Information out of information: on the self-referential dynamics of information growth

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Abstract

Purpose – The paper seeks to develop a theory of information processes that invokes three major explanatory factors to account for the escalating patterns of information growth that have been taking place over the last decades.

Design/methodology/approach – Conceptual analysis and review of relevant theories.

Findings – First, information is claimed to have a dual value as a description of a reference domain and a relationship that such a description may have or develop with already available descriptions within that domain or across reference domains. Second, the intrinsic combinability of technologically mediated information is substantially strengthened by the interoperable character of contemporary information infrastructures. Finally, information growth dynamics are intimately connected with the perishable and disposable character of information.

Originality/value – The paper presents a novel theory of information growth dynamics.

Keywords Complexity theory, Information research, Dynamics, Information management

Paper type Conceptual paper

Setting the stage

Despite its long and multifaceted history, the concept of complexity has over the last two decades or so witnessed a resurgence across a wide variety of social science disciplines (see, for example, Anderson, 1999; Arthur, 1988; McKelvey, 1999; Stacey, 1992), a development that is closely associated with the centrality which complexity theory has lately assumed in physics and the life sciences (e.g. Kauffman, 1993, 1995; Prigogine and Stengers, 1984). This paper is not, however, about the complexity of social systems and organizations framed predominantly in these terms, even though it may bring into play one or another insight developed within complexity theory. Rather, the paper draws on a variety of contributions made across social science disciplines (e.g. Bateson, 1972; Borgman, 1999; Luhmann, 1995, 2002) to develop a theory that seeks to account for a major contemporary development, i.e. the spectacular and perhaps escalating growth of information that has been taking place over several decades now. Looked at on a larger timescale, the impressive expansion of information emerges as rather evident, representing a distinctive mark of the current age (Hylland-Eriksen, 2001). From all signs to judge, it seems rather unlikely that the fast pace of its growth will abate in the years to come. On the contrary, it would be

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reasonable to expect an accelerating and socially diversifying pace of information growth (Dreyfus, 2001; Hylland-Eriksen, 2001; Shiller, 2003).

Be that as it may, the issues associated with the expansion and fast growth of information are many, complex and intriguing. It is vital to approach and understand the contemporary dynamics of information and also obtain a picture of the social and organizational implications such a dynamics is bound to have. Little wonder that the ways information is deployed across settings may differ (Brown and Duguid, 2000; Orlikowski, 2000). However, the sheer growth of information and the forms by which it is processed and organized provides a set of structural and technological preconditions whose significance and possible impact cut across local contexts. As information and the technologies by which it is sustained become increasingly involved in organizations they cannot but impinge upon the ways data and information are utilized to make sense of reality and to construct possible courses of action. For instance, in his much-debated book *The New Financial Order*, Schiller (2003) claims that the proliferation and integration of a variety of information sources into interoperable databases are bound to change, and rather drastically, the perception, shaping and delivery of financial and insurance services. Large and interoperable databases make possible the development and delivery of tailor-made services to a degree that has hitherto been unfathomable. For, services of this sort can now draw on technologically mediated and interoperable information on individual preferences, lifestyles, income expenditures, risk profiles and the like to construct services that are closely attuned to the life profiles of individuals and the shifts such profiles may exhibit over time. It is precisely the possibility of juxtaposing, comparing and combining continuously updated information on individual life patterns across systems and databases that opens a new space of opportunities, whereby reality can be perceived in expanded ways that, in turn, promote new courses of action. No matter whether one agrees with the implications Shiller (2003) draws from current developments or not (see, for example, Ciborra, 2006), his account provides a good illustration of the far-reaching institutional, organizational and behavioural effects the growth of information could be associated with.

This paper suggests that rather than being the outcome of haphazard incidents, the expansion and growth of information is an intrinsic characteristic of the contemporary world, closely associated with the sophisticated storage and updating mechanisms, the online availability and the combinability of technological information. There is a complex pattern of mutual implication of information with the technologies by which it is constructed and mediated, whereby the one reinforces the other in an iterative cycle of interactive sequences (Castells, 2001; Ciborra, 2000). The expansion and growth of information are mediated by an increasing array of sophisticated technologies of information processing and information exchange. In turn, such an expansion and growth of information feeds back on technological development by acting as the springboard for the further diffusion and the social or organizational embeddedness of these technologies, as a means of organizing, taking advantage of and generally dealing with information.

