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Deconstructing information packages

Organizational and behavioural implications of ERP systems

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Abstract Argues that the organizational involvement of large scale information technology packages, such as those known as enterprise resource planning (ERP), has important implications that go far beyond the acknowledged effects of keeping the organizational operations accountable and integrated across functions and production sites. Claims that ERP packages are predicated on an understanding of human agency as a procedural affair and of organizations as an extended series of functional or cross-functional transactions. Accordingly, the massive introduction of ERP packages to organizations is bound to have serious implications that precisely recount the procedural forms by which such packages instrument organizational operations and fashion organizational roles. The conception of human agency and organizational operations in procedural terms may seem reasonable yet it recounts a very specific and, in a sense, limited understanding of humans and organizations. The distinctive status of framing human agency and organizations in procedural terms becomes evident in its juxtaposition with other forms of human action like improvisation, exploration or playing. These latter forms of human involvement stand out against the serial fragmentation underlying procedural action. They imply acting on the world on loose premises that trade off a variety of forms of knowledge and courses of action in attempts to explore and discover alternative ways of coping with reality.

Introduction

During the last decade or so there has been an impressive diffusion of large-scale integrative information packages in organizations. The comprehensive character of these packages and the issues their diffusion raises suggest that they presumably mark a distinctive stage in the history of computer-based information technology's involvement in organizations. There is a seemingly urgent and perhaps steadily accelerating quest for bringing some sort of uniformity to the disparate ecology of applications, operating systems and information management techniques that are commonly re-encountered across organizations. Interoperability of applications, smooth file sharing, computer-based cooperative work and communication across institutional and geographical boundaries are everyday demands in contemporary organizations. Most significantly, the integration of organizational operations in ways that address their functional interdependencies in real time is increasingly becoming



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a crucial yet recalcitrant issue for many organizations (Ciborra *et al.*, 2000; Fleck, 1994; Markus *et al.*, 2000a, b).

Large-scale information packages respond precisely to this quest for achieving some sort of integration across functions, departments and task modules. Enterprise resource planning (ERP) systems present a common and widespread manifestation of these developments. Systems of this sort are believed to help organizations overcome the fragmentation of domain-limited management information systems through the construction of a relatively unified, organizational-wide software platform. ERP systems exhibit a modular architecture that by and large coincides with the conventional functional segmentation of organizations (Kumar and Van Hillegersberg, 2000). However, the standardization of information requirements and information processing permits inter-modular transference of data and the tying of operations across modules (i.e. cross-functional processes). In this respect, ERP systems can be used as an administrative framework for planning, conducting and monitoring a large array of functionally segmented operations in ways that both accommodate, in real time, the intrinsic cross-functional interdependencies underlying these operations, and enable their posterior retracing and control.

In this paper I seek to lay open a set of implicit yet crucial organizational and behavioural premises onto which large-scale information packages such as ERP systems are built. More specifically, I focus on the impact ERP packages may have in promoting a procedural vision of organization and human agency in work settings. ERP packages represent a powerful means for segmenting, organizing and carrying out work in organizations. They establish distinctions and work items throughout the organization, connect them within and across functions, bring about standardization in input and output data and set up elaborate procedures to be followed with respect to the execution of organizational tasks.

ERP packages are particularly germane in influencing human agency at work. A distinctive characteristic of information systems of this sort is the reconstruction of the very micro-ecology of organizational tasks to which any single transaction belongs. In the world ERP systems help bring about there are no isolated acts. Any single organizational transaction impinges on one or other aspect of organizational life and its effects must thus be accounted for. Transactional interdependencies are thus carefully defined or recorded and their execution becomes accordingly codified. By recording and interlinking organizational transactions, ERP packages provide the information infrastructure that enables the sharpening awareness of the effects which one's actions may have on others and indirectly on oneself. ERP packages bring thus the dream of a wide organizational transparency/visibility (Zuboff, 1988) a step further into its technological perfection. Any organizational change from the most minute (e.g. goods movement in the warehouse) to the most encompassing (e.g. production rescheduling) are recorded and their

organizational impact on others are captured through interface connections to other modules or sub-modules (Fleck, 1994). Furthermore, ERP packages shape human agency at work by proactively stipulating the steps that have to be followed in order for a transaction to be properly executed.

For instance, vendor evaluation in the SAP/R3 "Materials management" module comprises the following criteria for evaluating suppliers: price, quality, delivery, general service and external service (Bancroft *et al.*, 1996). The information about the suppliers recorded in the database is structured along these dimensions and the system provides, in addition, information about the past performance of suppliers. This way the system stipulates the steps through which the evaluation of suppliers (a subtask within the wider task of choosing and placing an order) must take place. At the same time, the link of placing an order to "Financial accounting and controlling" modules and the "Warehouse management" sub-module help establish the awareness of the effects one's choices may have on others and the organization (Bancroft *et al.*, 1996; Ptak and Schragenheim, 2000; Soh *et al.*, 2000) It is in these respects that organizational-wide information systems move a step further in shaping human agency in organizations than traditional MIS or expert systems.

The assumption that ERP packages may be instrumental in shaping human agency in organizations may easily be dismissed as deterministic these days (Orlikowski, 2000). To enter that discussion would lead us astray, however, from the major issues this paper seeks to address (see, for example, Kallinikos, 1966, 2002; Kling, 1992). Claiming that ERP packages influence patterns of cognition, action and communication in organizations is not equivalent to saying that ERP packages unambiguously determine human behaviour in organizations. Still, ERP packages have profound effects on the structuring of work and the forms of human action they enable or constraint. In this respect the article joins a longstanding tradition in social research focusing on the relationship between technology and human behaviour in general (e.g. Mumford, 1934, 1952, 1970; Noble, 1984; Perrow, 1967, 1986; Winner, 1977, 1984) and information technology and organizational behaviour in particular (e.g. Beniger, 1986; Kling, 1996; Orlikowski *et al.*, 1996; Zuboff, 1988).

