An observer-relative systems approach to information

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Abstract

By returning to the foundational principles of second-order cybernetics and resting on the central role of the observer, this essay explores how the distinction between data/information can be conceptualized. Using systems theory, we derive a series of systemic principles for the distinction between data/information and we illustrate them with a case study from Anti-Money Laundering.

1. Introduction

At the very heart of the field of Information Systems (IS) lies the concept of *information.* However, despite the critical importance of this concept along with the concept of the *system,* IS scholars have not really engaged with the combined theoretical challenge of exploring both. Approaching this topic systemically can allow us to delve deeper into the character of *both* data and information. We say *both* because systemically, as we shall see, it is not possible to 'define' one without referring to the other. This essay joins the call of several scholars that have stressed the need to investigate information further [8, 21]. Boell for example [3:3] stresses the need to develop frameworks that can "help IS researchers, practitioners, and students when they seek general orientation into how information can be conceptualized". Taking a step towards such a framework, we develop theoretical propositions from the body of systems theory, in the tradition of second-order cybernetics [2, 9, 16]; our goal is to reflect on the distinction between data/information through systems theory, in the context of an observer-relative approach. The essay is structured as follows.

The second section of this essay reviews in brief the main 'camps' of information. The third section delineates the key systems theoretical concepts and develops the relevant propositions. In the fourth section of the paper, the propositions are illustrated and applied through a sample case on anti-money laundering. The final section offers brief conclusions.

2. Related work

While there is no consensus or strict definition of *information* (or of an *information system* for that matter), we often tend to think of data as having some type of relation with the concept of information.

In tracing the different strands of information perspectives, Boell [3:10] provides a very useful classification and delineates four main stances on information at an ontological level: a) the *physical* stance where the existence of information can be conceived as independent of a human observer and is part of the physical world, b) the *objective* stance where information is observer-independent in the sense of true facts or physical inscriptions of knowledge, c) the *subject-centred* stance where information exists as cognitive process resulting from an observation, d) the *sociocultural* stance where information exists as shared sociocultural understanding of the importance of differences. Mingers and Standing [22:18] also identify the two main camps of *information as objective* (and independent of the receiver) and *information as subjective* (constructed by the receiver). While these categorizations are useful and we would like to position our essay in the subject-centered stance due to the primacy we shall place to the concept of the *observer*, we must stress that any categorization is in itself a product of observation that then abstracts the observer away [1]. In this regard, the concept of information is possibly one of the most challenging ones due to the level of abstraction that one has to attain for its description. For this reason, we develop the discussion starting from fundamental principles that relate to the function of an observer. We stress again that we're not trying to define data or information uniquely. This means that, from within the context of our analysis, neither information nor data can be 'defined' as standalone entities. They need each other, a boundary between them, and an observer.

In order to facilitate the discussion that follows, we will be extracting a set of theoretical propositions (designated as P_1, P_2, P_3, … P_n) through the application of systems concepts. Thus, the development of these principles has been weaved in together with the theoretical review.

3. Information through theories of distinction

Imagine a void (if that is physically possible) or more simply, a blank sheet of paper. Then *draw a distinction*. This could be a circle, or a mark like the one that Spencer-Brown [26] uses in his algebra:

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Figure 1. The form of the distinction

What happens to that void or blank space once a distinction has been drawn? In basic terms, we can say that the space has been severed and two distinct spaces can be recognized: a marked space (e.g. within the circle) that represents the 'inside' and an unmarked space that represents the 'outside' (e.g. external to the circle). This is the starting place that we take, following George Spencer-Brown [26] who builds on the concept of distinction as the fundamental starting point of any act of observing. Luhmann also places a paramount significance onto the primacy of distinction in relation to observation. For this issue he remarks that "the world is observable *because* it is unobservable. Nothing can be observed (not even the 'nothing') without drawing a distinction…" [17:87].

