorganizational relationships	• Consumer trust on online auctions: a set of functional magnetic resonance images, accompanied by a screenshot of a trustworthy offer on eBay, for examining gender-based differences on trust on online auction sites (Riedl, Hubert, & Kenning, 2010) • Online consumer: different conditions of images (human images with facial features, human images with no facial features, and no human images) in e-commerce websites for analyzing their emotional appeal in three different countries (Cyr, Head, Larios, & Pan, 2009) • Personalization: images of four different MP3-player skins projected to participants in a study that concludes that the beauty of a product is related to its hedonic attributes rather than to its pragmatic attributes ones (Hassenzahl, 2004)
5. Information technology and groups: examines how information technology affects group dynamics	• Interaction in virtual worlds: avatar subjects performing a task in a virtual space for analyzing how social, location, and task awareness influences their intention to return to the virtual world where they had interacted (Goel, Johnson, Junglas, & Ives, 2011) • Collaboration: screenshot of a virtually co-located but geographically dispersed participants in the analysis of sociomaterial configuration of contemporary organizations (Orlikowski, 2010) • Virtual teams: video systems supporting remote pointing and representational gestures for performing physical activities in the real world (Fussell et al., 2004)

The papers in Table 2 reveal some differences in how authors have used visual material. Some authors use images for illustrating the descriptions provided in the text (e.g., Bergman et al., 2007; Nissen & Sengupta, 2006; Orlikowski, 2010). Some others include sketches showing diagrammatic representations of IT-mediated and -coordinated activities (e.g., Goodwin & Goodwin, 1998; Suchman, 1998). Some other researchers developed visual material as part of the research design (e.g., Antheunis & Schouten, 2011; Cyr et al., 2009; Goel et al., 2011; Hassenzahl, 2004). In some cases, the researchers expressly collected visual data to subsequently analyze them (e.g., Riedl et al., 2010; Seddon et al., 2010), while others developed and collected images in a combined fashion (e.g., Hardless et al., 2007; Suh et al., 2011). A special circumstance, yet a common occurrence in design

science research, is producing and analyzing visual material as part of the design process (e.g., Bellotti et al., 2005; Fussell et al., 2004; Halskow & Nielsen, 2006).

Despite the fact that the uneven use of images in the aforementioned examples correspond to different research objectives, we believe that no concerted discussion or consideration of visual data in our field as a whole exists. As such, we present a starting point for that discussion, and, in Section 5, we present some considerations for information systems researchers when using visual data.

4. Collecting, Analyzing, and Presenting Images

In this section, we explain how visual data affects each of the three stages of the research process: collection, analysis, and publication. We argue that using visual material has the potential to supplement the gathering of more conventional sources of numeric or verbal data (or a combination of both), enrich the analytical process, and enhance the presentation of results in information systems research. The three-stage framework resonates with Banks's (2007) contexts of production, consumption, and exchange of images in the knowledge-creation process (Pink, 2007).

4.1. Collecting Images

The first stage in the framework involves collecting visual data. Building on Pauwels's (2010) work, we consider three main sources of visual material: images already existing in society, images produced by participants, and images produced by researchers.

The social world is a pictorial world in which both individuals and organizations constantly produce and reproduce images. In this case, images have already been created or captured and are generally available to the public in different formats. These images range from personal webpages (e.g., individual photo profiles on Facebook) to professional material (e.g., portraits on institutional websites) and corporate identities (e.g., Apple's logo). For instance, Susarla et al. (2012) use videos posted on YouTube by amateur users to examine how social influence affected their dissemination. Similarly, Wattal, Schuff, Mandviwalla, and Williams (2010) also rely on already available visual material to understand the role new media sources (e.g., YouTube, websites, and others) played on candidates' performance in the United States' 2008 presidential primaries.

When collecting visual data already existing in society, researchers can opt for different approaches. The first one entails devising a systematic, predefined data collection strategy guided by specific questions (Suchar, 2006). The second one involves a form of theoretical sampling (Glaser, 1978) in that analyzing the first few images directs how one collects the next ones. One can combine these two approaches into an opportunistic and programmed image-gathering strategy, whereby the researcher integrates the capture of images of unexpected naturally occurring phenomena with a predefined visual data collection plan (Sorenson & Jablonko, 1995). In addition, images can be collected at different points in time to observe visual indications signaling changes on individuals, places, or practices (Rieger, 2011). For instance, capturing students' observable behavior before and after classrooms have Internet access.

Researchers can also work with visual material produced by participants. For instance, Willett (2009) analyzed the videos her participants recorded on their camera phones to understand the construction of individual memories and social relationships. An antecedent can be found in Zuboff's (1988) groundbreaking study that includes drawings that participants produced to understand how information technology in the workplace can depersonalize and empower employees. These works resemble the audiovisual material Amazonian people in Brazil produced to make their voices heard using video technology that a researcher provided (Turner, 1992).

