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ECIS 2016 Proceedings

Summer 6-15-2016

# DOING INFORMATION SYSTEMS: INFORMATIZING AND SYSTEMATIZING FROM A PRACTICE LENS

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# DOING INFORMATION SYSTEMS: INFORMATIZING AND SYSTEMATIZING FROM A PRACTICE LENS

*Research Paper*

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## Abstract

*This study applies the theory of practice to view the information systems (IS) field in terms of its essential activity—what it does as an intellectual enterprise. Drawing from Foucault, Bourdieu, Pickering and other practice theorists, it defines the IS field as continuously informatizing and systematizing its objects of study. Each of these two activities is elaborated into three dimensions: informatizing is characterized as automating, informating, and complexing; systematizing is characterized as analysing/synthesizing, sensemaking and enacting. These dimensions are mapped into themes that can be characteristically said to be IS research, and based on each of their essential activities, provide a theoretically coherent image of research in IS that connects the dots despite the field's apparent theoretical diversity and incongruity. Focusing on what the IS field does builds a distinctive identity for the field, opens up possibilities for theorizing the IT artefact and enables IS researchers to theorize not only traditional IS topics, but especially novel, unpredictable, and emergent socio-technical phenomena. By bringing back the IS field to its core concepts—information and system—the performative act of doing IS in both its discursive and non-discursive practices hold the potential for enhancing the intellectual and social relevance of the IS field.*

*Keywords: information systems (IS) theory, IS disciplinarity, theory of practice, socio-technical phenomena, IS identity.*

## 1 Introduction

As a field that draws from multiple social and technical disciplines and a variety of academic traditions, the information systems (IS) field is in the fortunate position of being able to address many of today's complex, dynamic, and unprecedented socio-technical phenomena. For example, recent global financial crises were made possible by the existence of global information technology (IT) networks that ignore nation-state boundaries and regulatory agencies. Terrorists are taking advantage of social media to recruit and organize like-minded elements around the world—something that was inconceivable just a decade ago. Work and employment, culture, entertainment, news and media, enabled by IT and communications technology, are all creating a "transformation in the space and time of human experience" (Castells, 2011, p. xxxi). As Keen (1991, p. 27) had prognosticated, the IS field should be at the "forefront of intellectual debate and investigation about the application of information technology across every aspect of business, government and society." However, the diversity in its traditions also threatens to diffuse the field's potential to focus on these issues. The goal of this essay is to provide a coherent view that connects the dots between seemingly disparate traditions within the IS field as it works towards addressing these global issues.

In order to build this coherent view of IS, we need to understand its two different domains. Every discipline has both its academic and the practitioner sides. The nature of the activities both sides in each discipline not only distinguishes them from other disciplines; their nature describes the division of intellectual and practical activities that the academics and practitioner of the discipline perform as they accomplish their different goals and undertake day-to-day activities. For example, the details of how professors teach and research in the disciplines of engineering or economics will not be the same as those who teach biology or physics. Similarly, in the practitioner side, it is safe to assume that biologists or physicists will go about their work in very different ways from engineers and economists, but each contributes to the discipline's development as well as benefits the discipline's stakeholders. Within each discipline's culture lies a certain kind of obsession with specific goals, models, and tasks.

The target of this essay is the whole discipline, although its primary audience is the academic side, or the intellectual enterprise represented by the community of researchers that attend the same conferences and share their publications in the same journals. The term "discipline" should not be confused with the material disciplines that typically make up the division of teaching in universities. For instance, the material discipline of *organizational behaviour (OB)* in the school of management refers to the same scholars, content and discourse as *organizational psychology* in school of liberal arts. However, the professionals that are trained in these two material disciplines would likely work in the same hiring department, suggesting that perhaps the discipline that these two material disciplines teach and research is one and the same. Hence, whereas the primary audience of this essay is the field of study, the focus of this essay is on the subject matter of IS itself, which is practiced by experts trained in and hired into IT departments or IT consulting companies. Thus it matters less if the discipline is called "information systems" or "computer information systems" or if they are located in the college of business or in the college of science an engineering. What matters is the subject matter that is being studied and at the same time practiced—the field itself. And it is this subject matter, as it is practiced in industry that forms the content of both the research undertaken and the curriculum taught in the academic domain.

Foucault (1972) distinguishes these two domains of academia and industry by referring to the former as a discursive practice and the activity of its practitioners as its non-discursive practice. For the discursive practice, Foucault (1972) defines the discipline as a field of study that demonstrates norms of verification and coherence, thereby able to exercise a dominant function over knowledge. Non-discursive practices can exist without any discursive practices studying them as can be seen in the case of the Pharaohs engineering the pyramids. There weren't any civil engineering departments around, but the pyramids' builders represented early prototypes of civil engineers. Nevertheless, the subject matter of engineering had already existed even if no discursive practices were organized to support it. The progress of non-discursive practices depends on many factors, not the least of which is how well its discursive practice or its discipline organizes itself to contribute to its associated non-discursive practice. The $18^{th}$ and $19^{th}$ centuries saw a significant increase in the emergence of discursive practices that developed from various fields of study to become established disciplined. As far as the discursive practice of IS, Hassan (2011) argues that the IS field does not yet qualify as a discipline because it is still to demonstrate a level of coherence capable of exercising a dominant function over knowledge. This essay provides arguments and related evidence for an intellectual structure that is capable of demonstrating such a level of coherence.