Placed against such a background, this paper seeks to understand the complex character of technologically sustained information processes, the way they are constructed, unfold and become entangled with the operations of organizations. As already indicated, the paper draws on ideas derived from a variety of social science

disciplines to develop an explanatory account of the relevant developments that construes information processes as basically self-propelling and, in some respects, escalating. Despite the mounting significance of these developments, we seem to lack adequate theoretical explanations of this complex and, in a sense, "out-of-control" character of information growth processes. It is reasonable to expect these developments to have important implications for all those practices and activities associated with the management of information. For information expansion and growth are not isolated phenomena. They take place in larger ecosystems composed of practices, tasks, information structures and technologies interacting in ways that usually extend beyond the immediate inspection and control of particular actors and organizations and their local pursuits. Under these circumstances, only a limited portion of these developments can be attributed to deliberate actions and the intentions or goals of locally embedded actors. Both the design and development of information systems and the wider practices by which they are accommodated within and across organizations can only partly be understood as a process of local accommodation or adaptation (March, 1994; March and Olsen, 1989; Orlikowski, 2000) to the internal or external demands facing particular actors and organizations (see, for example, Hanseth and Braa, 2000). For these reasons, it is necessary to study the dynamics of information growth in ways that are able to accommodate wider processes taking place beyond local contexts (Searle, 1995).

The paper is structured in ways that accommodate the exposition of the three major claims advanced to account for the expanding and partly escalating growth patterns of information. These claims are taken up in three successive sections.

First, the dynamics of information expansion and growth are construed as being closely associated with the self-referential, non-foundational constitution of information. This is an elusive and in a sense counter-intuitive claim, whose exposition involves a series of complex and abstract theoretical arguments. It suffices, perhaps, to point out here that the conception of information in self-referential and non-foundational terms contrasts sharply with a widely diffused view of information that sees it as description or representation of states and relations in a reference domain (see, for example, Devlin, 2001). This latter understanding is predicated on the assumption of information mapping a reality that is considered to pre-exist the generation of information, for example user requirements as an essential step preceding coding. Such an account is not erroneous, but rather inadequate and incapable of accounting for the contemporary information growth dynamics that to a considerable degree involves the generation of information out of information (Zuboff, 1988).

Second, the expansion and growth of information is seen as being crucially related to the diffusion and involvement of contemporary technologies of information and communication. The self-referential character of information growth and the generation of information out of information can, to a substantial degree, be attributed to the availability of technological information and its combinability or permutability across systems, databases and organizations.

Third, contemporary information growth dynamics reflects an institutionally orchestrated game for obtaining information that is fresh and relevant. However, such a game inevitably results in information becoming readily depreciated and obsolete, thereby setting up a complex institutional process for maintaining and expanding the

informativeness of information. Manifested in various ways for storing, processing, updating and recombining information, the objective of maintaining the informativeness of information is essentially contributing to the self-propelling, runaway character of information expansion and growth (Arthur, 1988).

The paper ends with a concluding note summarizing the basic argument of the paper and entailing a few reflections on the implications ensuing from such an admittedly abstract account of contemporary information processes.

Information processes and self-reference

In order to be informative, a message (i.e. the semantic content carried by a string of syntactic tokens) must be able to add a distinction and confer something new on what is already known about the world. The value of information, what may be called its informativeness[1], is indeed a function of the kind of "news" it is capable of conveying. "News" differs substantially with respect to what they add upon that which is already known. Conveying something that is already known is to communicate no information, no matter how important such a message may be. As Borgman (1999, p. 133) expresses it, "to be told that the sun will rise tomorrow is to receive no information. To learn that one has won the jackpot in the lottery is to have great news". Thus understood, information is distinct from data, i.e. the syntactic elements by which it is carried, but differs too from knowledge[2]. As a rule, knowledge entails more elaborate and durable cognitive structures on the basis of which the world is comprehended (i.e. the sun will rise tomorrow). The durable character of these structures suggests that knowledge cannot adequately be understood in terms of novelty and the quality of "news" Borgman's statement rightly attributes to information.

In view of a widespread confusion prevailing in the literature, it is crucial to reiterate that information is not a measure of the importance (moral or cognitive) of a message but its newness. Information may differ from knowledge in several respects, yet a major difference pivots around the short-lived status of information as distinct from the value of knowledge and its persistence over larger time scales. Knowledge, being tacit or formal, may change as the result of either the reorganization of experience (i.e. tacit knowledge) or the reformulation of the theories by which it is supported (i.e. formal knowledge). Neither of these changes occurs as the result of knowledge losing its newness, for knowledge is not defined by its newness. By contrast, information is depreciated to the degree that it is bereaved of its basic quality of being informative, and the difference such a quality makes, as the result of the "news" it carries (Borgman, 1999).