Compared to visual data available in society and produced by participants, researcher-generated visual data offers the advantage of first-hand access to contextualized information (Pauwels, 2010) such as distinctive cultural settings, meanings of social symbols, and layouts of social spaces. Researchers obtain an overwhelming amount of information through their visual sense during their time in the field (Pole, 2004). In a natural environment, the research site offers the researcher a wide

range of visually available elements (e.g., material arrangements, symbols, individuals, and rituals) that represent the physical and cultural environment (Ball, 1998). When capturing images, the researcher needs to engage in reflective inquiry to be sensitive to what is happening and choose what elements to record (Banks, 2007). In particular, capturing subjects and objects from backgrounds different from the researcher's requires a conscious involvement in the participants' world (Goldstein, 2007). This exercise entails justifying capturing specific images and the social circumstances of their production since the social action and interaction continues after the shutter closes. Researchers can also produce images in a controlled setting under experimental conditions (see Dimoka, 2012). Whether in a natural environment or in a controlled setting, what makes researcher-generated visual data distinctive is that the researcher takes control of the image-production process.

Table 3 shows the three categorizations of sources of visual data researchers can collect and exemplary studies using these sources in the information systems field.

Table 3. Collecting Visual Data in Information Systems

Categories	Examples
Visual data available in society	Data set consisting of 4106 videos posted on YouTube by 913 amateur users, collected through 11 observation points in time, each five days apart (Susarla et al., 2012)
Visual data produced by participants	PowerPoint materials produced over a 30-month period at three different stages containing information about scope, resources, and time for an information technology project (Yakura, 2013)
Visual data produced by the researcher	Functional magnetic resonance images from 15 participants subject to visual stimuli of four seller profiles and measurement items for trust, distrust, and price premiums (Dimoka, 2010)

In addition to the three sources of visual data in Table 3, researchers and participants can collaboratively produce and examine images. Using images, especially GIS maps, in action research offers a valuable option in participatory approaches for collective decision making (Collins, 2011). For instance, the combination of 3D maps to visualize the environmental impact of wind farming and multi-criteria decision analysis made explicit the acceptance of people who had a stake on how land was going to be used (Higgs, Berry, Kidner, & Langford, 2008).

4.2. Analyzing Images

In the analytical stage, one can unleash the potential of images for research. The endeavor of analyzing images is what essentially confers on them the status of data. Otherwise, they are no more than graphical material, with neither value nor contribution to one's research effort. This stage is the fundamental one in our call for incorporating visual material in information systems research.

The richness of the sighted content confers images the quality of "epistemic objects" (Ewestein & Whyte, 2009). Images contain knowledge material germane to the subject matter that provokes the intellectual engagement between them and the researcher (Gold, 2004). It is the analytical material contained in the images, not their aesthetic quality, that is the essential element for the analysis (Wagner, 2007). Since images are not unambiguous representations of reality but visual representations of specific locations and instants in time, analyzing them is tantamount to constructing representations of representations (Harper, 2006a). Thus, analyzing images goes beyond only examining their material content; it requires understanding of the subject matter and an awareness of the particular circumstances under which they were produced. A case in point is Barthes's (1973) analysis of a photograph published in the front cover of *Paris Match* magazine in 1955, in which he distinguishes both the denotative and connotative meanings of the image. On the one hand, the material content refers to the description of the corporeal disposition of the elements included in the photograph (i.e., the martial posture of a young black soldier giving a military salute in

French uniform); that is, the denotative meaning. On the other hand, connotation reveals a deeper system of meanings that challenges the supposed obviousness of the represented content (i.e., an African subject of the colonialist French Empire). This example illustrates the consciousness of the researcher's position during the analysis (Bourdieu, 1990a) and reflects what Sekula (1975) calls "the myth of photographic truth" (p. 37).

If the researcher has produced the images, the researcher often resorts to their memory of the data collection experience. The first-hand experience gained by the researcher gives them additional insights (i.e., contextualized information) that helps them examine images (Banks, 2007). At this moment, images demonstrate their usefulness in supporting "perception and memory" (Milgram, 1977, p. 50). Images contain data that can be analyzed in the same way as excerpts from interviews and field notes are (Emmison & Smith, 2000). Moreover, analyzing images while simultaneously listening to recorded interviews or reading transcripts enhances the researcher's cognitive advantages compared to analyzing them separately (Bassett, 2011). During this dialectic process, the researcher recognizes not only the content of the image but also the context in which it was produced to fully understand the meaning of the image (Banks, 2001). For instance, a photograph of a group of people receiving computer training in a classroom represents the material content, but knowing that those who are receiving computer training are refugees adds other dimension to the analysis.