Everything else that follows in this essay, stems from this fundamental starting point through which all the rest unfold: we "take as given the idea of *distinction* and the idea of indication" [26:1]; we cannot make an indication without drawing a distinction. In other words, distinction is the starting point of all analysis, through which, "once a distinction is drawn, the space, states, or contents on each side of the boundary, being distinct, can be indicated" [26:1]. Put differently and as established by Spencer-Brown [26:ix], any indication implies duality in the sense that we cannot produce a thing without coproducing what it is not. In turn, this duality implies a "triplicity: what the thing is, what it isn't and the boundary between them". Or else, "you cannot indicate anything without defining two states, and you cannot define two states without creating three elements" (p.ix). The primacy of the distinction is fundamental, as is the role of the observer in defining a state. Following Spencer-Brown then, a number of questions are raised if we take the concept of 'information': what is information? What *isn't* information? What is the boundary between these two states?

The moment we draw a distinction, we indicate two distinct sides (a marked/observed side, and an unmarked/unobserved side). A convention in systems theory has become to call the space created inside the distinction the *system* and the side outside of it, the *environment*. Between the two, one can find the boundary. Then, the central paradigm under which we inform our systems theoretical analysis is neither the system, nor the environment, but the "*relationship* between system and environment" [16:176] (emphasis added). Thus, in our context, it is neither data, nor information, but the relationship between data and information. It is important to emphasize that "the concept of the environment in relation to that of the system, should not be misunderstood as a kind of residual category. Instead, relationship to the environment is *constitutive* in system formation…the point from which all further investigations in systems theory must begin is therefore not identity but difference…the system is neither ontologically nor analytically more important than the environment; both, are what they are only in reference to each other" [16:176–177]. Thus, we reach a first important principle that is general in systems theory:

P_1: We can only observe by drawing a distinction that indicates two sides (e.g. system/environment) and both are what they are only in reference to each other.

So when we are considering the application of P_1 to information and what information is not, we need to recognize that neither *data* nor *information* can ever be defined uniquely (this applies to all words as language itself is a self-referential structure where each word is 'defined' by others, *ad infinitum* as noted by Korzybski [15]). Furthermore, strict definitions of either data or information will fail as any effort to define them would equate to the creation of an "isolated ontology"; this is an impossibility based on P_1. However, data and information can be approached relationally and considered as sides of a marked/unmarked space (e.g. system/environment). Thus, the task at hand is to place these two concepts (data and information) on the sides indicated by a primary distinction like system/environment.

So how should we start to explore the relationship between data and information? At this stage, two options present themselves if we were to start with data. The first option is to consider data as part of the *system*; the second option is to consider data as part of a system's *environment*. However, in the context of taking an observer-sensitive approach, we posit that data can only be considered as part of the environment. This may be taken as an axiomatic position on our side but there is a logic behind this decision: once we consider the primary distinction to be that between system/environment and the elements that need to be placed on either side to be data and information, then we have the following combinatory possibilities.

#	***System*** (marked space)	***Environment*** (unmarked space)	**Distinction**
1	Information	Data	information/data
2	Data	Information	data/information
3	Information	Information	information/ information
4	Data	Data	data/data

Table 1: Elemental distinctions of data & information

We shall illustrate our preference for option one by using *reductio ad absurdum* for the remaining options (a reminder here that this does not only mean that we eliminate *absurd* propositions but also those that are impractical or irrelevant in a specific context). Thus, the starting point of the application of *reductio ad absurdum* for us, is the context of an *observer-relative* analysis. We focus on the impracticality of the remaining options.

The fourth option (#4) whereby we have data both in the system *and* in the environment does not concern us as no observer is participating in the interactions between the system and its environment. If an observer internalized data then we would have information. But in option #4, we have both the marked and unmarked spaces containing identical elements (data/data); this essentially reflects a data processing system where there is no interference of a cognitive entity (i.e. a human being). As we will see in a moment, we consider that to be an essential part of using the concept of 'information' as part of any distinction.