This essay is concerned with the nature of such activities and their culture as they pertain to IS. What is the nature of the activity of IS? How can one distinguish the IS expert as they go about doing their day-to-day routines from the experts of other disciplines? Just like the experts of biology are called biologists and those of economics are called economists, what can the IS expert be called if indeed it has a distinguished set of practices? And how can these distinctive activities address the kinds of complex, dynamic and unprecedented issues raised above? These are some of the questions that this study will begin to address. This essay will show that the history of the IS field essentially consists of two activities: *informatizing* and *systematizing*, the nouns of which, not surprisingly make up the title of the field. These two activities were briefly introduced in Hassan and Hovorka (2011) but not elaborated on. This essay extends that paper by describing with more details what IS practitioners do, and essentially what IS, as an academic field, does, in the same way biologists do biology, physicists do physics, economists do economics and sociologists do sociology. With the proliferation of IT networks and the subsequent societal transformations, the implications of these activities have taken an even greater significance. This essay will elaborate on how informatizing and systematizing relate to extant research in IS as well as how they relate directly to practitioner concerns, thus bridging the gap between the two domains. Ultimately this essay suggests how focusing on these two disciplinary activities opens up ways to develop the IS field into an intellectually influential and socially relevant discipline.

## 2 The Theory of Practice in Disciplines

The notion of the essential activity of a discipline is drawn from Foucault's (1970; 1972) search for the cause of the emergence of new disciplines, the sudden changes that overtake disciplines, why new concepts appear and how they obeyed certain "rules of formation." Psychology emerged from philosophy by applying biological knowledge and metaphors, and the tools of language to study the human mind and behaviours. As a result of the work of Augusta Comte, early sociology would emerge as a form of "social physics," taking cues from the order and mechanics in physics to address social ills. These new disciplines, often called the human sciences, place their foci on the human being. Unlike the natural sciences that apply tools from mathematics and philosophy, these human sciences are not strictly based on the dimensions defined by mathematics, physics, or biology; instead these human sciences lie in the space and interstices of these branches of knowledge. This is the reason why these human sciences are often difficult to situate and define. As a result of borrowing from others, they have very porous and flexible boundaries, often appear to be in peril but at the same time, are perilous to others due to their encroachment into these branches of knowledge (Foucault, 1970).

As a result of where they are situated, it is often difficult to decide which human science a study is associated with. For example, the classic text the *Psychology of Attitudes* (Eagly and Chaiken, 1993) has psychology in its title, however it is also about sociology. Foucault's notion of the essential activity and practice of disciplines enables us to distinguish these two human sciences. Psychologists remain in the essential activity of representing the human mind, in the "extension of its functions," "neuromotor blueprints" and "physiological regulations" (Foucault, 1970, p. 355) giving rise to certain mental conditions and behaviour. Sociology, would take this individual activity, and focus on how the individual represent offers itself to groups, imperatives, sanctions, rites, rules and beliefs. In other words, it is possible to know when one begins to "psychologize" or when one begins to "sociologize," based on their essential activity or which discipline is primarily operating. Each discipline uniquely handles its objects of study. This handing off in the objects of study can also be seen in the activities performed by computer scientists and experts in IS. Whereas computer scientists concern themselves with the activities of formulating means by which the computer would process signs, the experts in IS would take over from them at the point in which the machine has successfully performed its intended function (Lee, 1999). The question is, after this hand-off, "what then is the nature of such IS activity?"

Scholars in the pure sciences support the notions of disciplines accomplishing its essential activity. In describing what physicists do, Krieger (1992) notes that they assume the world to be like a factory with its mechanisms and specialized functions, its workers and systems in which their labour is coordinated, and find out about the world by "poking at it" (p. 5). Pickering (1995) describes science as "practice and culture" and as a "mangle of practice." Bourdieu's (1977) view of science as practice situates the researcher inside the phenomenon constructing it. Just like Pickering's (1995) performative view, to Bourdieu there is no subject observing an object from the outside; the strengths of both objectivist and subjectivist knowledge is combined in practice. Post-humanist science and technology studies led by scholars such as Callon (1986), Law (1986) and Latour (1987; 1979) also contribute to the view of practice and the notion that disciplines are essentially the re-enactment of social action.

Another unique characteristic of the human sciences stemming from the way they interlock and situate themselves, is how they can be used to operate on other disciplines as well as one another. Thus, while researchers might balk at the prospects of studying the "biology of science," the "sociology of science" is not only feasible, sociologists have built a credible tradition focusing on how individual scientists relate to other scientists in their day-to-day activity of producing scientific knowledge. The essential activity remains in the domain of sociology. Thus, Stuart Card, a PhD in psychology worked with Thomas Moran and Alan Newell, both computer scientists by training, to publish, *The Psychology of Human-Computer Interaction*. This classic text leverages the unique nature of the human science of psychology to "lay the scientific foundation for an applied psychology concerned with the human users of interactive computer systems" (Card et al., 1983, p. vii). In this way, the authors "psychologize" computers or human-computer interaction, to benefit both computer science and psychology. Following this logic of the essential activity and assuming that the IS field is a human science, we surmise that the nature of IS activity then has to do with how the field handles its objects of study and what the IS field does with other disciplines.