Using images in research spans different philosophical approaches. Positivist researchers feel comfortable treating images as a visual record and accepting the objectivist connotation this premise carries. They deem images (especially, photographs and video recordings) as pieces of evidence that produce a rather accurate record that can be subsequently delivered with almost no deformation. Since the early days of anthropological research, the possibility of capturing a concrete element of reality on film made cameras an almost essential tool for fieldwork. As Lajoux (1995) argues, a film record "may be considered the element which most authentically describes a moment of one reality" (p. 166). Certainly, a rather abstract notion as culture can be literally seen through "an integrated series of symbolic systems" (Ruby, 2006, p. 71). In this sense, the role of images in research under the positivist tradition is "to measure, to count, and to compare" (Collier, 1995, p. 237). Informed by the positivist paradigm, advances in neurophysiological imaging tools (e.g., electrocardiograms, electromyography, functional magnetic resonance imaging) offer new opportunities to investigate information systems development and use, information systems strategy, and decision support systems (Dimoka et al., 2012) in a positivist fashion. For instance, using functional magnetic resonance imaging to investigate IT-enabled interpersonal exchange, Dimoka (2010) demonstrates that trust and distrust stimulate different brain areas, something that was not unambiguously distinguished in the corresponding psychometric data. Similarly, Riedl et al. (2010) resort to functional magnetic resonance images in analyzing gender-based differences on trust on online auction sites. In addition, the emerging field of visual analytics (Keim, Mansmann, Schneidewind, Thomas, & Ziegler, 2008) offers opportunities for retrieving, browsing, and analyzing visual content (Eidenberger, 2004) in an objectivistic fashion.

Conversely, under a phenomenological approach, images represent more than simple attestations of reality. They characterize how their producers have constructed and reconstructed reality (Harper, 2006b; Newbury, 2011) depending on their perspective and intention (Goldstein, 2007; Latour, 1986). Despite the fact that images depict concrete instances of reality, they are incomplete representations of the social world (Harper, 2006a; Pauwels, 2006; Stanczak, 2007); images are only proxy representations of reality (Banks, 1995). For instance, a photograph of a hospital depicts a building, but does not capture the patient afflictions, the stress of health professionals, or the joyfulness of new mothers. Moreover, even though the imprints recorded on a photographic film might be considered an accurate depiction of reality, they are nothing more than "the result of an arbitrary selection" (Bourdieu, 1990b, p. 73) representing "discrete slices of time" (Harper, 2006b, p. 88) of the real world.

Table 4 explains how researchers analyzed the collected visual data shown in Table 3.

Table 4. Analysis of Visual Data in Information Systems

Categories	Examples
Analyze visual data available in society	Social network analysis and structural equation modelling to understand how social influence affects the diffusion of user-generated videos (Susarla et al., 2012)
Analyze visual data produced by participants	Examination of PowerPoint materials presented over time in relation to the scope, resources, and time to understand the evolution of an information technology project (Yakura, 2013)
Analyze visual data produced by the researcher	A behavioral experiment followed by a functional magnetic resonance imaging study for measuring brain activity to analyze trust and distrust on impersonal IT-enabled exchanges (Dimoka, 2010)

4.3. Presenting Images

Images are more than mere descriptive devices frequently used only as redundant depictions to text or inserted just to break the boredom of a long text. Images are not for romanticizing the story; presenting images increases the ability to communicate. Images can stimulate the viewer's analysis by providing multimodal material. Images can close the gap between the researcher, who has gone through the analytical process, and the viewer, who is trying to capture the essence of the research, by providing a graphical and vivid testimony (Becker, 2002). If used correctly, images are a bonus that provide information that it is difficult to present in only textual form (Pink, 2006; Wagner, 2007). Images are included because they have the power to endorse the researcher's textual explanation (Ball & Smith, 2006). For instance, Rexford Tugwell, the economics professor at Columbia University and United States Under-Secretary of Agriculture, co-authored the first ever illustrated economics book that included photographs of the poor migrant laborers to explain abstract economic concepts (Smithsonian Institution, 1965).

Images become resources that help readers to understand the context of research and that communicate research findings (Gold, 2004) in a holistic way by breaking out from the constraints of the written word (Rabikowska, 2010). Not including images may weaken the overall presentation since they are "intellectual propositions" to the viewer in their own right (Newbury, 2011, p. 652). While entirely visual accounts are possible (see Berger's (1972) classical work), we still believe in the need for a written explanation that creates synergy between the text and the visual. Writing reduces the variability in how one construes images given their polysemic characteristics (Wagner, 2007). Meaning is constructed through intertextuality. In this sense, a holistic understanding comes from not only specific images and pieces of text but also their constitution out of other images and texts (Rose, 2012). They force "both the writer and the reader to stop and look and then to realign" the text and the image (Engeström & Middleton, 1998, p. 5), which establishes a two-way communication. The onus is on the researcher to elaborate on not only what has been captured in the image but also what is not seen—the context of the research. In this sense, the textual description of the context and content of the image helps in shaping the viewer's response (Aitken & Craine, 2005; Becker, 1998; Goldstein, 2007). The accompanying text needs to be written in a way that invites the reader to inspect the images to fully make sense of the researcher's analysis, which makes transparency indispensable in disclosing theoretical and epistemological positions.

Sharing images with the audience offers unique advantages. Including images makes the viewers accomplices of the research process by showing scenes that they otherwise could not have seen: "You are there…because I was there" (Clifford, 1988, p. 22). By making images available to the audience, they do not simply have to rely on the author's account since words might "move an account closer to or farther away from things as they are" (Morris, 1999, p. 34). Ball (1998) elaborates on the transparency images grant to the research process:

> *Sharing* [images] *with the reader is in one sense analogous to sharing with them pages of raw field notes, before they are interpreted and fashioned into a written report for publishing. In another sense, it is to share with the reader something of the messy processual and fragmentary character of how analysis is always fashioned and arrived at* (p. 141).