The third option (#3) between information/information requires two distinct observers (one in the system and another one at the environment of that system). This would imply that the observer in the system receives the information that was communicated by the observer in the environment. Furthermore, this would demand perfect communication between these two cognitive observers. This is an impossibility. As Luhmann notes in a much discussed quotation: "humans cannot communicate; not even their brains can communicate; not even their conscious minds can communicate; only communication can communicate" [16:71]. Whatever is being communicated from one observer to another, it cannot be the information that exists in the cognitive state of an observer. Information in an observer's cognitive state would need to be depicted in a notational schema (e.g. language, mathematics, etc) before being announced/uttered. The very act of depicting a cognitive state of an observer into a form that can be communicable, reduces its complexity [1]. In that sense, information is the observer-relative/cognitive state that exists prior to communication. When an observer seeks to impart information then he/she needs to reduce its complexity so that it can become part of a semantic space and then a communications channel. This necessary complexity-reduction (of information that an observer wishes to communicate) is required so that information can be uttered; more critically, when this happens, information collapses into a state of being pre-observed (or waiting to be observed) and could thus be classified as data (instead of information). In this sense, we cannot have information without redundancy [14]. As Luhmann frames it: "Information is the surprise value of news, given a limited or unlimited number of other possibilities. Redundancy follows (in a circular fashion) from the fact that information is used when autopoietic systems operate. An operation reduces the selection potential from other contributions. A sentence, for instance, reduces the scope of contributions that fit into it" [19:33]. Thus, in the process of dismissing #3 for our primary distinction, we are led to pose a rather counterintuitive proposition, but one that is in line with the preceding discussion in an observer-relative context:

P$_2$: Information cannot be communicated (not without suffering a necessary reduction in its complexity); it is observer-sensitive.

Of particular interest is our last remaining option (#2 where we have data in the system, information in the environment). This distinction however is meaningful if and only if there is an observer in the environment. For such an observer, without any loss of generality, we could assert that they – from their own observing perspective – would consider information inside their own marked space (*their system*). In this regard, this reversal would end up in the same form with option #1. Thus, option #2 would coincide with option #1 in the context of an observer-relative system. All options considered, we are left with option #1 where we retain information inside the system and data in the environment of that (observing) system. In brief, whatever data is, it can be found in an unmarked and unobserved state where the observer does not observe.

P$_3$: Data is always in the environment of a system and part of an unobserved/unmarked space. It becomes information once the space on the 'inside' of the distinction between system/environment (i.e. the observing system) internalizes data.

In this context and using Spencer-Brown's notation, an information system could be represented in the following way (Figure 2) and defined as follows: An *information system* is a demarcated state, a space where an observer-relative transformation occurs and data crosses a systemic boundary to become information. This requires a cognitive observer. Alternatively, it would have required a mechanism capable of spontaneously creating distinctions through which this transformation can be realized (e.g. some future artificial intelligence).

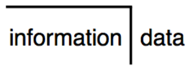

Figure 2. An observer-relative information system

There are two consequences to the above definition and the primary distinction between information/data. First, the centrality of the concept of the observer in indicating the two sides is fundamental; information is entangled with the observer. From this perspective, we cannot have information without observers, only data. Second, the indication created by the distinction between system/environment as information/data, highlights an important role for the boundary. The boundary is ontologically neither part of the system nor of the environment [18]. It is part of both. Through the boundary, the transmutation of data to information becomes possible. Through the boundary, the multiplicity of *informational potentialities* that exist in data is selectively internalized by the observer. We define the concept of *information potentiality* to be a characteristic of data prior to systemic (and thus observer-sensitive) internalization. Or else, if we consider the exact same data entity to be observed by different observers then each of these observers would generate different information; such variation in information will emerge from the interaction of the observer with the data. Thus, data entails a multiplicity of information potentials and these are selectively reduced by an observer that will allow for the emergence of information.

P$_4$: Data entails a multiplicity of information potentialities which are selectively reduced by an observer.

