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WHY DO FIRMS HAVE INFORMATION SYSTEMS?

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Abstract

In this essay, it is suggested that a multi-level interaction perspective offers insight in answering the fundamental question, “Why do firms have IS?” The role of human-computer interaction (HCI) in firms is recast in this context and seen to be basic to the modern firm’s interactions more broadly, with implications for firm capabilities and organizational learning.

Keywords: IS foundations, interaction perspective, human-computer interaction (HCI), machine agency

Introduction

Why do firms have information systems (IS)? In this paper, I ask this seemingly innocuous question to explore some foundations for IS study and practice in a business context. Over the last half century or so, with the rise of digital computing, modern IS of various kinds have emerged and become ubiquitous among firms. But both theorists and practitioners still struggle to describe and explain what has been and is still being accomplished with this transformation. A broad understanding and appreciation of IS beyond those immediately committed to it in their work seemingly remains to be achieved. Here I seek to make a small contribution toward this understanding.¹

To begin then to address our question, let’s consider a familiar everyday phenomenon, where downtown shoppers routinely approach and engage a bank’s automated teller machines (ATMs), often simply to withdraw needed cash from their accounts. These shoppers will give little or no thought to *how* these ATMs work, much like human tellers would work, in interaction with them, asking for identification and responding to their straightforward requests. Of course, upon reflection, these ATMs, like human tellers, can work only because they have access to the bank’s online systems, where information about customers and their accounts resides. Too, for the customer’s convenience, ATMs, unlike their human counterparts, have this access 24x7. So, a first answer to our question, and a good one insofar as it goes, is that *firms have IS so that they can readily do business with their customers.*²

More broadly, consider that in doing all manner of business, such as that just illustrated, firms basically need to know where they are in whatever they do. They need to know, one way or the other: (1) what business they have

¹ My purposes here are thus primarily expository. This is the first in a planned series of short essays addressing foundations for IS study and practice. In the interest of increasing readability, references are confined to footnotes. This present version has benefited from a talk given at the Bauer School of Business, University of Houston, as well as from the comments of the AMCIS 2007 reviewers.

² Alter (2002) defines an information system as a “work system that uses information technology to capture, transmit, store, retrieve, manipulate, or display information” in support of the business processes that create value for internal or external customers, a definition that itself suggests much the same answer to the question posed.

already done; (2) what business they are now doing; and (3) what business they should do next. With its ATMs, the bank needs to know, for instance, who now requests what, and whether to meet the request, in the light of past actions. More generally, I argue in this essay that the firm's "need to know" relative to its own *actions*, past, present, and future, fuels its development of IS that become natural to the business, in the sense that they become an inseparable part of the business, as with the IS that support a bank's ATMs. The firm's compelling need for information, in short, is rooted in the streams of actions it takes.

Consider too that firms need to know relative to their own actions, much like people need to know relative to theirs. Neither firms nor people act in isolation, however. Rather, both firms and people *interact* with purposeful others in their respective environments, as illustrated in the case of banks' interactions with their customers, and how well both firms and people interact has much to do with their successes and failures. While the need to know by both firms and people is thus rooted in their own actions, it is largely as these actions pertain to their interactions. This idea is one I want to explore further here.

Interaction Foundations

Firm-level actions and interactions

In the case of firms, their actions are directed most fundamentally toward interactions in the markets in which they do their business. The firm's exchanges in these markets are marked by binding *transactions* between parties. Hence the firm's need-to-know centers first of all on its business transactions with its customers, and then too, with its suppliers in what is termed the value chain that meets customer needs.³ Viewed in microcosm, the firm undertakes a series of related actions to carry out each of its business transactions, coordinated with a similar series of related actions undertaken by its trading partner, and at any one time the firm needs to know which of these actions have been accomplished, which are underway, and which remain to be initiated. Each such business transaction commonly involves the exchange of goods or services and money or claims on money, but also information pertinent to the exchange between the parties.⁴ Much of this information eventually finds its way into the firm's accounting systems.