Intertwining words and images not only adds to the authenticity of the research work but also contributes to the chain of evidence by "blending the textual and the sensual" (Pope, 2013). Images are particularly well suited for case-based research since it requires enmeshing some instances of raw data (Yin, 2003). For presenting images, the researcher can opt for a chronological sequence or a thematic organization. The former is particularly useful if the researcher wants to highlight changes facilitated by ICT tools (Rieger, 2011) (e.g., capturing patron behaviors and patterns of interaction at cafés before and after making Wi-Fi available). A thematic organization in a narrative fashion is especially beneficial to the viewer for understanding the researcher's reasoning (Harper, 2006b).

From here, we build on our categorization of sources of visual data and present examples under each of them: images available in society, images produced by participants, and images produced by researchers. The first set of photographs represent visual data available in society.

The photograph in Figure 1 is part of a set of 20 photographs taken from January to March 2009 for a study on the introduction of information systems to a rural setting (Vaidya, 2012). In a context characterized by distrust among different stakeholders (i.e., government officials, traders, farmers, and private partners), the launching of the e-Krishi Vipanan Initiative in 2003 in the Indian state of Madhya Pradesh brought computer technology to the agricultural market yards. The intention was to make transactions transparent and protect the farmers, the usual victims of widespread corrupted practices. The project was eventually abandoned in 2011. The assumption that introducing information technology could change unfair practices proved to be wrong. The handheld device shown in Figure 1 was used to capture transaction data (e.g., trader name, commodity type and weight, auction rate) at one of the market yards. The photographs accompanying the textual description provide a vivid account of every step of the trading process: from data captured at any given yard, automatically uploaded to a central server, and redistributed through a very small aperture terminal satellite to other yards and government offices across the state, to commodity prices displayed on websites at government offices, or to TV sets at other yards. In this way, farmers had information on the auction rates at various other yards.

Figure 1. Hand-held Device for Recording Transactions at Market Yard (Vaidya, 2012, Reproduced with Permission)

Figure 2 depicts two photographs taken as part of a research project that examines user adaptation behaviors to mandatory information systems in organizations that had implemented ERP systems for at least three years at the time of the fieldwork (Wanchai, 2012). In the course of gathering data, the researcher observed that some participants adopted what was labelled as a "compliance adaptation behavior", by which users made limited efforts to adjust their previous work practices to the ones imposed by the sanctioned ERP system. The researcher observed that one of the manifestations of this behavior was the coexistence of traditional work practices with what was supposed to be an integrated, more efficient technology. The content of the photographs is revealing and supports the researcher's observation. The photograph on the left depicts documents and a calculator next to a laptop, whose screen shows a view of SAP's accounting module. The photograph on the right portrays the same laptop now with an active spreadsheet, a technology that was supposed to be phased out in favor of SAP. The author analyzed visual material obtained in the field, as the one shown in Figure 2, along with other sources of data (interviews, organizational documents, and field notes) to theorize on the dynamic user adaptation process in the context of mandatory systems.

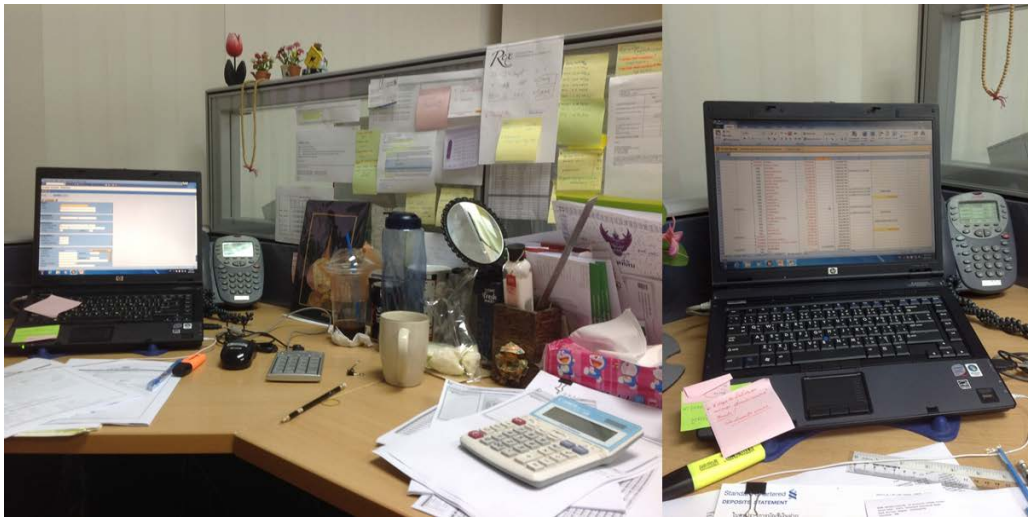


Figure 2. Combining Traditional Work Practices (i.e., Paper-based Documents, a Calculator, and a Spreadsheet) with SAP Technology (Wanchai, 2012, Reproduced with Permission)