We draw from all these traditions to support the claim that each field of study, including IS, has its own set of unique practices and activities that define the field. By analysing these set of activities, it is possible for us to not only uncover where the field is going, we can also prescribe strategies that could enhance the progress of the field. In essence, this practice lens brings the IS field back to its two core concepts—*information* and *systems*--that together build a distinctive culture of goals, values, models, and research tasks

# 3 Informatizing

The first essential activity of the IS field is in handling its first object of study—information. Informatizing can be defined as the set of activities that relate to and handle information. The academic studies describe how information is handled or even prescribe various ways information is handled, while the practitioner actually handles and manages information. Many other disciplines also handle information, e.g., information science, accounting, finance, economics, to name a few. The difference lies in how the IS field performs this activity, with the assistance of the programmable computer—the system. Additionally, informatizing can take place without the system, in which case, it would not fall within the purview of IS, as in the case of cataloguing books in the library (in information science), or figuring out the break even point of a financial investment (accounting and management). In coining the term "information technology" (IT) Leavitt and Whisler (1958) described a new kind of technology, the programmable computer, that they predicted would transform the practice of management. Leavitt and Whisler's discourse on IT as "intellectual" technology distinguished it from the "industrial technology" of the industrial revolution. This new technology, they surmised, is composed of three parts: (1) a computer which implements, (2) the techniques and methods for decision-making and, (3) a component, yet to be perfected at the time, which they claim would "simulate higher order thinking through computer programs" (p. 41). We can say that the practice surrounding the use of these elements would form the IS field's first essential activity-*informatizing*. What Leavitt and Whisler described was, of course, already taking place in organizations applying the system.

An early form of this activity is data processing, which matured as corporate leaders worked on figuring out how the newly invented computers could be exploited for business. Before computers could be exploited in business, something else had to take place to ease the entry of computers into the workplace—the rationalization of executive and clerical work. As a result of the success of Taylorism in the early 1900s, the principles of scientific management were being applied in offices in order to relieve pressure from the mounting work of documentation. Elaborate filing systems, pneumatic tubes and assembly-line like processes were instituted to reduce as much human interaction and communication as possible in order to efficiently process all the required information. It was natural for computers to take over from those infrastructures and to automate processes and *informatize* the work. In the UK, as Frank Land (Anonymous, 2011; Jowitt, 2011) described it, the first commercial application of computers, the LEO, "didn't do much that had not being done before but it did it faster" and added, "it was the first machine that could produce business and commercial reports." In the US, among the leaders of this new application of computers in business was General Electric. A report on one of the earliest major implementations of the UNIVAC mainframe in a business environment describes the various aspects of informatizing taking place (Osborn, 1954, p. 100) including that of IT-enabled decision making:

> [W]e figured on reaching the break-even point when the computer is used only two hours a day. And in computing the break-even point, savings were only evaluated in terms of salaries, space rentals and equipment depreciation applicable to those clerical jobs eliminated in four limited routine applications. No value was given to such intangibles as more prompt reporting, the ability of management to make more informed decisions quicker, and reduced investment in inventory.

These narratives of informatizing reflect the layers of activities taking place throughout the history of IS that are distinct from the activities in computer science, accounting or management. The following subsections elaborate on those layers of activities.

## 3.1 Informatizing as Automating

The obvious candidate activity for computers was to automate time consuming and labour intensive tasks. As history has shown, among the earliest activities to take place was to automate accounting and later production-related activities that could be easily programmed into the computer. This description fits with the general definition of automation as “device or system that accomplishes (partially or fully) a function that was previously, or conceivably could be, carried out (partially or fully) by a human operator (Parasuraman et al., 2000, p. 287). Again, the academic may study or suggest how automation might take place and what impacts it might bring, while practitioners automate. Drawing from Taylorist approaches to increase productivity by streamlining and rationalizing factory operations, the industrial engineering applications of the automating meant the reduction of physical effort. Thus scanner devices automate the task of looking up the prices manually, documenting them onto the receipt and processing the inventory file. Automating implied breaking down the physical process and making them explicit, thereby allowing the computer to perform individual tasks that would then be monitored via an electronic interface or printed reports (Zuboff, 1988). One aspect of informatizing therefore involves the translation of information into action resulting in the reduction of effort.

What is particularly significant about automation is the possibility for computers to perform tasks that humans do not wish to perform or cannot perform as accurately or as reliably as machines (Parasuraman et al., 2000). Thus auto-body painting by robots, autopilot landing of a commercial liner and docking of a spacecraft are all clearly tasks that automation excels with little doubt. However, from the point of view of IS, it is the extent of automation which involves human decision making and meaning construction that are most relevant to informatization. It is these IS-related tasks where full automation is rare or even impossible (Parasuraman and Riley, 1997). Although effort in work was made leaner, scientific management also separated the craft of the individual making workers more replaceable, and place less dependence on their abilities or motivation. Automating does not only reduce effort, it also increases the sense of alienation on the part of the worker. All these positive and negative social implications of automation implies that a clearer understanding of automation is significant for IS (Zuboff, 1988).