Elsewhere, a firm also enters into transactional relationships with its employees, with whom it contracts for ongoing work in exchange for wages and certain other "benefits." Over time, the firm's many interactions with its employees involve substantial exchanges of information. Increasingly, these interactions are mediated by a firm's online human resource (HR) systems. So, for instance, an employee might now access an online system to change the contribution made to her non-taxable savings plan, whereas formerly she would have made a request to the payroll department, or she might now access a list of open job positions posted online within the firm, whereas formerly she might have had little awareness of these opportunities.

Similarly, a firm engages in transactional relationships with its owners, who provide it with capital in exchange for shares of the firm's ongoing profits, and with financial creditors who also expect to earn from the firm's returns. These relationships are of course thoroughly grounded in information exchanged between the parties. Indeed, the financial exchanges themselves are executed in informational terms.

Finally, firms also act interact with others in their broader institutional environment, where in doing business they are subject to public acceptance and governmental oversight and regulation. Certain of a firm's actions and interactions are accordingly directed at securing this acceptance and making its other actions known as necessary to external agencies and authorities. Here again, IS are often developed to support the firm's various actions and interactions in this environment, especially where these are ongoing, as with a corporation's periodic issuance of its formal financial reports or most recently its development of controls and reports in compliance with Sarbanes-Oxley requirements.

³ The notion of the value chain and its pertinence to information systems as a source of competitive advantage for the firm is described in Porter and Millar (1985).

⁴ This gives rise to what is termed the "information value chain" which the firm may exploit to advantage, for example, through data mining of its accumulated transaction records (Glazer, 1993).

In sum, as a socially and legally recognized economic entity, a firm acts and interacts with many others in the environment in which it does business. It acts as a “whole,” but not of course in the manner of an individual person. Hardly a human organism with a central nervous system, the firm is rather a kind of social *organization*, one that must be somehow coordinated across its interacting subunits to execute the business processes that enable it to make and deliver on its commitments.⁵

Subunit-level actions and interactions

Historically, the modern firm’s task of coordinating across subunits fell largely to its management and to a hierarchical form that allowed for vertical communication within the form, while necessitating frequent lateral communication across it.⁶ Subunits were coordinated vertically through their common higher-level management or laterally through established work procedures and special means such as cross-functional teams, liaison roles, and the like. Through the first half of the 20th century, firms developed many varieties of this costly organizational form, which relied almost entirely on human effort to sustain it. In carrying out the firm’s tasks, much of this effort was devoted to paperwork originated and shared among interacting parties, often to serve the business customer, as in filling a customer order.⁷

With the rise of modern IT in the latter half of the 20th century, however, and with the emergence of easily accessible online systems, in particular, the firm’s internal as well as external interactions have been gradually, but fundamentally, transformed. Today, a substantial amount of the information processing needed to coordinate the firm is typically automated. Still lacking a coordinative central nervous system, the firm now develops computer-based systems to assume an analogous role, flexibly supporting both centralization and decentralization, and thereby both traditional and radically new organizational forms.⁸

Most significantly, with the rise of computing and new reliance on IS, certain of the firm’s systems have themselves become interactive “machine agents” in the coordinative process. They are now interactive machine agents, just as its employees are interactive human agents, in the sense that their actions, in their interactions, are undertaken on behalf of the firm and can formally commit the firm in its marketplace transactions and relationships with external others.⁹ The result, I argue, has been the gradual and still not widely understood emergence of a third fundamental level of action and interaction.

System-level actions and interactions

To grasp what has happened in firms, consider what is commonly now seen when one walks about an office complex. One observes many instances of individuals at their desks working with their desktop or notebook PCs, often tackling their email, or seeking information from the Web, but in many cases accessing online systems, often by means of the firm’s intranet. One sees much of what is termed “human-computer interaction” (HCI), where the individual engages the online system to accomplish in tandem with the system and others what is often a coordinated task. The individual collaborates electronically with others in preparing a report, completes an assigned project task, undertakes online training, arranges a face-to-face meeting, orders supplies, or engages in any number

⁵ Morgan (1986) provides a number of alternative “images” of organizations, including that of the organism, and discusses the strengths and limitations of each. A problem with the organism metaphor is the assumption of functional unity. “If we look at organisms in the natural world we find they are characterized by a functional interdependence where every element of the system under normal circumstances works for all the other elements.” (p. 75) This is hardly true of organizations, whose elements may also pursue their own purposes.