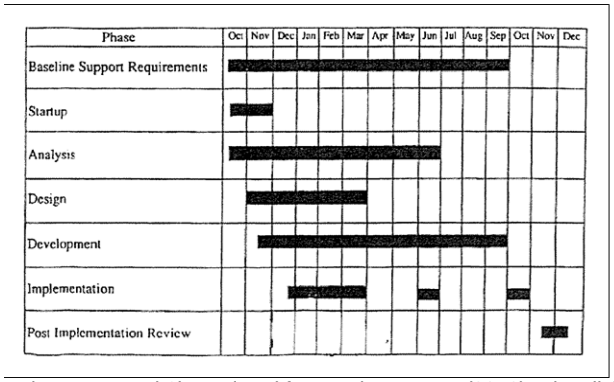
Figure 3 depicts a photograph containing information that might have been ignored during the first author's time as a researcher conducting fieldwork in the Andes. A closer inspection allows the discovery of some informative details. It portrays a woman (center) and her child waiting for a phone call outside a tele-center in an Andean hamlet. This tele-center along with seven others implemented in the Peruvian region of Cajamarca were part of a joint initiative of a group of non-governmental organizations that sought to provide local villagers with access to computers connected to the Internet. At the time of producing the photograph, the authors intended to document an instance of the local tele-center use as part of a large research on the dissemination of computer-mediated information (Díaz Andrade & Urquhart, 2009).

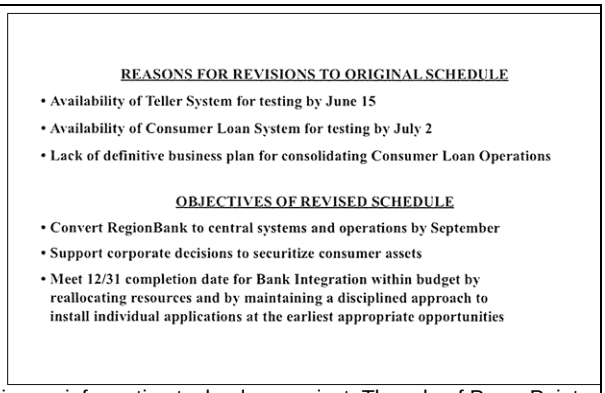
Figure 3. The Unnoticed Information During The Fieldwork: The Tele-center's Loudspeaker (Circled)

A second look at Figure 3 reveals the loudspeaker (circled) just under the tele-center's eaves. The loudspeaker was frequently used to announce incoming calls; after an initial call, the caller would ring again in ten minutes or so to allow the addressee time to make their way to the tele-center. This common practice reflected how local people use the provided tele-centers. This example serves to illustrate how the lived-in experience of the fieldwork prompted the researcher's recollection of the details found in the field. The researcher may well discover things that might have been unnoticed during the fieldwork on calm reflection once at home (Strecker, 1997).

The researchers themselves captured the images available in society shown in the previous figures. None of them was a professional photographer, but they were at least competent to use the now widely available and affordable cameras. Understanding of the subject under investigation and sensitivity to the issues relevant to the topic found in the field are far more important than photographic dexterity and access to state-of-the-art technology.

Figure 4 illustrates the use of visual data produced by participants. It shows two PowerPoint slides that consultants produced and presented to a bank's executive team as part of an information technology project. These slides support Yakura's (2013) observation on the mutability of how referents (time in this case) evolve from abstract to more concrete representations. The slide on the left, presented in the early stages of the project, shows timelines associated to high-level project phases. As the project progressed, timeliness gave way to specific lists of tasks as shown in the slide on the right.





Figures 4c and 6b reprinted from Yakura, E. K. (2013). Visualizing an information technology project: The role of PowerPoint presentations over time. *Information and Organization*, 23(4), 258-276. Copyright (2013), with permission from Elsevier.

Figure 4. Two Presentation Slides Denoting The Transition from Broad to Specific Project Activity Representations Over Time (Yakura, 2013)

Figure 5 represents an example of visual data produced by the researcher. Using functional magnetic resonance images, Dimoka (2010) analyzed brain activation on different regions when participants were subject to different stimuli associated with trust and distrust and concludes that trust and distrust are distinct constructs.