In this context, the boundary between the system and the environment (ultimately in our context the boundary between information and data) plays an important role in shaping the mode with which data becomes internalized. Though it would take another paper altogether to explore in-depth the boundary conditions that shape the transmutation of data to information and vice-versa, it is important to emphasize that it is the (observing) system that 'controls' the sensitivity of the boundary [16], thereby affecting the dynamics between itself as an *information* system VS its *data* environment. Let us explore these aspects (the centrality of the observer in information *and* the role of the boundary) a bit closer.

First, as we have already noted based on P$_1$, the function of the observer is to create a distinction to begin with. Without the concept of the observer, the distinction would not have been possible. Thus, the form of the distinction is only in the eye of the observer. One example here comes from Heinz von Foerster who describes a piece of paper with letters/symbols on it. We can think of this as 'data'; they are in a sense, some symbols in a piece of paper. Foerster then argues that only when *you* (i.e. the *observer*) look at the paper, you *generate* the information. As he put it: "information is generated in the one who looks at things" [11]. Of course, this condition presupposes a cognitive observer that can create a distinction through which the indication between information/data becomes possible. The crossing from the unmarked state to the marked state places the relationship between information/data within the remit of an observer. In addition, this affects how data can be defined *relationally* through *both*: a) the concept of the observer, *and,* b) the concept of information. These aspects lead us to establish the following:

P$_5$: Information presupposes the existence of an observing system (i.e. a system capable of creating distinctions spontaneously); data is what exists *before* observing.

In other words, the observer plays the most pivotal role in a sequence of fundamental operations. These are interlinked with how any space becomes marked/unmarked and how the distinction between information/data can be conceptualized. For a first-order observer that is engaged in the act of observing, we have the substitution of the subject/object paradigm to the triplicity mentioned before. Thus, we have an observing system, a boundary, and an environment. Applied to the distinction between information/data we have: an observing information system, a boundary (whereby feedback processes between information/data exchanges take place and the information system enables the transformation from data to information), and of course, an environment of data.

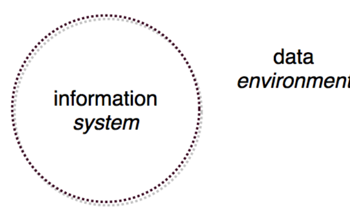

Figure 3. Observer-guided information/data systemic differentiation

A second-order observer, who can act as an 'observer of observers' may subsume the distinction above into his/her own marked space, but not without creating yet another unmarked space [19]. However, regardless of the level we're looking at observation, for any given observing system, the environment is always more complex but that does not mean that the environment has no structure [16]. Indeed, observers exist in the environment as well. In both cases, the form of the distinction (system/environment) remains the same as another observer in the environment would create another distinction that would have the same system/environment form. This has implications for information/data. As each of them creates unique system/environment (and thus information/data) differentiations, then

P$_6$: The observer-relative nature of distinction-making implies relational conditions; coupled with the idea that the environment has structure, data can be *data* for one observing system (if it remains at its environment) and *information* for another observing system (if that system internalizes such information).

Once again, from a different relational angle we come to the position that there is no information without an observer. Here, we must make a clarification. While an obvious observing system would be a human observer, an organization can also be considered to be an observing system since every organization observes itself and its environment and based on these observations, it reproduces itself [24]. Of course, the latter does not involve cognition. Also, we leave open the potential of a future artificial intelligence as another observing system capable of enabling the transformation illustrated in Figure 2.