Information could be seen as involving novel descriptions (oral, written or electronic) of facts, relationships or states in a reference domain. Such a domain may not necessarily be limited to referential reality (i.e. objects and acts). It may well extend to entail descriptions of other descriptions. A simple example of a referential fact is a bank client's transaction in an automatic teller, which, by virtue of being recorded, provides available information about an act and its context, i.e. the identity of the client, the volume, time and place of the transaction, and so forth. Another example is furnished by a medical or criminal incidence added to an existing database of medical or criminal facts, respectively. As these plain examples suggest, information is often the outcome of technologically sustained routines by means of which an impressive variety of details, with only a little or modest degree of newness, are recorded in

organized data fields. Deployed this way, information allows organizations to keep track of their operations in a fairly routine and repetitive way.

An interesting relationship emerges at this point, for as soon as they are recorded, descriptions provide the ground onto which new information can arise, not necessarily through the additional description of referential facts or states, but rather through the very insertion of recorded facts into the greater picture of available information about similar facts. Such a picture can itself be composed in several ways. A client's transactions, for instance, can be related to her/his transactions during the last week, month or year, or be compared to the transactions of other bank clients during that day or week, and so forth. Similarly, a criminal or medical incidence can be related to available criminal or medical information to provide new information about criminal or medical facts or even brought to bear upon other available information to produce profiles as geographical or demographic distribution of criminal or medical facts. A large variety of such combinations are usually available. Which ones of these combinations will be actualised to some degree depends on the characteristics of the contexts within which they occur and the interests and preoccupations of local actors. On the other hand, some of these combinations are currently produced on a routine basis across local contexts, through specifically tailored information systems (e.g. profiling and data mining applications).

Organized information has therefore a dual value, i.e. as a description of a particular aspect of a reference domain and as a relationship such a description bears to already available descriptions. Correspondingly, a description of descriptions (i.e. a meta-description) may entertain a relationship with other meta-descriptions. It is thus of crucial importance to point out that newly generated information does not simply add or record a new fact or state. It modifies and reframes, and not infrequently in a decisive way, the value of already existing information, which can thus be interpreted in a new light. Shiller's (2003) claim about the emerging financial order, referred to briefly in the introduction to this paper, is indeed based on such an understanding of information, for the making and delivery of new tailor-made financial and insurance services, which he assumes will come to revolutionize the financial world, are heavily contingent on the ability to correlate data items across continuously updated information sources and databases[3], e.g. income tax returns, data on consumer expenditures, mortgages, travel habits, other demographic or medical data, and so forth. New information on individual life patterns, which tailor-made services make necessary, is emerging not solely on basis of recording particular facets of an individual's life but crucially through the very comparison, juxtaposition and combination of data across information sources and databases. Simple or straightforward as it may be, this systemic or, perhaps more correctly, structural view of information provides a fruitful path for understanding the self-referential and increasingly expanding forms through which contemporary processes of information develop[4].

Taken together, these observations suggest that every time a new information item (or series of items) is brought to bear on an already existing information corpus, it is destined to reveal a novel pattern or relationship that was not there from the very beginning. Given that an information item could enter into a relationship with more than just one item in a dataset, it is understandable that even a modest addition of information items to a modestly large information system might lead to the

exponential growth of the information contained in that system, even in the presence of strong combinability constraints. Constraints of this sort usually arise for technological, organizational-institutional or behavioural reasons (Brown and Duguid, 2000; March, 1994), but they are themselves subject to change and modification.

The dual and self-referential constitution of information provides one of the principal reasons why information processes are intrinsically tied to unintended consequences that may betray the purpose of certainty and control by which they may have been motivated in the very first place. Information generated to illuminate and also control specific aspects of reality may, through its recombination with already existing information sources, result in the creation of a new picture that may come to challenge, and rather radically, established truths. Obviously, information growth does not have these dramatic effects every day. But incremental changes do bring periodically qualitative changes, some of which may in fact have far-reaching implications. The outcome of such incremental changes is that while information generated for particular purposes may lead to increasing control of those aspects of reality by which it has been motivated, it may too increase rather than reduce uncertainty with respect to wider processes, an outcome that is often difficult to anticipate in advance (Beck, 1992; Beck *et al.*, 1996; Luhmann, 1993).

Paradoxical and counter-intuitive as the relationship of information to certainty may sound, it ultimately reflects the non-foundational nature of information that Bateson (1972) genuinely defined some time ago as "a difference that makes a difference". Differences by necessity emerge through the juxtaposition or comparison of two or more items or objects. Differences, Bateson (1972) suggests, are not singular entities located in discrete objects but relationships between objects that emerge as different from one another with respect to one or another property (see also Cooper, 2005). The non-foundational nature of information suggests that the relationship between information and certainty (as a description of reality) is not exogenous (Bateson, 1972; Cooper, 1986; Derrida, 1978). Information does not simply describe an external reality that can be emptied from facts or information through elaborate descriptions. The amount of information contained in reality is not finite because it is not an attribute of that reality alone, but also of the type and discriminatory power of the sign systems deployed to describe that reality. The more fine-grained the distinctions signs carry, the more reality is discovered within reality, i.e. the richer the description of that reality becomes (Kallinikos, 1996)[5]. Information thus partakes in the construction of reality, providing descriptions of it that may lead to the counter-intuitive outcome whereby information raises rather than diminishes uncertainty[6]. To use another terminology, observing is intrinsically involved in the observations it makes (Luhmann, 1995, 1998, 2002).