## 3.2 Informatizing as Informating

Zuboff (1988) made famous the notion of *informating*, the activity of registering data from the automated activities thus generating new streams of information. The supermarket checkout scanner does not only act on the products like inventory and the receipt; it introduces “an additional dimension of reflexivity” (p. 9) and potentially contributes to both the product and the human operator, if that is allowed to happen. To *informate* means to translate activities, events, and objects into information and to make what is partially or completely opaque visible and shareable (Zuboff, 1988). Part of the outputs of informating is used in automating (as in the case of monitoring processes) and others are used in decision-making and strategizing. Informating therefore occurs at a higher level over automating.

While automating seeks to reduce communication and human interaction, informating enhances communication and enhances the transparency of information. The implications of informating are often not well understood, intended or rarely planned for, but potentially trigger a series of dynamics that reconfigure the nature of work and social relations.

The implications of both automating and informating were what Leavitt and Whisler (1958) prognosticated. They saw automating replacing more and more work, and informating moving the traditional boundaries between management (planning) and workers (execution) upwards, resulting in management taking in a larger proportion of planning and innovation, ultimately thinning out middle management. They predicted that the intellectual capabilities of the worker will be extended and the number of new jobs such as the "operations researcher" or in today's terms, the analyst, will increase. A new set of skills emerged from this radical change, which Zuboff (1988) calls "intellective" skills. These skills require a quality of thinking that combines abstraction, explicit reference, and procedural reasoning. When something goes wrong, workers do not immediately go down to fix it, they need to think about what's going on, using the electronic symbols presented to them. They need to theorize about the process and how their tasks are accomplished, and make their way through the web of interdependencies to find the source of the problem. As a result of the transformation, workers are actually promoted based on the quality of their theoretical understanding, rather than their physical exertion. Informating provides for a broader and more holistic view of the organization, allowing workers to better organize and manage their environment.

## 3.3 Informatizing as Complexing

Despite the reduction of labour from automation, it did not make the life of the worker simpler; it made it more complex. Complexity is the necessary outcome of computerization (Zuboff, 1988). Understanding informatization also involves understanding its unintended consequences, one of which is complexity. Computerization legitimized the existence of new structures of managerial line and staff positions that was required to coordinate the increasing complexity of work. Both workers and managers are now faced with several levels of complexity. The first level concerns the relations between the informatized symbols and the real world. Informatization increases the level of ambiguity among workers. "What have I done? Did pressing the button work? Did I really accomplish the task?" Computer mediation makes the task tentative and often workers will add more layers of complexity in order to resolve the first. The need to understand theoretically the process is further required as the complexity of the system increases and "you have to know more in order to do more." Complexity means that work will depend more and more upon thinking than physical activity and know how. Although informating enhances the workers' intellective skills, it comes with complex implications and need to continuously making sense of abstract cues.

Warren Weaver (1948) had prognosticated some 60 years ago that despite developments in the natural sciences, computers and his own theory of information, we have yet to solve the most perplexing scientific problems. He divides the problems in science into three categories. The first are problems of simplicity that involve several variables. These problems are programmed and both the natural and biological sciences have addressed them quite satisfactorily. The second are problems of disorganized complexity that involve hundreds or more variables which are addressed by statistical methods, probabilities and averages. To Weaver, it is the third category of organized complexity that are most significant to life and society, which involves a sizable number of variables but not too large so as to be amenable to statistical analysis. What distinguishes these kinds of problems are how the factors are interrelated into an organized whole, and as a result becomes extremely complex. Social issues and specifically socio-technical problems fall into this category. And with the advent and proliferation of computers and information as factors that enact and create this category of problems, a study of informatization offers the potential towards addressing this phenomenon of organized complexity.

# 4 Systematizing

The activity of informatizing naturally takes place within a system; consequently, the implications from informatizing that come with being in a system are significant. Ever since Bertalanffy (1968; 1972) articulated what a system was and others (Boulding, 1956) built on his concept of the system, the bare skeleton of systems theory has slowly grown albeit at a limited rate. Many have successfully applied the principles of systems theory in organization theory (Daft and Weick, 1984; Morgan, 1986; Weick, 1995) and this study extends that work into IS using the lens of practice. Systematizing can be defined as the set of practices that are directly related to the system such as breaking down a system (analysing), building a system (synthesizing) and organizing the system (sensemaking). These set of practices can be distinguished from the set of practices related to informatizing. Whereas informatizing handles information, systematizing acts on the system.