A few crucial presuppositions of the present work need to be spelled out here at the outset. In this article, ERP packages are treated as independent products capable of being analyzed in their own right, without reference to the contextual dynamics by which they are often reshaped and their functionality reconfigured. This is not an uncontroversial stance but one that has, alas, to be part of the agenda of research on ERP packages or any other information system whatsoever. Analyzing ERP packages in these terms does not by necessity discard or downplay the significance which the implementation process may have in reshaping these packages to the demands of particular organizations. Implementation, as Fleck's (1994) seminal article has successfully demonstrated, is not a procedure of unproblematic installation

but rather a complex socio-technical process of renegotiation and redevelopment. However, no matter how important, the changes brought about during the implementation phase do not exhaust the effects ERP packages have on particular settings. Many of these modifications are performed on an anterior system of solutions which any ERP package embodies and which is heavily conditioned by the historical trajectory of ERP technology in general and the organizational philosophy onto which it is predicated (Kallinikos, 2004).

Drawing on these ideas, I would like to argue that the abstract, context-free analysis of large-scale, integrative information packages is justifiable on several counts. First, contextual adaptation and reshaping of such packages cannot undo the logic and the very presuppositions on which the package is predicated. For instance, other criteria may be added by particular organizations to those which we referred to above in connection with vendor evaluation. But the evaluation is still made and justified by recourse to a number of discrete criteria, and the information which the system is capable of providing. Other forms of evaluation based, say, on loyalty or opportunism, holistic or tacit information not possible to supply through the system are thus forgone or become subordinated to the logic the system embodies (Fleck, 1994). Second, contextual adaptation is conditioned by characteristics of technology that become black-boxed and thus escape or withstand deliberate manipulation (Fleck, 1994; Kling, 1992). ERP packages in particular are solidified technologies whose complexity usually transcends the ability of particular organizations to rework the source code, reprogram or redefine the logic on which any such package is based. Third, the adequate understanding of the issues occasioned by any technology, not just ERP systems, entails the depiction of common elements that cut across specific cases. Explanation always involves the appreciation of the general in the specific (Cassirer, 1955), and the context-free analysis of particular technologies is particularly well suited to this project. To these factors one may perhaps add the complex institutional and economic relations by which ERP packages are sustained (Hanseth, 2000; Sawyer and Southwick, 2002) and which are hardly negotiable *in situ*.

Reflecting these preoccupations, I seek in this paper to approach and analyze ERP packages independently of the ways by which they may be contextually reshaped during the process of implementation. The ultimate purpose is to attempt to disclose the logic or action “philosophy” onto which these systems are predicated, and to lay open the forms of human agency, organization and work which they seem to implicate. Prior to it, however, a brief review of current research on ERP and information infrastructures is undertaken. The review suggests that the critical examination of the organizational and behavioural foundations of large-scale information systems to remain, by and large, an uncharted territory.

Relevant research

Despite the relatively recent emergence of large-scale information packages, there exists currently a rather extensive literature that identifies various problems or issues that seem to be associated with their organizational involvement. Indeed, this literature is fairly heterogeneous and comprises several strands of thought and practice.

To begin with, a technical or quasi-technical literature with strong managerial focus has sought to provide the guidelines for the successful implementation of information platforms as those exemplified by ERP packages. The major concern of this literature has been the development of methodologies, tools and techniques necessary to accomplish this goal (e.g., Bancroft *et al.*, 1996; O'Leary, 2000; Ptak and Schragenheim, 2000). While being concerned with the entire range of questions relating to the implementation of ERP packages, the technical-managerial literature cannot but address the working practices, operating procedures and the human skills necessary to deploy this technology successfully. After all, the implementation of ERP packages demands the "reengineering" of the organization. This by necessity implies new methods for designing tasks, jobs and work modules and leads to new work structures and procedures. However, these issues are framed in strictly technical terms. Despite the inevitable focus on issues of work, the behavioural assumptions underlying the implementation of ERP systems are never examined in this rather technical literature. The definition of tasks and their chaining to larger sequences or processes, the construction of roles centred around these processes, and the constitution of human agency along distinct lines that may reflect the meticulous segmentation of work and the overall architecture of packages are not given particular attention (e.g. Markus *et al.*, 2000b).

A quite distinct research agenda has been documenting various problems and issues relating to the introduction of ERP packages in organizations. Major attention has been given to factors influencing the successful implementation of ERP packages, e.g. the size of the package and the number of users concerned (Francalanci, 2001; Kumar *et al.*, 2001; Markus *et al.*, 2000b; Parr and Schanks, 2000; Scheer and Haberman, 2000), the pattern of implementation activities and its temporal effects (Sawyer and Southwick, 2002), the significance of organizational and national cultures (Krumbholz *et al.*, 2000; Soh *et al.*, 2000) and learning (Fleck, 1994; Parr and Schanks, 2000), and the patterns of knowledge transfer from the supplier to the host organization (Lee and Lee, 2000; Parr and Schanks, 2000). Other studies have investigated the significance of the designing methodologies, as these are reflected in the overall architecture of the package and the flexibility this last provides for rapid environmental adaptation (Fan *et al.*, 2000; Sprott, 2000). There are, in many of these studies, occasional comments on the effects of long driven standardization brought about by ERP technology and the restructuring of

organizational tasks along the lines suggested by “reengineering” (see, for example, Kumar and Van Hillegersberg, 2000). A few studies focus on specific behavioural aspects, i.e. the relationship between national and organizational culture and ERP implementation and use (Krumbholz *et al.*, 2000; Soh *et al.*, 2000), the temporal effects on work and organizational patterns associated with ERP implementation (Sawyer and Southwick, 2002) or the influence ERP systems may have on organizational structures and processes (Markus *et al.*, 2000a; Soh *et al.*, 2000). And yet, the detailed investigation of the constitutive effects, which ERP packages have on work, human agency and organizational action does not receive systematic attention.