The self-referential and self-propelling character of information processes suggests that the game of information is thus constituted that the deficit is always on the side, so to speak, of the responses, which information itself supplies. While incoming information may help clarify pre-existing questions, it cannot help, by virtue of being related to other chunks, but disclose new aspects of reality that raise novel questions, begging further information search and so on (Luhmann, 1995, 1998, 2000). Hardware and software standardization further accentuate these trends by rendering information recombinable across a wide variety of systems and contexts. We will examine in the

next section a few basic ways by which technologically based information processes are pushing these runaway information processes almost to their outer limit. It is important to stress here that the self-propelling dynamics of information growth are constitutive of the game of information. The unpredictable consequences of information generation could be seen as side effects, if by this term is meant effects unintended by a particular group of actors or even by society in its entirety. Yet side effects, it should be stressed, are intrinsic (rather than accidental) to this game and thus form an inevitable accompaniment of it.

This last observation forces us to introduce some complications to the original argument. For expository reasons it was suggested above that information has dual value as a description of a certain fact or state and as relationship that description bears to already available descriptions. As a matter of fact, what we call description is itself a relationship between items, albeit much more elusive and easy to overlook (Bateson, 1972). What is described as this and not that emerges as a description against a background of a web of primary differences *vis-à-vis* other descriptions (i.e. entities, states or processes conveyed by sign tokens). For instance, a transaction is identifiable as this transaction against an implicit background of differences to other similar transactions, transactions of other kind, non-transactions and so forth (Derrida, 1978). Placed in this light, descriptions could be conceived as first-order differences, whereas the relationships descriptions obtain with one another could be seen as second-order differences. Information processes produced on the basis of first-order differences are, as briefly alluded to above, elusive and less amenable to control and manipulation. Being the outcome of cultural processes stretching over larger time periods, they provide the very ground onto which human perception and cognition develop and thus easily escape reflection and examination (Borgman, 1999; Cooper, 2005)[7].

The permutability of technological information

The pattern of generating information out of information described above is substantially re-enhanced by the increasing degree of permutability underlying technological information. There is usually a large variety of ways by which information items can be related to one another within and across information systems. The choice of a context into which an information item or chunk can bear upon is conditioned by a variety of technological or quasi-technological factors (e.g. standardization, compatibility of measurement systems, relevance of the reference domains) that impact the combinability of information.

Information combinability is conditioned too by a variety of social factors. The social practices and work patterns within which information processes develop play an important role in this respect (Ciborra and Lanzara, 1994; Orlikowski, 2000). Routines and meaning-driven activities in organizations are essential factors that shape to a considerable degree the forms by which already available information is acted upon, recycled, explored or recombined. Given the institutional and behaviourally conservative character of routines and many an organizational operations, it is reasonable to expect that the production of information out of information takes place along paths that have been engraved by the repetitive identification of information needs and the use of information (Brown and Duguid, 2000; March, 1994; March and Olsen, 1989). For, routines, habits and established structural mechanisms or interaction patterns frame the practical concerns of organizational actors and ultimately provide

the horizon of meaning against which the combinatorial possibilities of information as a means of disclosing novel conditions are explored. In this respect, the nature of established practices, the structural arrangements supporting them and the routines they are associated with function as stabilizing mechanisms by means of which only a portion, perhaps a very limited one, of what is possible within a given information space is explored.

However, routines and social practices are not immune to technological change. As briefly indicated in the Introduction, the involvement of computer-based technologies in organizational and institutional life expands the production and dissemination of information and in this respect influences the perception of reality. New systems and the information they make available, sooner or later, induce new practices and habits either as means of accommodating the expanding information or as means of pursuing new goals and opportunities. Currently, information generation in organizations or other complex settings of the contemporary world occur within complex, socially organized, technologically sustained information systems or infrastructures that exhibit a significant degree of standardization across applications and systems (Bowker and Star, 1999; Ciborra, 2000). Thus organized and standardized, information processes develop over time, resulting often in cumulative data and information sets that both expand considerably the combinability of information items and reframe the perception of what could be possible, useful or relevant. Information growth dynamics could to a certain degree be accounted for by the incremental changes which the growing involvement of computer-based technologies are prone to bring in terms of information availability and the mechanisms for acting upon information (Zuboff, 1998).