## 4.1 Systematizing as Analysing/Synthesizing

The basic notion of any system is that it is made up of components that are interrelated into an organized whole. Thus, the first step of any scientific efforts is to analyse or break down the whole system into its individual parts. Such efforts have been the foundations of all sciences beginning with the physical and biological sciences. The next step is in understanding how the components relate to and impact each other. The staple of most natural and social sciences, and especially positivist type research has been to build such frameworks of cause and effect. Within the social sciences, the social system becomes an additional variable to the already increasing number of variables in the environment that needed to be analysed. As Gareth Morgan (1986) describes organizations, they are "many things at once". Much research in this area adopts mechanistic and organismic metaphors of organization in order to understand how they work. Mechanistic models of socio-technical systems usually end up with the "one best way" of accomplishing their tasks or search for "optimal" solutions. This time tested scientific approach of breaking down (analysing) and figuring out how they relate (synthesizing) served the modern sciences well. Early IS research that study decision support and group decision-making falls into these categories of studies that view the human user as a social or psychological variable.

## 4.2 Systematizing as Sensemaking

The limitations of merely analysing and synthesizing become apparent especially in the social sciences. Human intentions, volition and its multifaceted variables make understanding the individual components and finding their relations extremely difficult. As Sir Geoffrey Vickers (1983) wrote, *Human Systems are Different*. Human systems are open, learning systems that are able to generate and reset their own system settings. Human beings make use of signs and symbols and create meaning from them based on ethical criteria unlike natural systems. This semiotic nature of information processing differs greatly from Shannon and Weaver's (1949) mathematical theory of communication and information processing that were applied by early IS research. Several versions of this semiotic approach towards doing IS are available. Weick (1979; 1995; 2005) defines sensemaking as a significant process of organizing where people extract cues and make plausible sense retrospectively, while extracting order into on-going, often vague circumstances. A major part of constructing an IS involves making sense of the situation, and information becomes the raw material for the knowledge that people have in order to turn sensemaking into action. As many IS scholars repeatedly state (Lee, 1999; Mingers and Willcocks, 2014), IS is the intertwining of both worlds, the social and the technical, and several threads of research are active in this genre. Major theories in IS, such as the Media Richness Theory, make use of sensemaking as its foundation. Several studies in IS have applied semiotics and sensemaking including for studies of instrumentation and the human–computer interface (HCI), the development of information systems having regard to both their technical and human aspects (Stamper, 2000) to studies of IS within their organizational context.

Thus, IS scholars began formulating approaches that eschew viewing IS purely from the "hard" sciences. Checkland (1998; 1990) proposed the soft-systems methodology (SSM), not merely to provide a method for developing IS, but to provide a more holistic approach towards viewing IS as more than just an assemblage of hardware and software functions to be used by a human operator. A major genre of research that focus on the social element in IS is critical research which is founded on critiquing the status quo and exposing deep-seated structural contradictions that create repressive social conditions (Richardson and Robinson, 2007). All of these theories fall under the rubric of systematizing as sensemaking.

### 4.3 Systematizing as Enacting

The value of systems lies in how they construct reality as a whole that is more than the sum of their component parts. Sometimes this process is called "synergy", while others call it with other names such as "gestalt," "holism," or "autopoiesis." Each of these terms provides a different description for the same outcome that is manifested in the *enacting* of systems. All of these characteristics of systems describe how systems demonstrate novel, indeterminate and emergent phenomena. The concept of synergy goes all the way back to Aristotle as he describes how "the whole is something over and above its parts, and not just the sum of them all..." (Metaphysics, Book H, 1045:8-10). A simple example is that of an automobile that consists of some 15-20,000 parts. If all of these parts were thrown into a heap even in an orderly manner (perhaps by size), they would not constitute an automobile. Only when they are assembled in a very precise manner do they produce the "whole" that the parts alone cannot produce. The correct enactment of the system produces many emergent properties that is not limited to its internal parts.

Synergy is said to be the combination of cooperative effects by two or more elements that produce effects otherwise unattainable. In this sense, synergy is not only "more" than the sum, it produces something different. One example of these "functional complementarities" is sodium chloride that is composed of two elements toxic to humans by themselves, but, when they are combined, produces a very different, beneficial and tasty element (Corning, 2002). Organizational theorists describe these processes as the relationality of mutual constitution (Feldman and Orlikowski, 2011). Biologists propose the theory of autopoiesis (Maturana and Varela, 1980) to explain how systems "maintain themselves in this way using a network of processes of production (transformation and destruction) of components which: (i) through their interactions and transformations continuously regenerate and realize the network of processes (relations) that produced them." Autopoiesis is being applied in the social sciences to explain how social systems maintain themselves (Luhmann, 1990; Mingers, 1995). However, as Vickers (1983) noted, the way in which these social systems do so, differ from the mechanical autopoiesis of the natural systems and enactment of the system need not follow the Enlightenment model that displays optimism in materialism, and in science and technology promising unending progress.