It is impossible to do justice to such a wide and heterogeneous literature. But it would not be unfair to say that, with a few exceptions (e.g. Fleck, 1994; Sawyer and Southwick, 2002), the overwhelming majority of the mentioned studies exhibit an unambiguous prescriptive orientation. They are by and large concerned with depicting the factors that may inhibit the successful implementation of ERP systems and developing guidelines for selecting, implementing successfully and managing such systems. Wider issues relating to the nature of work and its transformations as well as the structural templates by which work has been historically accommodated and which ERP systems impinge on (Engestrom and Middleton, 1996; Kling, 1996; Lamb and Kling, 2003; Zuboff, 1988) have been bypassed or ignored by this rather restrictive managerial literature.

A different set of preoccupations is reflected in the work of Ciborra and his associates (see, for example, Ciborra *et al.*, 2000; Ciborra and Hanseth, 1998). Drawing on a limited number of intensive case studies, Ciborra and his associates have shown large information packages of infrastructures, as they call them, to be only partly subject to deliberate manipulation and planning. A complex tangle of technological interdependencies (some technologies or components fit only with certain others) combines with the needs for standards across various component technologies to limit discretion and the space of choices. Furthermore, the technological, organizational and social embeddedness of the various components of technology (each component is embedded in a complex network of other technologies, commercial interests and social practices external to the organization) join the other constraints to make technology a recalcitrant ally. All these factors together tend to produce unexpected outcomes. Solution of problems in one domain may export them in other domains or recreate them at an even more comprehensive level. Often, the accumulation of side effects drifts the implementation of large scale information packages along directions that were never imagined at the very moment of their inception into organizations. Integration is subject to double-bind effects. It both enables and undermines purposeful action. Similar observations have been delivered by Fleck (1994) in one of the earliest implementation studies of large scale information packages.

The studies mentioned so far represent but a sample of the contemporary literature that has been occasioned by the growing organizational involvement of large-scale integrative packages. However, the review is indicative of the very questions that have received the overwhelming attention so far. The review also shows that the implementation of ERP packages and the integration (or the limits to which integration is subject) of organizational operations have largely defined the agenda of questions relating to the introduction of these packages into organizations. The reconstitution of organizational functions, work duties and process along lines that reflect the overall philosophy and architecture of integrative packages have only been mentioned in passing. Accordingly, their implications for modes of human agency and work have largely been overlooked.

On the basis of a broader historical evaluation of technology (e.g. Beniger, 1986; Mumford, 1934, 1970; Noble, 1984; Perrow, 1967; Winner, 1977, 1993), it is possible to conjecture that the organizational involvement of integrative packages accomplishes much more than the sheer coordination of organizational operations. It too reconfigures the design and execution of organizational tasks, shapes the work environment of employees, and impinges on their behaviour (Kling, 1996; Zuboff, 1988). As already suggested, large-scale technologies of integration segment organizational tasks in specific ways, they combine them into sequences, often extended across functions and task modules. They do so in terms that cannot help but reflect a number of assumptions concerning human involvement in organizations. Brought into particular settings, such packages cannot but influence process and structural templates of organizations, and the forms by which human agents come to relate to the object of their work and to one another. On the one hand, the information items, sequences and procedures that underlie large-scale integrative packages structure and direct attention. On the other hand, they shape modes of communication, interaction and work. ERP systems in particular promote a very specific vision of what an organization is. Such a vision is most clearly reflected in the conception of organizations as an extended series of procedural transactions. In this process they construe work, human intervention and agency in very specific ways that need to be brought under scrutiny.

Organizational premises of ERP systems

As already noted, ERP packages address issues of organizational integration across functions and locations. Organized in function modules that draw on common databases, ERP packages establish inter-modular connections that recapture the cross-functional interdependencies of organizational operations. At the same time, the modular architecture of the package allows for functional autonomy and flexibility that address the specific requirements of each function. Gauged in sheer technical terms of information processing, the overall architecture of ERP systems introduces significant innovations. However,

placed in the wider context of the variety of organizational practices and the structural blueprints that have been known to accommodate organizations (Ciborra, 1996; Hedlund, 1986; Mintzberg, 1979; Nonaka, 1994), ERP technology definitely appears less innovative. Let me explain this claim.

The organizational blueprint onto which ERP technology is predicated seems to recount a rather traditional understanding of organizations. Indeed, organizations are conceived as systems being composed of major groups of activities that, by and large, coincide with the conventional functional segmentation of organizations, i.e. production, marketing, product development, purchasing and warehousing, human resource management, finance and accounting (see, for example, Mintzberg, 1979, 1983; Wigand *et al.*, 1997). Major operational modules in ERP packages available in the market today are based on this functional understanding of organizations. This rather traditional way of conceiving organizations is furthermore re-enhanced by the establishment of more narrowly defined categories that break functions down into sub-functional domains. For instance, the SAP/R3 "Human resource" module establishes sub-functional categories such as "Pay roll, benefits administration, applicant data administration, personnel development planning, work-force planning, schedule and shift planning, time management, and travel expense accounting" (Bancroft *et al.*, 1996, p. 33). Organizational functions and sub-functions are thus crucial building blocks of ERP packages (Kumar and Van Hillegersberg, 2000; Markus *et al.*, 2000a).