However, processes of this sort are only partly driven by deliberate planning or human conservatism. The exponential growth of the internet and other private or non-public databases tells another story and stands as the epitome of the complex and only partly controlled patterns of information growth. Once available, information tends to induce technological innovations, within and across organizations, as a means to the more effective ordering and processing of information (Beniger, 1986). Technological innovation, in turn, establishes favourable conditions for further information growth and access. Sooner or later, the interaction of technology and information obtains a life of its own, whereby what is available or possible gains precedence over the choice of courses of action based on the careful analysis of information needs. Available solutions (i.e. technologies) define problems rather than the other way around (March and Olsen, 1976, 1989). The diffusion patterns of enterprise systems (or ERP systems) over the last decade or so represent a good approximation of this process (see, for example, Fleck, 1994; Kallinikos, 2004). These trends are further accelerated by the huge commercial interests of software developments or vendors and the trends of normative or mimetic isomorphism whereby organizations tend to adopt technological packages, either as a way to respond to dominant norms and cultural schemes in their environment or as a means to catch up with competitors (Powell and DiMaggio, 1991).

Technologically generated information reinforces the self-propelling spiral of information in various ways. It does so, *prima facie*, through the hugely magnified capacity of computer-based systems for recording events or states and processing information. Technological processing of information is indeed a form of producing

information out of information that is controlled, at least for a limited period of time, by the automation of the rules (i.e. predetermined forms of combining information items embodied in the software) for processing information. But as experience suggests (see, for example, Hanseth and Braa, 2000; Ciborra, 2006), the proliferation of information demands, sooner or later, new systems with greater capacity and more complex rules for acting upon information. At an aggregate level, the transition from simple and functionally isolated computer-based systems to large-scale interoperable information infrastructures provides a good illustration of the process whereby the proliferation of information and technological innovation reinforce one another in an expanding spiral (Bowker and Star, 1999; Ciborra, 2000). Furthermore, computer-based technologies are instrumental in constructing an organizational and work environment where information reaches down to the minutest fabric of everyday operations (Kallinikos, 2004; Zuboff, 1988). In this respect, technologically generated information increasingly engulfs operations, which left little or no information traces before (Roland and Monteiro, 2002). In all these ways, technological information establishes the very conditions that lead to its further growth.

Less obvious is the crucial development whereby computer-based technologies manage to overcome some of the limitations of the older forms of information generation and processing that left paper-based classification and information systems, by and large, functionally incompatible or independent. Despite the fact that technologically sustained information infrastructures themselves remain to a certain degree segmented and subject to regulation (Sassen, 2004), they are involved in various ways in the homogenisation of the available information sources. They promote standardized principles of information recording and ordering that are often motivated by – or at least make possible – the crossing of the boundaries of specific and operationally independent information systems or datasets. Hyperlinks become a form that embodies this logic suggesting that, at least on the technical or syntactic plane, an information item can be brought to bear upon any possible item, without the semantic limitations and technical incompatibilities that have as a rule underlain the older practices of information generation and processing.

Interoperability, of which hyperlinks are just a surface manifestation, is a major ideal in contemporary technologically sustained information systems (Ciborra, 2006; Shiller, 2003) that is crucially related to the runaway dynamics of information growth described in this paper (Hanseth *et al.*, 2001). It contrasts sharply with the forms through which paper and traditional computer-based systems processed information. As Dreyfus (2001, pp. 9-12) suggests, older classification and information systems remained heavily tied to particular social practices and the specific kind of activities associated with them, e.g. medical or library science and the practices they gave rise to. Each system by necessity grew as the outcome of such practices that ultimately provided the horizon of meaning within which information was generated. Most crucially, such practices defined the social relevance of information and, by extension, the cognitive boundaries that the information thus generated could seldom transcend. Boundaries of this sort were further reinforced by the incompatible classification and ordering principles social practices embodied, and the technical simplicity of paper-based and early computerized systems that did not often allow for the crossbreeding of information. By breaking the self-stabilizing and functionally independent character of social practices, technologically interoperable information

brings to apotheosis the possible permutations of information items and thus reinforces and ultimately escalates the processes by which information grows. These are, in fact, the cognitive and quasi-technical foundations (at the level of the software) underlying the immense expansion of the internet and large-scale information infrastructures.