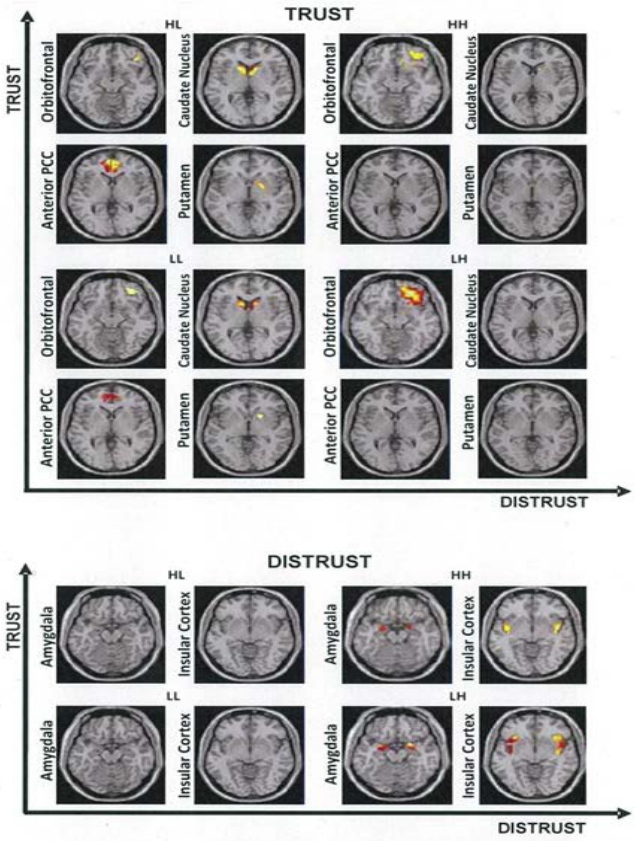


Figure 3 reprinted from Dimoka, A. (2010). What does the brain tell us about trust and distrust? Evidence from a functional neuroimaging study. *MIS Quarterly*, *34*(2), 373-396, Copyright (2010), with permission from Regents of the University of Minnesota.

Figure 5. Functional Magnetic Resonance Images Showing Brain Activation on Different Brain Regions Associated with Trust and Distrust (Dimoka, 2010)

5. Suggested Considerations in Visual Research

In this section, we suggest some guidelines that information system researchers might adopt when considering using images in their research. The considerations we offer here are neither an exhaustive list nor specific to any particular method of analysis. However, they do provide a starting point to assist information systems researchers when embarking on visual research. In the following discussion, we draw on existing examples of visual research in information systems.

5.1. First: Consider the Role of Images in Your Research

When commencing research projects, we need to consider the role images could play. Therefore, we need to ask why images should be used in a research project in information systems. We identify three reasons for considering the inclusion of visual data as part of the research project.

The first and most important reason is that observing images triggers a flow of ideas in the researcher that facilitates the knowledge-creation process. There is a direct relation between seeing objects and visualizing meanings. While it is the visual sense that allows someone to perceive what can be seen of the world, visualizing entails a conceptualization process (Wagner, 2006). Cognitive science research demonstrates that seeing concrete entities or visual representations of concrete entities influences analytical cognition (Epstein & Pacini, 2000/2001). Similarly, neuroscience confirms that observing images stimulates complex thinking (Quian Quiroga, Reddy, Kreiman, Koch, & Fried, 2005). These are good reasons to grant images the quality as a source of data in their own right.

Second, building on the preceding argument, images contain data that can and should be viewed interrogatively. The most compelling example of this is perhaps Zuboff's (1988) study, in which images that clerks had drawn, before and after automation, provided the material for understanding the consequences of automation in the workplace. In the same way, images can be used to reveal patterns of social behavior (Susarla et al., 2012), understand how mandatory information technology is actually used (Wanchai, 2012), comprehend how resemblance to avatars influences attitudes to online shops, or predict individual actions in virtual environments (Goel et al., 2011). In addition, images can be an integral part of the research setting in some domains of research. For instance, in the case of research on social media, which is highly visual, one could argue that, without images, one has not finished analyzing the phenomena. The work of Antheunis and Schouten (2011) is a good example of how images offer a rich source of data in social media research.

Third, images constitute powerful elements to provide a sense of context and convey findings. Images can communicate rich information of the research environment with great immediacy, especially when the audience may not be familiar with the setting. For instance, the photos shown in this paper provide a sense of context and convey findings in a way that words by themselves cannot. Figure 1 makes vivid the introduction of information technology into a rudimentary farmer's yard market, while Figure 3 transmits the sense of cumbersomeness that taking a phone call is in a remote village. A few photographs can make all the difference in helping the reader comprehend an unfamiliar setting.

Therefore, this guideline makes a call for considering the role that images can play in research.

5.2. Second: Consider Your Epistemological Position When Including Images

In this paper, we explain how different types of images (i.e., photographs, functional magnetic resonance images, YouTube videos, MS PowerPoint® presentations, etc.) have been analyzed using different techniques. This diversity in terms of both visual materials and methodological approaches indicates the need to be clear on the epistemological position.

On the one hand, objectivist researchers—informed by positivism or post-positivism (Guba & Lincoln, 1994)—have the opportunity to use images as hard evidence that provide incontrovertible proof of their findings. Besides using images for triangulation, content analysis is one methodological option for scrutinizing images in the quest for objective truth (Howells & Negreiros, 2012). In addition, images can

be produced as part of designing experimental conditions, which allows the researcher observe the effect of any given treatment on participants in order to verify models and test hypotheses. E-business research usually uses images in experimental treatments; for instance, see Cyr's et al. (2009) comparative study on the effect of human images in e-commerce websites, Jiang and Benbasat's (2005) analysis of how visual and functional control help consumers evaluate products on simulated shopping websites, and Suh and Lee's (2005) investigation on how high and low visual and auditory cues assist consumers in learning about products. Functional magnetic resonance imaging techniques, along with other neurophysiological imaging techniques, allow one to produce visual material that, by monitoring neural activity, offer an exceptional opportunity for quantifying human attitudes in relation to information technology (see Dimoka, 2010; Riedl et al., 2010).