However, ERP technology is often acclaimed to proceed further from this conventional view of organizations in that it provides the means for connecting operations across functions (O'Leary, 2000; Ptak and Schragenheim, 2000). The successful integration of the temporal, functional and structural differentiation of organizational operations presupposes the restructuring of organizational operations that the ERP package is brought to bear on along the lines suggested by "reengineering" (Bancroft *et al.*, 1996; O'Leary, 2000; Ptak and Schragenheim, 2000). Now, "reengineering" demands the establishment of cross-functional processes in ways that provide a clear orientation towards the market or any other crucial external referent of the organization. The many discrete steps that make up the production of goods and services (i.e. function and sub-functions) must thus be defined and tied together so as to make the journey towards the ultimate or intermediate destinations, i.e. the customer of the organization or other units of the same organization, as smooth as possible. A process view of organization, assumed to provide the means for responding to the demands of the market or other internal constituents, is thus juxtaposed to the conventional functionally based organizational structure and its inward orientation.

And yet, at a closer scrutiny, this picture seems to be rather idealized and the claims tied to it strongly overstated. The identification of functional and cross-functional processes and their system codification reflects as much the technical prerequisites of computer automation as it presumably does the

demands to market adaptation. ERP technology, as perhaps any technology, reconstitutes organizational operations only after it has broken them down into the most minute detail. The meticulous definition of data items, the precise identification of transactional steps, and the fashioning of such steps into clearly described sequences that cover the operations of the entire organization are essential to ERP packages. However, the sequential unfolding of organizational tasks does not necessarily coincide with what is often referred to as business process. Indeed, it could be conjectured that the larger the number of steps that define a sequence, the more difficult would it be to discern the direction pattern of the sequence and infer the purpose of each step. The details into which the completion of the various operations (e.g. warehousing, accounting) are immersed increase the risk of these operations being cut from their ultimate destination (e.g. customer satisfaction).

It is thus of utmost importance to stress that ERP systems recount a conception of organizations as a huge series of procedural steps, tied together to sequences, sub-functional categories, modules and cross-modular operations. The unspoken or hidden premise onto which ERP systems are predicated assumes that organizational operations can ultimately be reduced to a large series of procedural steps. On this account, organizing is no more than the mechanics by which these steps are brought together and coordinated. Beyond this processual focus, other forms of human involvement at work and organizational practices, hard to pin down yet crucial to the ways things are done in particular settings, are thereby ignored and bypassed (Fleck, 1994; Soh *et al.*, 2000). The syntax of ERP systems just entails carefully defined data items, transactional steps and rules for bringing them into various combinations. Placed in such a context, the meaning of process tends, in fact, to dissolve into that of procedure, i.e. a linear sequence of discrete transactional steps necessary to accomplish a certain task (Sawyer and Southwick, 2002).

These claims can be exemplified by reference to any of the commercially available ERP packages. The SAP/R3 "Materials management" module, for instance, divides the totality of operations relevant to the identification, procurement and internal distribution of inputs into the following eight data/action categories:

- (1) purchasing;
- (2) external services management;
- (3) vendor evaluation;
- (4) inventory management;
- (5) invoice verification;
- (6) warehouse management;
- (7) consumption based planning; and
- (8) material ledger.

Each of these categories or steps are further broken down into subcategories or steps. Inventory management, for instance, is composed of the following data or action subcategories:

- material master;
- data inventory management;
- goods movement;
- environment;
- planning goods receipts;
- goods receipts for purchased orders;
- reservations;
- goods issues;
- transfer posting and stock transfer;
- print functions; and
- physical inventory.

Even these subcategories are broken down into minute data items of steps. For instance the subcategory good issues identifies the following distinct groups of operations:

- deliveries to customers;
- withdrawal of material for production orders;
- other internal staging of material; and
- return deliveries to vendors, scrapping and sampling (Bancroft *et al.*, 1996).

Now it is well known that the design of computer-based information systems in general is predicated on the meticulous segmentation of the operations that these systems are called on to monitor (see, for example, Dreyfus and Dreyfus, 1986; Newell and Simon, 1981; Zuboff, 1988). Such meticulous segmentation of the object world on which the system is brought to bear is essential for defining the data items, the steps and the rules by which they are combined into transactional sequences. ERP systems cannot differ in this respect. The proceduralization then of organizations could be seen as the inevitable outcome of computer-based automation in general rather than the outcome of the distinctive logic underlying ERP systems. True as it may be, such an assertion tends to conceal that ERP systems accentuate some of the problems intrinsic to procedural standardization. Due to their comprehensiveness and depth, ERP systems tend to construe almost the entire scale of organizational operations (rather than particular operations or tasks) as an extensive series of transactional steps. After all, ERP technology aims at mapping organization-wide flows and transactions rather than constructing domain-limited information systems.