These processes are further reinforced by the increasing technological sophistication of a growing number of computer-based systems and applications. The awareness of the relatively open nature of permutations enabled by the standardized character of technological information is manifested on the rapidly growing number of technological applications (meta-devices) for extracting information out of information. Apart from the diffusion of a variety of second- or third-order devices and forms for organizing and processing information like portals and search engines, the rapid diffusion of data mining and profiling techniques provides sufficient evidence of the permutability of information and its self-propelling character. New information is, in the case of profiling techniques, produced by identifying those relations between data items that are believed to exist in databases but which remain hidden or buried under the vast amount of data contained therein. Despite the fact that associations between information items are in such cases guided by an overall purpose (often spotting behavioural patterns in recorded transactions such as money laundering or consumer preferences), the methods by which such associations are constructed are similar to those of the search engines, i.e. syntactic associations made possible through formal classification systems and algorithmic techniques. The overall outcome of these developments is to substantially increase the number of possible permutations at the same time as they add new permutable information output to the available information sources.

These observations suggest that technological information can be recombined into new patterns largely by recourse to specifically tailored software, which significantly expands the generation of new information. In this respect, the exploration of already available information manually is subject to powerful limitations. The sheer volume of data indicates that the manual exploration of information is bound to be shallow. The speed at which data mining and profiling software or search engines can run across huge databases suggests that the permutability of the technologically available information will both be enabled and constrained (patterned) by the rules through which specific software-based techniques manipulate syntactic information tokens. Yet, the capacity of these techniques to manipulate data tokens constantly expands, as their short history well demonstrates. Overall, it would be reasonable to expect that the outcome of these developments cannot but increase enormously the information output and contribute to both strengthening the runaway patterns of growth of information and intensifying the disposable character of the information thus produced. This last observation brings us into the subject of the next section.

The disposability of information

The self-accruing processes of information growth that are the outcome of the self-referential and permutable constitution of information analysed above are further accentuated by another highly elusive characteristic of information, i.e. its short-lived and ephemeral character. In the contemporary technological world, the informativeness of information is subject to rapid depreciation and technological

information essentially remains a highly disposable good (Borgman, 1999; Esposito, 2003). This claim may *prima facie* seem counter-intuitive and perhaps controversial and, for that reason, needs analytic exposition.

If information is defined by its degree of novelty, then disposability cannot but emerge as intrinsic to information, for novelty does not and cannot last much. Information that transcends its short-lived character and retains it value over time is undergoing a significant change in status. By virtue of acquiring a kind of permanence in informing social action, information is transformed to knowledge, memory or even culture (Boyden, 2003; Luhmann, 2002). It can alternatively lose its informativeness, yet retain its syntactic constitution, thereby becoming data that may be recycled into information under novel conditions that could lead to the re-interpretation of these data (Borgman, 1999; Esposito, 2003). The "news" information carries is thus by necessity evanescent and subject to easy and rapid depreciation, a trend that is substantially re-enhanced by the distinctive qualities of technological information analysed in the preceding sections. For that reason, information must be constantly renewed and updated to retain its informativeness, a condition that seems to be closely associated with the asserted self-propelling character of information growth and its runway dynamics.

Updating is crucial to technological information. Far from being accidental, the need to update information is precisely the outcome of the nature of information (as distinct from knowledge) and the expectations it sustains with respect to informing social action. Examples abound all across the information landscape covered by technological information, e.g. medical registers, taxation systems, accounting and financial systems, police archives, stock markets, and so forth. Without up-to-date information all these rather complex socio-technical systems are running the danger of losing a significant portion of their value. Indeed, compared to paper-based forms of dealing with information, one of the most crucial innovations of technological information is its smooth and constantly improving updatability. By contrast to knowledge, information is not concerned with the essence and durability of things but rather with the shifting and surface amalgamations which things (and states) enter and dissolve. Knowledge may change and does change periodically, yet its relative permanence resists what we typically mean by updating. To use another terminology, the value of information is closely tied to contingencies, to the local and event-like character of states or processes that it may help illuminate and possibly control. But it too dilutes and evaporates as the very events it tries to capture.

Paradoxical as it may seem, the disposable character of information is both what makes information useful and useless at the same time. It makes it useful as a way of filling the gap which information depreciation is prone to produce and as a means of responding to the swift parade of contingencies that beset the contemporary world of steady change. Information is needed to contemplate alternative courses of action, to act and respond timely to prevailing conditions, and evaluate outcomes in due course. But, at the same time, contingency and change too depreciate available information rapidly, making it irrelevant or obsolete and, at times, even misleading or detrimental. Uselessness itself further triggers the generation of information. The disposable and ephemeral character of information thus makes necessary the development of complex organizational and technical arrangements that ensure the continuing relevance and actuality of information through continuous updating, thereby participating in the

self-referential, self-accruing nature of information processes that characterize the contemporary world in general and organizations in particular.