On the other hand, subjectivist researchers—informed by interpretivism or critical theory (Guba & Lincoln, 1994)—distinguish between the content and the context of images. The dialectical process by which the researcher analyzes the image and its context become an important point to ponder (Ball & Smith, 1992). Yakura's (2013) study of the evolution of presentations illustrates how images cannot be analyzed in a vacuum; they need to be scrutinized against specific contextual conditions. The photographs depicted in Figure 2 in this paper provides another example of the importance of the content-context nexus. Without knowing that a flexible arrangement that allows the coexistence of a mandated ERP system with more traditional—and even manual—systems was in place in that particular organization (Wanchai, 2012), the viewer cannot fully understand the images. Furthermore, images can be viewed as not neutral but as constructed texts (Banks, 2007). This makes sense particularly with social media, where people manage how they appear online (Schultze, 2012). At the time of writing this manuscript, the "selfie" can be seen as the ultimate constructed text. In addition, there are websites devoted to photobombs, where the subject of the image is sometimes accidently, sometimes deliberately, upstaged by another element in the photograph[3]. We can take a Foucauldian view of the image by inquiring who is doing the looking, whom does society empower to look at and be looked at, and what knowledge does this produce?

Design-science research represents a singular class. Design scientists emphasize the planning and execution of activities needed for creating technological artifacts to address specific problems (Gregor, 2006). By not being axiomatically informed by any particular epistemological position, they can identify themselves as either objectivist researchers or subjectivist researchers and evaluate their research output accordingly (Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007/2008). We contend that using naturalistic images can contribute to bridging the design science and behavioral science gap (see Hevner, March, Park, & Ram, 2004).

Whether the images are available in society, are produced by researchers or by participants, the researcher's epistemological position, along with the research problem, will define the choice of the appropriate method of analysis. This choice entails a decision between analyzing the intrinsic meaning of the collected images and using images for counting, classifying, or observing occurrences. In other words, the depth-versus-breadth consideration applies with full force when thinking about analyzing images.

5.3. Third: Consider the Ethical Dimensions of Visual Research

Researchers engaged in visual analysis must follow the same ethical principles applicable whenever human participants are involved: informed and voluntary consent and confidentiality. In addition, they need to observe the issue of ownership of and rights to reproduce images, aspects unique to visual research.

As regards informed and voluntary consent, if photographs, video recordings, or sketches of individuals are to be produced, the researcher needs to get the participant's approval in advance in the same way an agreement to have an interview is sought beforehand. If the simple act of looking at people can bring uneasiness, shooting or drawing a sketch may inhibit some participants (Banks, 2007). In any case, a close-up picture of one participant or a group of participants requires their

[3] Interested readers may want to visit www.photobomb.com, www.photobomber.org, or www.rodgersphotobomb.com.

explicit consent. This is not much an issue if the researcher produces images from a long distance (e.g., Figure 3) or where individuals are not the main subject of the image (e.g., office layout).

As for confidentiality, if there is any possibility of individuals being recognizable in the image, the researcher needs to take the necessary steps to guarantee that they cannot be identified when the image is shared with an audience. For instance, the subjects captured in Figure 1 and Figure 3 are virtually unidentifiable. Similarly, the image shown in Figure 2 and its accompanying text do not compromise the participants' identities. Blurring faces or recognizable traits is also an option to protect participant confidentiality (e.g., the photo profiles in Antheunis and Schouten's (2011) work have been blurred). The same applies for images associated to the participants, as in the functional magnetic resonance images produced by Dimoka (2010) and Riedl et al. (2010), who have protected their participants' identity.

When the researcher is the one who has produced the visual data, they are the owners of the material and have the right to reproduce it. Moreover, they can share the images they have created, in the same way they can do with the written text, under a Creative Commons license. However, when participants have produced the images, they retain the ownership; consequently, reproducing those images requires their permission. In the case of visual data found in the public domain (e.g., photographic sites such as Flickr or Pinterest), the principle of informed consent may not be applicable. However, if the images may make individuals recognizable, the principle of confidentiality holds true (Rodham & Gavin, 2006). In any case, publicly available images cannot be reproduced without explicit permission from their owner and the researcher needs to be aware of the legal implications, which may vary from country to country (Allen, Burk, & Davis, 2006). Since we have included images produced by other researchers (i.e., Figures 1, 2, 4, and 5), we obtained their permission to use them in this paper.

Regardless of what legal approaches may apply to different jurisdictions, ethical behavior goes beyond merely complying with existing regulations. Honesty with participants and truthfulness about their role are paramount in visual research (Wiles, Clark, & Prosser, 2011).

5.4. Fourth: Consider Capitalizing on What Images Afford

A continuous debate in academic circles is how to make research meaningful by addressing pressing issues in society and simultaneously meeting the thoroughness that characterizes scholarship production (Vermeulen, 2005). This debate has not been unfamiliar in the information systems field (Robey & Markus, 1998), where rigor and relevance under a positivist tradition (Benbasat & Zmud, 1999) has been contrasted to alternative philosophical approaches (Lee, 1999; Lyytinen, 1999).