Furthermore, the role of the boundary between any system and its environment is critical. While the separation between system/environment is a starting assumption in systems theory and a primary distinction, we've already mentioned how it demands a triplicity and a boundary between the two. Of course, "a system boundary never just is, ontologically, but is always coming into being as part and parcel of the system's total ontogenesis, or as this will come to be called, *autopoiesis*." [4:98]. As systemic ontogenesis (i.e. the act of a system coming into being) is observer-dependent and observer-relative, the role of the boundary in the distinction between information/data is 'controlled' by the observer. The observing information system makes (*poies)* itself (autopoiesis), it identifies itself as an information system, by establishing a boundary between itself and its environment. It uses its environment (i.e. data) in order to maintain and organize itself (self-organization). By the concept of a self-organizing system we mean "a system that eats energy and order from its environment" so that it can increase its own internal order [9:8]. In that way, in the short term, the system can (attempt to) become *negentropic.* Negative entropy (negentropy) is perceived as contrary to entropy - the thermodynamic principle that systems run down to ultimate disorder or death. A good example to reflect on these conditions comes from evolutionary biologist Ernst Mayr who describes that this is what every member of every species on the planet does, humans of course, included. As (biological) systems, we exploit the resources of our environment (natural resources) in order to avoid temporarily our natural tendency towards maximum entropy. For instance, if you stop eating and drinking, it won't be very long before yourself (as a biological system) is driven to its maximum state of entropy (i.e. death). But even though that state of maximum entropy is unavoidable in the long-run, in the short-term we are able to survive and flourish. We do that by consuming energy from our environment and so our system (the organism) becomes negentropic in the short-term by exploiting these resources from its environment [20]. It is through a similar mechanism that information systems develop an autopoietic character: they consume data from their systemic environment and through such consumption, they maintain themselves. Applied to an information system:

P$_7$: Information systems support themselves in the autopoietic sense by consuming data (equivalent to a source of energy) from their environment. They do so in order to become negentropic in the short run.

While this negentropic pursuit remains a general goal orientation for any system that seeks to survive its (more complex and demanding) environment, it also raises further questions as to how this is achieved, pursued, or even structurally configured by the system. With the fear of stating the obvious, the richness of the IS literature in dissecting IS failures, illustrates that information systems can also be swayed towards a state of maximum entropy and an information 'death'. This depends on how the (information) system enables the transformation of (part of) its data environment into a reduced, and thus, more manageable stream of information potentialities, before the users/observers internalize those as information. Building on the work of von Foerster [9] who addressed the connection between the system and the order it can consume from its environment, the following question can be raised: how much informational order can a system assimilate from its data environment, if any at all? While the quantitative rendition of this problem through the concept of entropy was introduced by Shannon to indicate *the capacity of information transmission in a communication channel,* it is important to remember here that Shannon's constructs relate to communication from an engineering perspective. Strictly speaking, these relate to 'data' and not 'information'; this is because meaning does not, and of course, cannot enter the equations. To add to the confusion, Shannon's theory developed in the "Mathematical theory of communication" [25] is widely referred to as 'information theory'. However, as documented by Heylighen & Joslyn, "while Shannon came to disavow the use of the term 'information' to describe this measure, because it is purely syntactic and ignores the *meaning* of the signal, his theory came to be known as Information Theory nonetheless" [13:7].

In this regard, we must state clearly that the conceptual basis of the IS field, as it has evolved by recognizing an interaction between the technical and the social, and a role for human agency (however limited on occasion), cannot have a theory of signal transmissions as its foundational basis, one that is absent of 'meaning' and 'observer' considerations. Ultimately, the communication channel (*a la* Shannon) is a carrier for signals, *data* alone; such data enables a multiplicity of information-potentialities to be extracted by different observers. In other words, the observer internalizes and activates a particular selection of data that will cross over from the environment so that the emergence of information can surface. In this manner, we view the information-potential that can be extracted from data, not as an objective property that characterizes data itself. It is dependent on different observers. Different observers will assimilate a different 'order'. Also, strictly speaking, the information is not generated in the human observer from data alone (in a one-to-one correspondence relationship). Information *emerges* in the cognitive observer when the observer relates the transformation of data to information and connects the latter with already existing knowledge.