Large and persisting information structures of this sort, though, in which data are stored over significant periods of time may not be thought of as subject to depreciation, at least not in the same way as information that stems or is related to events. Yet, information infrastructures substantially strengthen the disposability of information by both expanding considerably the production of new data and shortening the life cycles by which new data are produced and become available. As implied by the aforementioned claims, the value of information dilutes even in large structures if these last are not constantly updated and upgraded. But constant updating of information and upgrading of the computer-based systems by which it is sustained inevitably result in the depreciation of the old information, along the lines suggested in the preceding sections. For the new elements that are added to existing information bases inevitably reframe the information contained in them, rendering obsolete some pieces of information and changing the value of others. In large-scale information structures, such a process tends to get naturally accelerated by the massive character of incoming technological information and its fast accumulation. Once again, the depreciation of the old content of information may not need to imply that the syntactic, material expression of that content (i.e. as data) is itself depreciated. This last may still retain and even increase its value. The perception of the counter-intuitive and perhaps controversial character of the claim concerning the disposability of information is often the outcome of the inability to systematically separate data from information.

In sum, disposability and depreciation are constitutive characteristics of information that find a clear manifestation in the quest for its continuous updating. Indeed, updating, like the speed that keeps the aircraft flying, is both an expression of and at the same time a solution of the intrinsic information qualities of disposability and depreciation. These qualities, I suggest, are crucially involved in the escalating pattern of information growth while they also provide an explanation of it. For the pending dilution of information value drives a self-defeating yet inescapable game, resembling in many respects the effort to catch the wind, to compensate for the imminent evaporation of the advantages it offers. Strangely enough, the more information is produced the greater the disposability of the available information. The cycle is virtuous or vicious, depending how one wishes to see it. Usefulness rapidly dissolves to uselessness, which forms a precondition for the usefulness of pending information.

Complexity in this sense is the product of the very constitution of information processes, their intrinsic relational nature and character, rather than simply the outcome of the multiplicity of components defining the information landscape and the increasing interconnectedness of systems and operations. It is the very disposability and the steady production of information out of information that evade manipulation, planning and control in the ordinary sense of these words. There is no way to arrest in advance the pattern of information disposability. That it becomes obsolete and irrelevant is the outcome of the interaction of many factors, among which the production of information, itself hardly predictable, is crucial. While particular aspects of information processes may be amenable to control, in the sense of being successfully deployed to assist the accomplishment of particular tasks, intention increasingly dilutes as one moves towards the greater ecology of processes, systems and operations

sustaining the production of information in organizations and the contemporary world at large (March, 1989, 1994; March and Olsen, 1976). Quite obviously, the interconnectedness of systems, information sources and operations further increases, as demonstrated in the preceding section, the complexity of the processes under which the production of information takes place. In particular, the standardization of software components vastly increases the combinability of information items and in this respects contributes to the aforementioned escalation of information growth and its disposability.

Concluding remarks

This paper has put forth a number of ideas that hopefully begin to shed some light on the current dynamics of information growth. The vast amounts of information generated and stored everyday is not the natural response to the information needs that may be underlying institutional life. To be sure, part of the information currently generated in the various settings of contemporary institutional life may conform to such an ideal. Yet an increasing part of current information is produced out of a matrix of technological and institutional relationships that cannot be accounted for by a quasi-rational, means-ends analysis. Information is often identified as useful only after it has been produced, while new needs and usages develop upon its sheer availability, thus producing new information in an expanding spiral.

Rather than being the outcome of deliberate planning and action, information growth, this paper claims, develops in a self referential and self-propelling fashion that reflects three key and intrinsic characteristics of information. First, information has a dual value as a description of a reference domain and as a relationship such a description may have or come to develop to already available descriptions within that domain or across reference domains. An inevitable concomitant of this systemic or structural view of information is the intrinsic possibilities it provides for the production of information out of information. Second, the interoperable character of contemporary information infrastructures vastly expands the permutability of information items and sources, and thus considerably contributes to the production of information out of information and the self-propelling, runaway dynamics underlying information processes and their growth. Third, information growth dynamics is intimately connected with the perishable and disposable character of information. The informativeness of information is by definition a transitory accomplishment and its pending dilution of value must thus be recompensed through its ceaseless updating and reproduction.