The conception of organizations in procedural terms is almost certain to have far-reaching implications. That is, the comprehensive pre-structuring of data items and the detailed specification of procedures (i.e. pre-programming of execution patterns) inevitably reduce the space of open, people to people encounters. They also impose significant constraints to less structured ways by which humans may relate to their work and work objects (Fleck, 1994; Sawyer and Southwick, 2002). They thus construe organizational behaviour in terms of procedure enactment. While responding to the demands of predictability and control, the procedural standardization of organizations, which ERP systems promote, considerably simplify the forms by which organizational action develops. Rather than unfolding as prearranged sequences of steps (Kallinikos, 1996; Lamb and Kling, 2003; Lindblom, 1981), organizational action entails holistic patterns of cognition and open encounters marked by sidesteps, unpredictable turns and improvisation that defeat straightforward procedural standardization (Ciborra, 1999; March and Olsen, 1989; Weick, 1979a, b, 1993). However, before we turn to the closer examination of these aspects of organizational action, we need briefly return to the issue of the external orientation of organizations commonly tied to the organizational involvement of ERP packages.

Functional prerequisites versus external adaptation

As already indicated, the meticulous and comprehensive segmentation of organizational operations underlying ERP packages may indeed work at cross-purposes with the goals of customer satisfaction and market adaptation. Despite assertions to the contrary, the huge number of procedural steps that define the system may impede the ultimate purpose of responding successfully to the demands of the environment. In the meticulously parsed universe of ERP systems, the ultimate goal of responding to external conditions may easily be lost in the maze of transactions that reconstruct organizations as extensive procedural fields. Concern with internal processes may obscure and finally replace external adaptation.

It is often suggested that the distinction between core and support processes helps restore the sense of external orientation that may become impeded by the huge number of steps that constitute the package. Contemporary students of practice note boldly that, in most organizations, core processes, i.e. processes that are responsible for the major building blocks of an organization's products or services, range from half to one dozen (Bancroft *et al.*, 1996; Ptak and Schragenheim, 2000). True-sounding as this may seem, such a claim adopts the viewpoint of key actors in organizations. The distinction between core and support processes makes sense from the viewpoint of those that can obtain a bird's-eye view of organizational operations. By contrast, those that lack such a wider perspective may become overwhelmed by the cognitive complexity of the package and lose sight of the wider purpose their contributions are supposed to

serve (Kallinikos, 1999). Observations of the author and others across several organizations implementing ERP packages re-enforce the finding that the ordinary user tends to turn their back to cognitive complexity, retreating instead into their own limited and seemingly controllable zone of duties (March and Olsen, 1989; Turkle, 1995; Zuboff, 1988). In this sense, the comprehensive character of ERP packages is prone to reintroduce the very fragmentation and sub-optimization that they have set out to combat. It is well known that the loss of the perspective into which particular transactions must be placed is among the principal reasons for sub-optimization, and people's concomitant inability to perceive the role they have to play within the greater organizational system (March and Simon, 1958; Mintzberg, 1979; Perrow, 1986).

The internal orientation of SAP/R3 (the dominant and perhaps most sophisticated ERP package in the market) has been widely acknowledged (see, e.g. Davenport, 1998; Fan *et al.*, 2000; Gartner Group, 2000; Sprott, 2000). The comprehensive character of ERP systems plays an important role in the very internal orientation which software packages of this sort are bound to exhibit. The many date items, transactional steps and processes must be fashioned into a working whole, a task that cannot be accomplished unless the system accommodates its internal relations and dependencies (Kallinikos, 1999). Underneath, the demands for standards or gateways throughout the organization prompt the accommodation of component technologies to one another (Hanseth, 2000). These observations suggest that the major issue at stake in ERP systems is not the external orientation of organizations, as the official rhetoric of ERP vendors and consultants often implies. Rather, the key question is to find a surrogate depiction model of organizational operations that captures the ongoing character (as opposed to the static, structural mapping of organizations) of a huge number of organizational transactions, in order to explore and control the ways they ramify and bear on one another (Kling, 1996).

ERP packages are basically concerned with dissecting the complex texture of organizing into discrete steps with the ultimate purpose of raising the manageability of organizations. The project of depicting the interdependent character of organizational operations and the way the various tasks and the information they generate bear on one another is motivated by the desire to render the entire system of internal relations predictable and controllable. Though dressed in the fashionable rhetoric of business processes and market adaptation in the age of the Internet, ERP packages are basically inward looking (Kumar and Van Hillegersberg, 2000), being concerned with tying together the overwhelming part of the internal relations and activities of an organization. The primary goal is less to contribute to the adaptability of the organization to external contingencies than to build a detailed map of the organizational territory that can be used as the springboard for organizational action. In the last resort, ERP packages aim at raising the manageability/control/predictability of the organizational system's routine

operations. This could be a noble goal but one that has to be explicitly acknowledged (Beniger, 1986; Kallinikos, 1996; Kling, 1996).

These claims suggest that the organizational involvement of ERP packages is bound to have implications that derive from the predominantly inward-looking orientation of such packages, and the very organizational premises on which they are predicated. ERP systems imply the comprehensive design of items, relations and operations moulded into a management model that could be brought to bear on any organization (Soh *et al.*, 2000). It is obvious that the design of such a system is based on an abstracted, shorthand version, no matter how rich in details, of organizational operations. It therefore represents a decontextualized (i.e. deprived from particular characteristics) accomplishment that can, in the best case, be adjusted a posteriori to fit the circumstances of the particular organization, whose tasks the ERP package is called upon to monitor (Fleck, 1994).

Now the vendor/consultant industry built around the commercial exploitation and implementation of ERP packages would make the claim that a package of this sort cannot be brought to bear on the management of an organization, unless the tasks and processes underlying the host organization are studied in detail. It is only through such a detailed study that the package can be adapted to the specific contingencies facing that organization. The effort and the time spent (several years) for adapting ERP packages to particular organizations suggest that their implementation constitutes a complex venture that cannot be brought into being unless significant portions of the package are negotiated locally.