⁶ Chandler (1977) describes the emergence in the late 19th century of the modern firm and its hierarchical form. Galbraith (1973) takes an information processing view to describe design strategies for enabling the firm to coordinate its activities within and across the hierarchy. The firm’s management plays a fundamental information processing role in this regard, as do the firm’s information systems.

⁷ The classic paperwork vehicle was the multi-part carbon paper form, filled out manually or by typewriter, with its parts then distributed and filed for reference among organizational subunits whose actions needed to be coordinated in carrying out the business action.

⁸ For background and analysis, see Malone, Yates, and Benjamin (1987), Gurbaxani and Whang (1991), and Malone (2004).

⁹ I acknowledge that the difference between human and machine agency is a profound one; the former is understood to bring a certain self-conscious or motivated choice to situations that has no equivalent in the latter. See, for instance, human agency in structuration theory as developed by Giddens (1984).

of other everyday tasks mediated by online systems. While we might still observe substantial human interaction in the office complex, we are now likely to see HCI in just as much or even greater amounts, reflecting the rise of machine agency in the firm.¹⁰

Significantly, the new machine-based systems do not typically represent the interests of single organizational subunits. Rather, they often represent the interests of an “end-to-end” *business process*, such as customer order fulfillment, that cuts across organizational subunits. They thus form another means with which the firm divides and coordinates certain of its labor, however departmentalized. Too, because the firm’s systems typically pass data among themselves, or share a common data base, they must themselves be coordinated or even integrated, much as traditional subunits have had to be coordinated in the firm’s interests. It is in this sense that they come to serve as part of the firm’s “central nervous system.”

A Multi-level Interaction Perspective

As should now be apparent, I am arguing that in understanding why a firm has IS, one should focus on the multi-level actions and interactions that both constitute and enable the firm to do its business. We identify these as follows:

1. The firm’s *firm-level actions and interactions* in doing business with external others, and in securing a favorable business environment
2. The firm’s internal *subunit-level actions and interactions* that coordinate the business across its subunits
3. The firm’s *system-level actions and interactions* among various human agents and machine systems, that serve the above levels of actions and interactions

Consider that while the first two levels characterize the firm’s need for IS, the third level characterizes the way in which IS themselves function to meet this need. What is arguably interesting in this formulation is the pervasive role of action and interaction across all three levels. In addressing the question, “why do firms have information systems,” one arrives at the insight that action and interaction lie at the core of an explanation that goes beyond the simple answer, “so that they can readily do business with their customers.”

With regard to the firm’s need for IS, while some may view IS a mere complement to action, invoked as needed, I claim the contrary, that IS are integral to the modern firm’s many day-to-day actions, which could not be carried out without them. While IS can obviously serve other roles, their primary role in firms is indisputably to serve the firm’s basic actions and interactions, both at the firm level and at the coordinative subunit-level or its equivalent.

IS function in this role at the level of individual and system-level actions, where human and machine agency work together for the firm. In the case of the firms’ machine systems, except where they are observed in interaction with their human users, they carry out their work largely behind the scene, in interaction with each other and with the machine systems of other firms. Significantly, in all their interactions, their application software incorporates the firm’s “business rules” and their data instantiate the firm’s actual practice. In this regard, the firm’s machine systems tend to be more “knowledgeable” than any of their individual users. As a consequence, to the extent they are working properly, the firm’s machine systems tend to be authoritative in their agency and interactions with their various human users.¹¹

By way of summary, what might be termed an “IS Interaction Model” which brings together the basic elements of our argument is shown in the Illustration below. Here the firm-level interactions between a firm and its customers and suppliers are shown by the double-head arrows. The system-level interactions are suggested by the curved lines linking the systems, as well as the spokes linking the systems to their users. The subunit-level

¹⁰ What goes entirely unseen is the machine interaction within the network(s) that support the observable HCI. Here too machine agency may be at work, as with interorganizational systems that automate portions of transactions between business partners.