## 5 Views of Doing Information Systems

The three dimensions within informatizing and systematizing allow us to sketch the history of IS research and its landscape based on its essential activities. This framework provides a way to characterize IS research and identify research as being IS. In other words, research that informatizes and systematizes is unequivocally IS research. If the research contains elements of other cross-disciplinary activities (e.g. valuation of information systems incorporating economics), but if the focus of the research is to informatize and systematize, then the essential activity of that research can be said to be IS. Using Nicolini's (2012) notion of the accomplishment of the practice as a way of organizing different dimensions of practices, we can order and categorize the diversity of IS research by using a hierarchical ordering of the practices in informatizing and systematizing as shown in Table 1. Thus, informating cannot take place unless automating is accomplished, at least to the extent that makes informating possible.

| Informatizing Dimensions | Systematizing Dimensions | IS Research Areas |
|---|---|---|
| Complexing | Enacting | Systemic complexity, complexity science, sociomateriality, actor-networks, emergent socio-technical phenomena |
| Informating | Sensemaking | Organizational semiotics, conceptual modelling, design science, data analytics, knowledge management, executive support systems, competitive strategy and IT, media richness, decision support systems |
| Automating | Analysing/Synthesizing | Adoption, acceptance and use, cognitive science, business process management, human computer interaction, IS success factors, e-commerce, outsourcing, supply chain management, management and decision sciences, social computing, operations research, accounting information systems |

*Table 1: Landscape of IS Research Activities*

Because informatizing and systematizing can occur independently of each other, each sub-practice of informatizing can be combined with the sub-practices of systematizing as shown in Figure 1. The combination of the sub-practices represents a view of doing information systems. The dependence of the sub-practices within informatizing and systematizing does not limit how these sub-practices occur. For example, although automating can be expected to occur with analysing and synthesizing since both represent the most basic forms of informatizing and systematizing respectively, there is no reason why automating cannot be practiced with sensemaking as long as the system has already undertaken some form of analysis beforehand. Nevertheless, the more prevalent combinations can be found by pairing each level within informatizing with its counterpart in systematizing, thereby producing the pairs of practices shown in Table 1. It is not a coincidence that historically, topics within the IS field map reasonably well with these pairs of sub-practices. Each pair of sub-practices is described in the following sections.

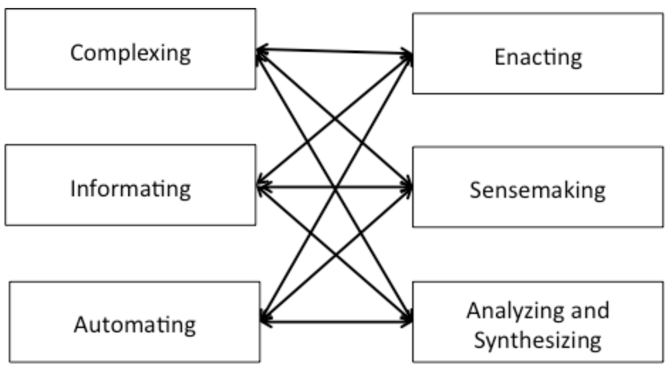


*Figure 1: Views of doing information systems*

### 5.1 Automating and Analysing/Synthesizing

The most fundamental dimension of informatizing is the practice of automating. IS rationalizes and streamlines human activity by translating information, often by digitizing it, into action. To automate the activity, tasks are broken down into its simplest elements, automated and then combined with other automated elements to systematize it. Such areas of human activities are usually represented in quantitative terms and models in order to streamline, rationalize and extract as much productivity as possible. Accounting information systems epitomize such essential activity in which organizations are compartmentalized and evaluated based on the numerical representations generated by the IS.

Operations research represents a sophisticated version of automation. The success of operations research in bolstering war efforts in the Second World War opened a new era of the use of computing in which complicated models were formulated for business methodologies, applications and other industrial uses. This area of activity later developed into modern supply chain management systems. Use of analytical models and optimizing algorithms to make better decisions characterized the activity in which IS played a major role. As a result of its success, management science and decision sciences became a major area of research in the organizational sciences and in IS. One of the main features of such practices is the never-ending search for the best way of accomplishing bigger and larger scope in automating human activities.

Another feature of this essential activity is the assumption that the human operator is one of many variables that complicate the environment. As we move up the hierarchy of the types of activity taking place with IS, the human element becomes more and more a concern, but is still regarded like other capital, financial and infrastructural resources that are being managed. A major research question that is often proposed for these kinds of studies are “What factors contribute to…” or “What success factors improve …” a specific context of IS. Hence, in TAM-related research, multiple variables concerning the perceived usefulness and ease-of-use of system impact the eventual behaviour and usage of the system, along with other variables such as self-efficacy, computer anxiety, perceptions of control of the system, facilitating conditions and performance expectancy form the cocktail of variables being research in order to optimize use and productivity.

### 5.2 Informating and Sensemaking

The first area of research in IS that took advantage of the informating power of IT was decision support systems in the 1970s and 80s. Information that was gathered was applied to make better decisions and to help organize and make sense of seemingly ambiguous situations. Later, industry practice realized that IT wasn’t limited to only transaction, data processing and even decision-making at the operational or middle management level; the new streams of information that was created provided a rich trove of insights that was even useful to top management whose main activities include making sense of the environment around them. As a result, IT was viewed as a competitive weapon not only at the operational level but also at the strategic level making way for advanced executive support systems in executive offices and boardrooms. The IS department is no longer viewed as being merely a service function. At the same time, human resources were no longer viewed as one of many physical resources, but became appreciated as a valuable knowledge resource for organizations. The marriage of informating and sensemaking gave rise to the phenomenon of knowledge management.