How genuine such an adaptation to local circumstances may become is an issue that falls outside the scope of this article. As indicated in the introduction, there is definitely variation on the extent to which implementation processes may reshape such off-the-shelf information packages. But there exist powerful constraints as well (Fleck, 1994; Kallinikos, 2002; Soh *et al.*, 2000). The systemic character, the procedural logic and the overall outlook of ERP packages as described above cannot be undone through contextual adaptation. ERP packages are not infinitely malleable (Hanseth, 2000; Hanseth and Bra, 2000). Indeed, it may be conjectured that the rituals surrounding the implementation of an ERP package (see, for example, Avital and Vandenbosch, 2000; Bancroft *et al.*, 1996) are, by and large, oriented towards transcribing the reality of particular organizations into the language of the package rather than the other way around. Complex as it may be, the implementation process by means of which ERP packages are reconfigured, changed or adapted to local contexts is subject to polyvalent constraints (Kallinikos, 2004).

Human agency as procedure enactment

The observations to this point suggest that the implications of ERP packages reach far beyond the officially acclaimed goal of rendering the organizational

operations tidy, visible and integrated. By providing the infrastructural means for tracing cause-effect, means-end relationships across the organization, ERP packages help construct a manageable/predictable organizational reality. At the same time, the procedural character of ERP technology, outlined in the two preceding sections, imposes itineraries of action, i.e. elaborate execution schemes necessary to accomplish a task or group of tasks. Now, a distinctive characteristic of all technologies is precisely the reshaping of human contributions along the lines suggested by the technological sequences (Beniger, 1986; Noble, 1984). In this respect, ERP technology resembles any other technology. It codifies routine or semi routine operations and standardizes their execution.

Unlike other software packages, however, the conception of organizational operations as an extended sequence of discrete steps brings into being a "behavioural mechanics" throughout the organization. In dissecting organizational operations in discrete items and providing the procedural sequences for the execution of particular tasks, encompassing computer-based applications, like the one ERP packages represent, engrave the paths along which human contributions should unfold. In this respect they help institute patterns of action and communication and shape human agency in organizations. The old debate concerning the effects of expert systems on professional behaviour (e.g., Dreyfus and Dreyfus, 1986; Goranzon, 1992; Winograd, 1990) is partly applicable in the case of ERP technology. However, ERP systems target not knowledge and modes of inference but rather procedures of action and execution. In this respect, the introduction of this family of technologies to organizations has less ambitious goals than the computer-based codification of expert behaviour. They are mainly concerned with the procedural systematization, standardization and computer-based instrumentation of organizational operations. In so doing, ERP systems become an important means for constructing governable and accountable patterns of behaviour in organizations (Kallinikos, 1996; Miller and O'Leary, 1987, 1994).

Simply put, ERP packages cannot but construct modes of human involvement as they go about integrating organizational transactions. Application packages of this sort do not simply recapture organizational operations in an organization-wide surrogate model. They definitely do so, yet with the ultimate purpose of inducing human action and directing it along certain lines. More than recording transactions, ERP packages are technologies of action. They define items and discrete transactional acts and construe relations between them. In so doing, they combine them into extended sequences that are vested with a sort of purpose and direction. For instance, the buying of input materials through the system obeys a strict procedural order. It involves inspection of a number of relevant data items, the making of the final decision and the following up of the delivery, e.g. checking available inventory, reviewing supplier catalogues, comparing prices and terms of delivery,

ordering, following up delivery, etc. Most significantly, the procedural sequence takes place now with a clear awareness of the greater ecology of relations (e.g. accounting and finance, operations and warehouse management) on which it tends to impinge, and which the system renders visible and possible to inspect and trace at any moment. In this respect, the influence of the system cannot adequately be gauged in terms of support to the user. Rather, large-scale, proactively oriented systems, like those ERP exemplify, invite highly selective modes of participation (compliance to the procedural logic, the data items and transactions the system entails) that block alternative ways of going about (Hasselbladh and Kallinikos, 2000).

Thus, ERP packages are distinguished by the insertion of every transaction they help define or record into the wider ecology of organizational relations to which each transaction impinges or is linked to. By tying steps together and placing separate tasks and contributions within the wider context of other tasks or missions, ERP packages tend to shape considerably the building blocks of organizational action such as jobs and roles. Rather than being simply descriptive, ERP packages are normative or, more correctly, performative in their orientation. That is, they do not simply automate and integrate transactions. They, in addition, frame the import such transactions may have by placing them in the wider organizational context to which the designers of the system construe that they belong. The very meaning of “best practices” onto which ERP packages are claimed to be based indicates that the target of such packages are ways of doing rather than the sheer codification, automation and integration of transactions.

The reconstruction and retracing of the interconnected nature of organizational tasks thus makes ERP technology capable of constructing extended action itineraries. It is thus important to stress that ERP packages are underlain by a profound actant constitution. Functional modules, sub-functional categories and cross-functional processes are not simply depictions of information flows but also and perhaps predominantly execution schemes. In this respect, ERP systems differ from traditional information systems but also the automated versions of human action we call expert or decision support systems. They definitely entail the shaping of larger enclaves of tasks and provide the informational and transactional infrastructure on which procedural modes of conduct are constituted.