¹¹ The qualification, “to the extent they are working properly,” is of course loaded with significance for IS practice. It may be said to constitute a perpetual challenge, one which if not met, can cripple the firm. The term “mission critical systems” invokes this crucial reality for the firm.

interactions are implicit and reflected in the two internal systems with different user groups. Note that in this particular illustration, a user can access another firm's system only through his or her own firm's system, to ensure integrity of the interaction between the firms.¹²

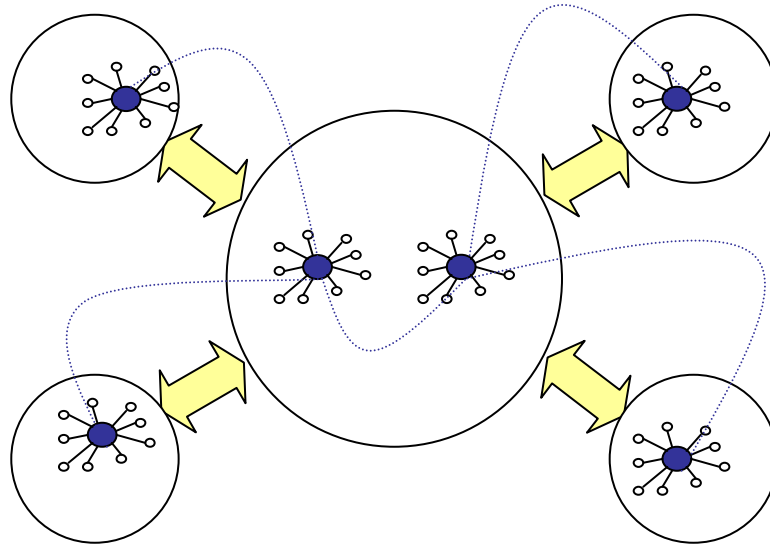


Illustration. IS Interaction Model. Here a firm interacts with two suppliers (to the left) and two business customers (to the right) as shown by the double-headed arrows. It coordinates its interactions with two internally linked systems, one linked also to the suppliers and one linked also to the customers. Users within and across the firms are linked to each other according to the system access they are given. System-level interactions are suggested by the curved lines linking the systems, as well as the spokes linking the systems to their users.

Discussion

What are the implications of our argument for IS study and practice? Let's consider first the popular issue of whether IS are of strategic importance to the firm. Increasingly, some have argued, a firm's IS are characterized by commoditization, e.g. as with the use of popular off-the-shelf enterprise software, that offers no competitive advantage, which comes only from possessing distinctive and superior capabilities.¹³ However, note from our argument that such capabilities must be manifest in the form of firm and subunit level interactions, achieved

¹² This is more an articulation of a design principle than a description of how many systems currently work in practice. For simplicity, the illustration also ignores the many unmediated person-to-person communications likely to be needed among system users. It further assumes that users can access only a single system. In practice, the firm is likely to be internally coordinated through dozens of interrelated, not always integrated, systems and individual users are likely to have varied levels of access to several of them.