In this sense, we believe that visual research adds to both rigor and relevance. The use of images contributes to strike a balance between theory-driven and practice-driven information systems research regardless of philosophical perspectives. On the one hand, we claim that images add to rigor in the analysis by giving researchers engaged in fieldwork (usually subjectivist researchers), which encompasses close interaction with participants, the opportunity to re-live the experience more than once after they exited the research site (see Schultze, 2012; Vaidya, 2012; Yakura, 2013), which enhances reflectivity (Pink, 2007; Rabikowska, 2010). On the other hand, the strength of visual material for objectivist researchers resides in images that allow them to count instances of events, signals, or symbols and to document changes and triangulate data (see Dimoka, 2010; Riedl et al., 2010; Susarla et al., 2012). In design science research, the use of images allows researchers to develop and test theories (see Saunders, Rutkowski, van Genuchten, Vogel, and Molina Orrego's (2011) virtual space and place theory).

The main advantage images offer to enhance the relevance of research is the opportunity to be conversant with the audience (Newbury, 2011). Reproducing two-dimensional images is now easy and inexpensive; presenting them makes possible communicating results to others and facilitate access to non-academic spectators. As Dr. Jack Bellivau, the renowned neuroscientist who pioneered the use of imaging techniques for studying the brain, was remembered on his obituary: "He wanted all

along to capture human thought and there's nothing like a picture to convince you that something real is happening" (Carey, 2014). For design-science researchers, images can assist them in conceiving and assessing the elements of grace embedded in the artifact's style that users will eventually use (see Hevner et al., 2004).

Table 5 summarizes the four points we suggest here to assist information systems researchers when embarking on visual research.

Table 5. Suggested Considerations in Visual Research

1. Consider the role of images in your research	• Images trigger a flow of ideas on the researcher that facilitates the knowledge-creation process • Images contain data that can and should be viewed interrogatively • Images constitute powerful elements to provide a sense of context and convey findings
2. Consider your epistemological position when including images	• Images are philosophically and methodologically neutral • Objectivist researchers use images as hard evidence that provide incontrovertible proof of their findings • Subjectivist researchers engage in a dialectical analysis of the image, its context, and its accompanying materiality • Design-science researchers, regardless of their epistemological position, can use images to bridge the gap between behavioral and design paradigms in information systems research
3. Consider the ethical dimensions of visual research	• Issues of informed and voluntary consent, confidentiality, and permission to reproduce need to be considered • Informed and voluntary consent entails obtaining participant approval in advance • Confidentiality requires taking the necessary steps to guarantee that participants cannot be identified when the image is published • If the researcher has produced the visual data, they are the owners of this material and have the right to reproduce them. • If images are publicly available or have been produced by participants, whomever produced them retains the ownership and that individual's permission needs to be sought before reproducing them

4. Consider capitalizing on what images afford	• Visual research adds to both rigor and relevance
	• Images add to rigor in the analysis
	  ◦ By allowing objectivist researchers to count instances of events, signals, or symbols and to document changes and triangulate data
	  ◦ By giving subjectivist researchers the opportunity to re-live the experience more than once after they exited the research site
	  ◦ By allowing design researchers to build tools for testing and developing theories
	• Images enhances relevance
	  ◦ By giving researchers (both objectivist and subjectivist) the opportunity to be conversant with the audience
	  ◦ By allowing design researchers to conceive and assess the artifact's style

6. Concluding Remarks

With few exceptions, the use of images in information systems research has been generally limited to supplying context to the research setting. We believe this underuses rich, visually accessible data that can be easily captured, mainly in digital form. Not to incorporate images in the research process, we argue, is self-restraining at best and self-defeating at worst, especially in an increasingly visual digital world. Systematically collecting and thoroughly analyzing and presenting images can only add rigor to a study, plausibility to its findings, and cogency to its conclusions.

In this paper, we extend an invitation to information systems scholars, regardless of their area of specialization, to contemplate using images throughout the research process. Accompanying this invitation, we offer considerations that researchers can use as general principles when using images in information systems research. Images have the capacity to contribute to knowledge creation under different philosophical paradigms. Visual material also contributes to the relevance of research by enhancing the communication of the findings to the audience. Presenting images helps the researcher to transmit a sense of authenticity and simultaneously strengthens the chain of evidence. While we maintain that using images in research entails espousing the same ethical codes as with other types of data, we stress the importance of observing the unique aspects to visual research.

More than two decades ago, Tufte (1990) longed for the day when computer visualization would free humans from the two-dimensional tyranny of paper flatlands. It is not only the world as we see it that offers visually available material. The Internet—and, in particular, the advent of social media—has resulted in an explosion of visual material that confronts the information systems researcher simultaneously with challenges and opportunities. The increasing affordability of technology for capturing, storing, and reproducing images offers information systems researchers an unparalleled opportunity to collect, analyze, and present visual material.

Today, when academic journals are largely published online, visual material can be easily integrated into the final product of research via hyperlinks. It is time for the still predominantly print-based mindset to give way to the arrival of visual material. We hope that this work contributes to building the intellectual foundations and justification for using images in information systems research.

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