The distinctive behavioural implications of ERP technology emerge against the background of the juxtaposition of human action that takes the form of procedure with other modes of human involvement. Anderson (1983) distinguished between declarative knowledge (knowledge about facts and relationships in a specific domain) and procedural knowledge (how-to-make-it knowledge), a distinction presumably akin to Ryle’s (1949) widely acclaimed categories of “knowing what” and “knowing how”. Anderson claimed that the translation of declarative knowledge to procedural knowledge is a basic

attribute of human behaviour. The transition to adulthood and the process of personal maturation involve not simply the acquisition of knowledge about the world but most decisively its transformation to procedural knowledge that provides the guidelines of how to go about things in particular situations. Professional training represents one of the clearest illustrations of this transformation (Dreyfus and Dreyfus, 1986). It shows how knowledge about facts and relationships in specific domains must be translated and ultimately evaluated on the efficacy of procedures for dealing with domain-specific problems. The transformation of knowledge about facts and relationships to procedures is therefore a major accomplishment by means of which humans become instrumental, test their knowledge of the world, understand its limits and its contextual embeddedness.

However, the conversion of knowledge about the world to procedural knowledge is just one out of the various paths that knowledge takes in its various transformations (Engestrom, 2001; Nonaka, 1994; Weick, 1979a, b). In resilient cognitive systems like those humans represent, procedural knowledge is undergoing changes that may occasionally cause an understanding of the world in terms other than procedural. The confrontation with the world often involves procedure modification as response to changing facts, or as the outcome of a procedure's inadequacy to cope with the situation to which it has been regularly applied. Most significantly, the invocation of a procedure presupposes the tacit definition/reading of the situation (Goffman, 1974). Before humans enact a how-to-do-it knowledge, they have to frame the situation and decide what sort of behaviour it calls for, even though such a framing may be provisional in unfamiliar situations (Weick, 1979b).

Framing is a highly complex cognitive activity (Bateson, 1972; Goffman, 1974) that allows for the tuning or behaviour adaptation to the demands of particular situations. It cannot thus be separated, at least not without serious consequences, from the web of significations underlying a particular social context. Weick's (1993) analysis of the Mann Gulch disaster is instructive as to what may happen when framing, or sense making as he calls it, collapses or becomes dissociated from action. Coping with urgent and ambiguous situations often presupposes the ability of responding innovatively to these situations. Such an ability in turn is inextricably bound up with the capacity of reading/framing such situations properly. Rigidly dissociated from framing, action loses its intentional component and tends to degenerate to mindless procedure of execution that may have devastating consequences as the Mann Gulch disaster clearly demonstrates. "Men act things but move" as Kenneth Burke (1966) used to say.

By inserting the enactment of a procedure within a certain ecology of organizational relations to which such a procedure belongs, ERP systems basically dissolve the link between framing and action. In so doing, they force, wittingly or unwittingly, a "behavioural mechanics" throughout the organization. Vendor evaluation, to refer to the same example again, is

proceduralized by providing a number of steps that have to be followed and the criteria on the basis of which each step must be completed. The procedure obtains its meaning within the wider framework of materials management as codified by the system, the work performed by peers in adjacent or related positions (e.g. accounting, invoice verification), the values supplied by the very criteria of vendor evaluation the system provides and so forth. There might be some leeway to manipulate these conditions, if experience shows the system to be inadequate, overconstraining or simply irrelevant.

However, the lessons of experience can only be fed back into the system through the periodic reconfigurations of the package and by actors other than those experiencing the limitations of the package. The procedure cannot be instantly modified, despite evidence suggesting particular situations to require a more or less different procedural treatment and other evaluation criteria. The demands of comprehensive automation/integration have rigidified the activities of framing and procedure enactment. This contrasts with the aforementioned claims suggesting that the ability to evaluate procedural modes of acting cannot be accounted for by procedural knowledge itself. The very judgement of how well a procedure does cannot be based on the procedure itself. It requires access to significations, values (i.e. goals) and beliefs about the state of the world. Knowledge about the world forms always the background against which procedural knowledge obtains its meaning and usefulness (Bateson, 1972; Goffman, 1974; Lackoff, 1995).

There are other concerns about the rigid separation of framing from action that may inhibit learning and adaptive behaviour (Engestrom, 2001; Engestrom and Middleton, 1996). Habituation and the insights stemming from human embeddedness into the practical world (Dreyfus and Dreyfus, 1986; Introna and Whitley, 2000) contribute to the withdrawal of procedural skills from immediate inspection and deliberate manipulation. This way, procedural knowledge melts into imagination and to the reservoir of knowledge about the world. Socialization and apprenticeship are other examples that Nonaka (1994) suggests exemplify the opposite journey, i.e. the transformation of procedural knowledge into knowledge about the world. Both involve learning through demonstration, exemplification and rule or procedure following. Overall, the complex ties between framing, acting and learning are considerably simplified by the very organizational/behavioural premises on which ERP packages are predicated. It is therefore crucial to uphold that the distinction between various forms of knowledge and the involvement they imply makes sense only in a cognitive system capable of sustaining the essential bonds between these two types of knowledge (Lackoff, 1995). Rigidly separated from one another, these basic human capabilities tend to degenerate to non-imaginative, mechanical ways of thinking and acting. The understanding of human agency as procedure enactment that ERP packages embody may have thus profound implications for humans and organizations.

Implications and conclusions

Sometime ago, the renown semiotician Yuri Lotman made a distinction between grammar-oriented and text-oriented cultures (see Eco, 1977). Broadly speaking, grammar-oriented cultures are characterized by the elaborate specification of rules on the basis of which appropriate modes of conduct are enacted as a means of coping with particular situations. Under such a cultural regime, human behaviour becomes relatively predictable. That is, people draw on this normative stock of knowledge to invoke those rules that respond to the situations faced. By contrast, text-oriented cultures rely on socially diffused yet vaguely formulated ways of dealing with various situations. Rather than being codified in terms of rules, appropriate modes of conduct must be inferred/constructed each time out of the variety of cues and materials that help make sense of particular situations.