¹³ See, in particular, Carr (2003), who in a widely read and controversial article points to commoditization to discredit the strategic import of IT. Porter (1985, 1996) provides authoritative expositions on strategy.

substantially through individual and system level interactions, rather than in acquired stocks of software or human “knowledge” as such. The latter must always be put to work in organizational context to display their “capabilities” and therein lays the rub. No two firms however similar with the identical enterprise software can be expected to manifest the same capabilities, which of course must be organizationally *learned*.¹⁴ Even with the same enterprise software, different firms will have different learning capacities and display different capabilities in their interactions with customers and suppliers, and in their own internal coordination among subunits. Even with the same enterprise software, different firms will further manifest very different individual and system-level interactions in carrying out their business processes. As a consequence, the strategic capabilities achievable with IS simply can’t be reduced to the question of whether the firm’s IT, such as its enterprise software, is proprietary or widely available as a commodity.¹⁵

As a second implication, a reframed role for human-computer interaction (HCI) studies in IS is suggested, one which goes well beyond traditional studies of human factors and designs for usability, and provides a clear organizational rationale for more contemporary studies of collaborative work, for example, that focused on the use of workflow or other groupware, or even the collective use of enterprise software. Somewhat surprisingly, notwithstanding recent work, we note that even in management oriented HCI studies, the primary research focus remains on the individual interaction, with the organization largely relegated to context.¹⁶ As viewed here, however, HCI provides an essential foundation for addressing larger issues, such as organizational learning and the assimilation of new technology, as just discussed. Consider that any individual interaction in our broader framework represents but one link in what is essentially an organizational network, within which individual interactions must often be coordinated. Where coordination is overlooked, HCI studies can in effect be blinkered from organizational insights. Thus, consistent with those who have argued for the importance of coordination theory more broadly, I suggest that HCI studies that focus in particular on the coordination of business processes offer special promise for addressing the larger issues.¹⁷ More broadly, in attending to coordination problems, HCI studies *in situ* might be motivated and positioned in terms of the insights they can yield in enabling a firm to use IS to organizationally learn, acquire capabilities, and better do its business.¹⁸

As a third implication, consider that our three-level interaction framework suggests a practical approach to IS evaluation. Any particular IS may be evaluated first as to the extent to which it supports firm-level actions and interactions, secondly as to the extent to which it supports subunit-level interactions, and thirdly, in terms of its constituent individual and system-level interactions, and, in particular, the effectiveness of its HCI. One can easily imagine a three-tiered scoring system for periodically evaluating all of the firm’s enterprise systems.

We have thus not only suggested an answer as to why firms have information systems, but through our analysis we have suggested too how firms may go about evaluating how well they are served by these systems. More broadly, we have seen, in particular, that an interaction perspective can shed fresh light on questions fundamental to IS study and practice. It remains to build more significantly upon this basic notion, which is merely introduced here.

¹⁴ Nelson and Winter (1982) in a classic exposition introduce the notion of organizational capabilities and discuss how they must be learned. Such capabilities are more than just the sum of the skills acquired by the organization’s individual members. Significantly, individual skills must be learned so as to be effectively coordinated within broader organizational routines.

¹⁵ It should be noted that strategic capabilities may be achieved purposefully via an articulated strategy, or “accidentally” via other pursuits, by stumbling upon a new way to improve operational effectiveness that proves to be strategic after the fact, for instance. Porter (1996) nevertheless contrasts strategic positioning with profitability achieved through operational effectiveness.

¹⁶ Zhang and Li (2005) provide a substantial review and assessment. Many management oriented HCI studies address individual IT use in the workplace, and focus on cognitive beliefs and attitudes and how they influence behavior. The popularity of these studies may reflect the relative ease with which they may be accomplished, with organizational variables serving only as controls. Surprisingly, individual learning is a relatively minor theme across more than 300 studies, addressed in only some 10% of the cases.

¹⁷ Malone and Crowston (1994) introduce coordination theory. Malone (2004) includes other useful references. As but one illustration of promising new approaches, Moran, Cozzi, and Farrell (2005) describe an innovative way to coordinate business activities that seeks to mesh formal business processes with informal human collaboration.

¹⁸ Swanson (2004) suggests that new systems must over time be organizationally assimilated through collective learning processes that combine ongoing actions with interpretation. Yamauchi and Swanson (2007) describe how workers learn on the job to use a firm’s new CRM (Customer Relationship Management) system, finding that workers do not experience HCI in isolation, but rather in close interactive relationship to each other. Successful use of the CRM hinges on these relationships.

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