Abstract as it may seem, such an account of information processes may not be devoid of implications. Indeed, two broad sets of implications could be sketched out, one for information policy makers at various levels, the other for the practice of information management at the micro level. Both these sets of implications are however shadowed by the wider understanding of information processes advanced in this paper and the basic claim that contemporary information growth dynamics to a considerable degree escapes the deliberate and controlling strategies of social agents. If, after all, such processes evade human control, then the effort to analyse them in order to improve the quality of operations, which these processes sustain, would seem to be futile. To be sure, the understanding of information growth advanced in this paper predicts that any attempt to control information growth processes is subject to

powerful limits and may even produce unwanted and unanticipated consequences. Yet, such an understanding is itself important for it cultivates a series of attitudes and predispositions *vis-à-vis* the relative processes that may be underlain by a deep awareness of the complexities involved and on this basic exhibit care and consideration in dealing with information along the lines described by Ciborra and his associates (see, for example, Ciborra, 2002; Ciborra, 2000). Knowing the duality of the effects particular actions may bring can never be harmful.

But there are other implications for the design of social systems along the lines suggested by Perrow (1984). Even though wider information growth processes can neither be understood in terms of individual initiatives nor fully be controlled by locally embedded actors, particular zones of this complex aggregate may be subject to some control and deliberation. As Perrow (1984) has suggested, the loose coupling of information systems and processes may be a key strategy to follow whenever the impact of connections and the understanding or control of cause-effects relationships is partial. However, as I have shown elsewhere (Kallinikos, 2005), loose coupling as a strategy is at odds with the overall project of interconnectedness and interoperability that seem to be underlying the current development of information systems and large-scale information infrastructures. What the present paper makes clear in this respect, and this is in itself a theoretical contribution apart from the practice implications this paper may have, is that we lack an adequate theoretical understanding of the factors and processes underlying the contemporary information growth dynamics.

With the exception of the tradition once pioneered by Rob Kling (see, for example, Kling, 1996; Lamb and Sawyer, 2005; Wood-Harper and Wood, 2005), sociologists do not study information growth dynamics. Information systems scholars, on the other hand, have traditionally been preoccupied with the design and implementation of individual systems, no matter how large and important these may have been. Therefore, the intermediate zone where information systems and information processes encounter wider societal concerns has remained underdeveloped. This paper sought to make a contribution in this respect and the major claims it has advanced can constitute a point of departure for the study of information processes that develop beyond the boundaries of particular systems and organizations. It goes without saying that such a project will have to involve empirical investigations of processes that are taking place in populations of organizations, and information and organizational fields, in a perhaps analogous way that neo-institutional theorists have studied the diffusion of administrative techniques and models of organizing (DiMaggio and Powell, 1983; Fligstein, 1990).

The ideas advanced in this paper do have implications for the design and implementation of particular systems, because they suggest that the current problems facing the development of information systems and the organizational contexts on which they are brought to bear are much more insidious and complex than what has often been assumed. A few established truths may accordingly be understood in a new light, and ultimately reframed and changed. The design and development of information systems cannot be an isolating enterprise, which is supposed to transform legible and clear user requirements in software code. Even simple yet basic concepts and principles such as users and requirements elicitation tend to acquire new meaning when information processes are understood in all their complexity and scope (Lamb

and Kling, 2003). How can one design and develop systems that take into account the current dynamics of information processes is, however, a highly intricate enterprise and demands lengthy and persistent effort that goes far beyond the purpose of this paper.

If the control and effectiveness of information processes and the systems by which they are supported can only modestly be achieved then the development of information infrastructures in organizations and alliances of organizations becomes a major issue. Each information system that is installed in order to improve an organization's control of the contingencies underlying its operations may indeed do so but at the same time may produce information that casts new light on the basic conditions underlying the operations of the organization. Awareness of the complex and unpredictable character of these processes may never be without implications.

Notes

1. Defined by the *Oxford Dictionary* as "The quality or condition of being informative".
2. Another way of framing the issue is to say that semantic information differs from the signal organization and the rule-based manipulations of syntactic tokens that is the domain of the engineering of information. Even if one accepts the common claim, already advanced by the information theory's founding fathers (Shannon and Weaver, 1949), that semantics is irrelevant to engineering aspects of information (i.e. data) while the latter may always impact the former, it is nonetheless legitimate, indeed imperative, as we will hope to demonstrate in this paper, to study the dynamics of information growth at both levels (see also Devlin, 2001).
3. Global and continuously updateable databases that are deployed as a means of providing background knowledge for the making of insurance policies on the basis of risk analysis are every now and then referred to as GRID (global risk information databases) technologies (see Shiller, 2003, chapter 14).
4. It should be noted that this argument bears a strong affinity with structuralism in linguistics and semiotics (see, for example, Eco, 1976; Leach, 1976).
5. An analogy could perhaps be drawn here to fractal theory.
6. As we will see later on, some of these combinations can themselves be controlled technologically through the construction of software developed for that purpose, i.e. profiling software.
7. These claims have been made with elegance and persuasive force within the linguistic tradition referred to as post-structuralism (see, for example, Cooper, 1986; Derrida, 1978; Kallinikos, 1995, 1996).

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