Though considerably more general, Lotman's distinction is akin to procedural versus less-structured forms of involvement with the world that I endeavoured to develop in this article. The diffusion of ERP systems and their expanding organizational involvement participate in the making of formal organizations to grammar oriented cultures, at the expense of other, less-structured modes of human behaviour at work. As noted above, ERP systems are technologies of action that set up elaborate procedures by means of which an impressive variety of tasks are accomplished. Inscribed to such an elaborate regime of rules and procedures, human behaviour becomes less unpredictable while organizational reality emerges as transparent (i.e. adequately described in terms of information) and accountable (i.e. traceable in terms of who made what under which conditions). In this process, organizations might come to better control their everyday operations but they may as well end up losing other important sources of innovation, learning and development that confer them a distinctive identity (March, 1991).

The transactional mechanics which ERP packages bring about may thus block exploration of alternative ways of perceiving and acting on reality and by extension organizational development and innovation (March, 1991). The opportunity to experiment, improvise and rehearse with alternative ways of perceiving and acting on the world thus presupposes forms of human involvement that are sharply distinguished from human behaviour as rule-following. Such forms of human involvement, often revealed in improvisation (Ciborra, 1999; Weick, 1979a, 1993) and play (Bateson, 1972; Kallinikos, 1996; March, 1991), collapse the distinction between general and procedural knowledge, knowing what and knowing how. They ceaselessly transform the one into another as a way of dealing with states of the world and learning about it. Most significantly, they break with the sequential pattern of procedural action and its linear imposition of a temporal order (Sawyer and Southwick, 2002). In improvisation and play, the world is revealed in its holistic and synthetic particularity, entailing flashes of insight into how things are tied

together (Bateson, 1972; Erikson, 1977). Procedural knowledge is of course implicated in these basic forms of involvement, yet never as a separate realm of human agency.

I cannot do justice to the variety of modes of human involvement with the world in this context. But, I have sought to make clear the limitations intrinsic to the conception and instrumentation of human agency as procedure that is embodied in ERP packages. The succinct treatment of organizations and human behaviour undertaken in the preceding sections provides an indication of the complex character of human agency at work, and the limitations which procedural modes of acting on the world may entail. More detailed conceptual and empirical work is however needed. We know from previous studies that the codification of situated practices into disembodied procedures has been a double-edged process (Engestrom and Middleton, 1996; Kallinikos, 1999; Kling, 1996; Orlikowski *et al.*, 1996). Yet encompassing computer-based systems like those ERP packages represent accentuate some of the problems that seem to be endemic to that project (Fleck, 1994; Soh *et al.*, 2000).

Some of the claims I have made in this paper could presumably be associated with those concerns Lamb and Kling (2003) have recently raised as concerns the notion of the user, underlying much of the information systems research and practice. Lamb and Kling (2003) question the rationalistic underpinnings and the cognitive individualism implicit in the notion of the user. They argue instead that social actors, using information and communication technologies, often find themselves embedded on complex networks of considerable social and technical complexity. They draw accordingly on several resources and enact multiple and shifting roles and competencies to cope with the complex situations facing them. The dominant notion of the user involves an utter simplification of this complex reality and needs drastic reconceptualization. In an analogous fashion, the behavioural presuppositions onto which ERP systems are predicated recount a rather simplistic conception of human behaviour that I subsumed under the label of procedure enactment. Such behavioural presuppositions certainly reflect the inheritance of cognitive rationalism and the dominant position it has assumed in information systems research and practice.

Reservations toward ERP packages does not deny any positive effects they may have on governing organizations. Technologically supported procedure development and standardization that are based on best practices can break with the languid forms of contextual learning, introduce and condense lessons of experience to particular organizations and contribute to the efficient management of their operations. Also, the comprehensive, organization-wide character of ERP packages represents an essential means to the better coordination of organizational operations across functions and production sites. But there are significant behavioural and organizational side effects too that have by and large been overlooked. The procedural standardization brought about by ERP packages delineates a distinctive form of human involvement as procedure enactment. By the same token, procedural

standardization contributes to the transformation of organizational practices to procedures. Standard operating procedures are ubiquitous in organizations and procedural skills and knowledge essential to human agents. However, their usefulness derives from the multiple connections they entertain with other forms of knowledge and modes of involvement. Technological embodiment of procedures by necessity loosens these connections. It cuts off procedure development from vital sources of knowledge and practice (e.g. tacit forms of knowledge, intuition, playful exploration and improvisation) that support and give meaning to procedures and makes it increasingly difficult to accommodate other forms of organizing experience.

Placed in this context, ERP systems strike a new balance in the delicate equilibrium of modes of human involvement and forms of knowledge that have been accommodating organizations. They privilege procedural knowledge and skills (an instance of general and codified knowledge) over other, mostly local, forms of knowledge and modes of involvement. They put a premium on control, efficiency and standardization and inevitably subordinate issues of exploration and innovation in organizations (March, 1991). ERP technology is a technology of regulation not of innovation and must ultimately be evaluated against the background of the variety of organizational and human trade-offs it cannot help but bring into being. Now, the growing significance of the Internet, and novel developments both in the designing methodologies of ERP packages (e.g. component based methodologies) and the forms of data/communication (multimedia) that they can accommodate may change ERP packages from transactional/procedural machines to information infrastructures supporting a variety of modes of human involvement. I have deliberately left these issues outside of consideration, focusing instead on depicting the distinctive forms by which ERP systems restructure work and organizational processes. It remains to be seen what sort of effects these new developments may have but I predict that the transactional/procedural legacy of ERP packages will persist in one form or another.

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