One particular area of research within this practice that is experiencing a renaissance as a result of the automating is data analytics, and a recent phenomenon that is taking data analytics to a new level is the Internet of Things (IoT). Embedded microchips in household appliances and devices used in everyday activities automate certain manual activities such as looking for parking or remote utility monitoring but more importantly generate new streams of information not otherwise available. These new streams of information are now making possible many novel sensemaking activities such as resolving traffic congestion and parking problems, remote monitoring patient systems that ensure patient compliance, reducing power consumptions by sensing the weather and local conditions or even reminding physically active users about their body's level of hydration and prompt them to drink more water when required.

### 5.3 Complexing and Enacting

IS researchers are noticing that socio-technical phenomena tend to be dynamic, distributed, mobile, transient and unprecedented (Feldman and Orlikowski, 2011). These kinds of novel, indeterminate and emergent phenomena, which are the result of complexing and enacting, are not on the same level of informating and sensemaking. The explosion of growth of the Internet, ubiquity of mobile and pervasive computing, and the proliferation of various networks with porous boundaries make existing approaches towards studying IS increasingly inadequate. Today, critical systems such as the electrical grid, air traffic control systems, financial transactions and banking systems are dependent on a global electronic network that is becoming more and more complex. It is becoming increasingly difficult to isolate cause of failure, security holes, or vulnerabilities when causal links within the network are non-linear or indirect. In September 2011, when a maintenance worker missed one of several maintenance steps at a substation on the West coat of the United State, that small mistake caused 5 million people in California, Arizona and New Mexico to lose power (Associated Press, 2011). Eight years earlier, 50 million people in the North eastern coast of the US lost power because some trees in Ohio weren't trimmed (Wald, 2013). Such instances of rather small events resulting in larger more pervasive emergent events are typical of complex systems. High frequency automated trading accounts for over 70% of the financial trading market (Parker, 2014). Such high frequency trading practices are enacting financial markets of unprecedented size and at the same time, unprecedented vulnerabilities. Both human and non-human agents are at play in this complex financial network. A new paradigm that views these systems as complexing and enacting provides the analytical tools and capabilities to address such dynamic, unpredictable, indeterminate and emergent phenomena.

### 5.4 Discussion on alternative views of IS practices

The three levels of practices in IS depicted in Table 1 are not meant to be exhaustive or meant to imply that IS operates only at those levels. However, they do provide an alternative practice-based view of what experts in IS do, instead of viewing IS in terms of philosophical paradigms such as positivism, interpretivism or others. Although all practice is based on some kind of philosophy, practice theory itself is philosophically neutral and places focus less on beliefs and worldviews, and more on individual and social actions, relations between those actions, culture, and the dynamics that arise. For example, it is difficult to situate the practice of Checkland's (1990) soft systems methodology (SSM) within any particular philosophical approach. It certainly applies "objective" measures of system performance and productivity, but at the same time assumes a social constructivist stance with regard to how systems are built and focuses also on the users' interpretation of the system goals, political aims and "hard" and "soft" properties of the system environment. What SSM does as a practice is to informatize and systematize, in particular, by way of complexing, sensemaking and enacting. In the practice of complexing, SSM's goal is to address unstructured and poorly defined problems, stemming especially from computerization. IS experts who go about applying SSM build a "rich picture" of the problem situation, literally drawing "messy" pictures using images and symbols to represent the different stakeholders, entities, relationships, tensions, generalized patterns while resisting any temptation to propose solutions—an act of sensemaking. With regard to the practice of enacting, SSM embraces holism, and how separate parts interact to produce emergent properties or behaviour that cannot be predicted by observing any individual component. This example of SSM demonstrates how this practice-based lens is capable of connecting the dots related to the diverse practices in IS.

Also, as depicted in Figure 1, it is possible that the practice dimension of automating takes place at the same time as sensemaking. Applying the notion that any component of the system, human or material, has agency in some form, it is very likely that in an operations research context, the human agent could be making sense of what is going on without the computer gathering or providing information, that is, without informating taking place. In this case, informating overlaps with sensemaking in the human agent.

# 6 Benefits of Viewing the IS Field as Practice

Viewing disciplines from the lens of practice makes it possible for the IS field to address several of its perennial concerns. These concerns hold back the field's intellectual, social and political progress and continue to be a source of confusion for future IS academics and practitioners. This section discusses how viewing the IS field as informatizing and systematizing addresses several of these major concerns.

## 6.1 Identity Based on Practice

As a means of enhancing the field's identity and legitimacy, DeSanctis (2003) proposes viewing IS as action rather than a domain of research. And because research is essentially a social process taking place in journals, conferences and academic circles, a focus on the social dynamics of the research community supports extending the boundaries of research beyond the IT artefact. Hirschheim and Klein (2008) strengthens DeSanctis' argument for the community of practice by adding an ontological dimension to the nature of this community, it taking the shape of not a single community of practice but several interacting communities of practice, each subscribing to different world views, values, research methods, legitimacy criteria and different mission for the IS field. But as Hirschheim and Klein (2008) note, the view of the IS field as a loose federation of communities of practice does come with dangers of fragmentation and the inability to marshal a critical mass intellectually and socially. This study provides a way of strengthening DeSanctis' (2003) and Hirschheim and Klein's (2008) view of IS as a community or communities of practice by focusing and elaborating on the nature of that practice in terms of informatizing and systematizing.

This "essential activity" which is inextricably tied to the essence of that discipline (its disciplinary subject matter) offers the members of the IS community a way of recognizing who they are professionally and what role they play in the universe of inquiry. The nature of IS as performing the activities of informatizing and systematizing provides the necessary model of where other disciplines end and where IS begins and vice versa without restricting the field from expanding its boundaries, interacting and closely collaborating with other disciplines. As a human science, the IS field does not only informatize and systematize its vast collections of and varied objects of study, it is capable of informatizing and systematizing other fields of study.

## 6.2 Theorizing the IT Artefact

Another perennial concern that is still unresolved is the black boxing of the IT artefact in IS research (Akhlaghpour et al., 2013). Despite the importance of IT as a core concern in the IS field and the major implications it holds for the IS phenomena, IS research itself ignores the artefact and its characteristics (Orlikowski and Iacono, 2001). Viewing IS research as informatizing and systematizing provides a foundation for theorizing the IT artefact at different levels of practice. The IT artefact can be described and evaluated based on the levels of automating, informating or complexing that it performs. Similarly, the system in which the IT artefact is embedded or the artefact itself can be characterized based its systematizing activities. IT artefacts can be said to analyse or synthesize its inputs; or alternatively, IT artefacts can be categorized by its sensemaking activities, or its enacting capabilities. The combination of the six dimensions provide at least a 3x3 topology of different IT applications, with each cell in the topology demonstrating different levels of activity for each dimension. The difference between this practice-based topology and traditional topologies of IS applications, for example, the Gorry and Scott-Morton (1971) topology, lies in its ability to cut across fixed structured/unstructured decision-making hierarchy inherent in such frameworks. Certain applications, such as social media and data analytics applications do not fit well into the structured/unstructured decision-making framework these models offer since they operate at the transaction processing level of the organization but are capable of providing strategic intelligence.

### 6.3 A Return to Information and Systems—The Two Core Concepts of the IS Field

The IS field has expanded into so many diverse areas of research that arguably, it has not only begun to neglect the concern for the IT "systems" component of the IS phenomena, it has also neglected the concern for "information" (Lee, 2010). The IT artefact is just one of the many elements of the "systems" component in IS. A focus on the activities of "informatizing" and "systematizing" brings the IS field's focus back to its core concepts. Ever before Daniel Bell (1973) heralded the coming of the post-industrial information revolution, different disciplines had already appropriated their own conception of information, from the very technical, including Shannon and Weaver's (1948) mathematical theory of information, to Bateson's (1972) social and anthropological theory of information. Where the theory of information lies within IS is vague at best (McKinney and Yoos, 2010) and because it is poorly understood as a concept, it provides little guidance for research. The same can be said about "systems" despite its defining label in the field. Although the traditions behind systems theory is extremely rich and varied (Mingers, 2006), what has come out of systems thinking has only begun to show fruit. Social systems theories are still divorced in many ways from computer systems theories. Several genres of research including critical realism (Mingers et al., 2013) and sociomateriality (Orlikowski and Scott, 2008) are competing for attention (Mutch, 2013). A focus on the practice of systematization opens up new possibilities for theorizing in this space.

## 7 Conclusion

This study began by highlighting today's complex, dynamic and unprecedented crises and conflicts that are transforming the human experience, all enabled by a combination of human and technological agencies. The IS field, which inherently studies socio-technical phenomena, is well positioned to investigate and address these issues. By viewing the IS field as a practice and culture, we are able to unpack how everyday IS-related activities construct and reconstruct the social orders within those complex socio-technical phenomena, and begin addressing those crises and conflicts. Beginning with the invention of the programmable computer, this new kind of intellectual technology is transforming work and daily life through the essential activities of *informatizing* and *systematizing*. The vast majority of research in IS can be characterized as investigating the practices of automating, analysing and synthesizing at its most fundamental level of practice. At a higher level of complexity in practice, more IS research are focusing on the *informating* of work, and better sensemaking and organizing of complex and ambiguous situations. At an even higher level of practice, where there is arguably less IS research, are studies that focus on the enactment of complex networks and structures creating novel, unpredictable, and emergent phenomena.

The kinds of socio-technical phenomena that are occurring, as computers become more and more a part of daily activities, elude efforts of traditional disciplines to explain, describe, understand and predict. With its focus on dynamics, relations and enactment, the practice lens is well suited to study unprecedented, indeterminate, dynamic and emergent phenomena (Feldman and Orlikowski, 2011). These kinds of phenomena are not deducible by examining the micro-level parts on their own; instead they emerge in their full richness as a result of the synergy that comes from enactment of systems. At the same time, the emergent phenomena do not appear as pre-given wholes, but arise as the complex system evolves over time (Goldstein, 1999). The tangling of human and material agency makes these socio-technical systems even more indeterminate, and more difficult to study (Pickering, 1995). Viewing these socio-technical phenomena as informatizing and systematizing provides two powerful tools that directly address both its informational constitution and its systemic characteristics.

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