4. An illustration of principles with Demetis' case study on Bank X on Anti-Money Laundering

In this section, we use a case study presented by Demetis [7] at Decision Support Systems about the role of technology in fighting money laundering in order to illustrate the principles presented in the previous section. While the analysis here does not substitute the in-depth case study, it gives us the opportunity to illustrate how the principles can be considered in an organizational context. Before doing so, we describe the institutional context in brief.

Banks (and several other reporting institutions like insurance companies, casinos, etc) are obliged to monitor transactions for potential money laundering (ML) behavior. When they think they've spotted suspicious behavior they have to file a Suspicious Activity Report (also known as a SAR) with the authorities who are tasked to investigate further and forward such cases for prosecution if there's enough evidence. The banks use a variety of data for establishing suspicion but the starting point is always *raw transaction data.* These are filtered through transaction monitoring systems that apply a variety of algorithmic queries in order to flag suspects. Members of staff would then evaluate such technology-oriented flags manually and would escalate the issue internally to the Money Laundering Reporting Officer (MLRO). In turn, the MLRO would submit these reports to a national authority, known as the Financial Intelligence Unit (FIU) that analyses all reports and may forward the cases further for prosecution. In the case-study itself, Demetis presents a series of internal, external and self-referential structural couplings in the context of AML and Bank X [7:101]. We will use those in the examples and analysis provided below.

4.1. P_1: Observing by drawing a distinction

Based on this principle, an observing system draws a distinction that indicates two sides (e.g. system/environment) and both are what they are only in reference to each other. Each observing system draws its own distinctions. In the example case of AML, the primary distinction that is being used is between the *bank* as a system and its environment (the environment here includes law enforcement, other banks, the financial intelligence unit, prosecution authorities, media, etc) however a number of subsystems in the bank are also analyzed. Informed by the case study of the bank, we can distinguish three different forms of *observing systems*: i) the entire bank as an observing system (the whole of the system) that distinguishes itself from its environment, ii) a department within the bank like the AML department or the marketing department (i.e. an observing (sub)system within the system) that distinguishes itself from both its internal environment (i.e. the other subsystems) and its external environment, and ultimately, iii) human beings (e.g. a member of staff in the AML department) as the *cognitive observing systems that can enable the transformation of data to information*. Thus, we can distinguish three different observing systems from the AML case study that relate to the financial institution.

Two more general types of observing systems that can be distinguished from the case: i) an observing system that is set up to receive data from its environment and, ii) a *cognitive* observing system (i.e.

a human agent) that is capable of the actual transformation from *data* to *information* We use the accepted Unicode symbol [12] for the observer (👁) to mean the following sentence: '*from the perspective of the observing system of the…*'. For example, the phrase "from the perspective of the observing system of the bank" can be written as "👁 bank". We use this to indicate an observing system in general and the combination "👁 human" would represent a cognitive human observer.

4.2. P_2: Information cannot be communicated; not without suffering a complexity-reduction

Unlike data, information is not a commodity which can be passed on from one observing system to another without any meaning modification, re-interpretation, or adjustment. No two observers can conceive of exactly the same thing as that would lead to a paradox of their identity. Furthermore, the "newness" [2] that any given information comes to bear on an observer is not an objective property of information. The emergence of information is itself contingent on the observing system wherein information emerges. In brief, if we take the observer into account then information cannot be communicated.

In the case study of the bank, Demetis [4:103] describes several mechanisms with which members of staff, ML analysts in particular, generate information about customer suspicious behavior by internalizing data. Based on P_2, this information emerges within the observer and cannot be communicated as is. An illustrative scenario is when a ML employee internalizes data from flagged 'suspect' transactions by using the transaction monitoring system. The case study describes a series of factors like staff experience, training, perceptions about transacting & lifestyle behavior of suspect, and other behavioral characteristics that affect the communication of suspicion by the ML analyst. In this specific case, as the true positive rate of the software (the rate at which ML cases generated by the software were confirmed as *true suspicions* once members of staff scrutinized them) was very low at first (starting at ~1%), high levels of staff demotivation also became an important consideration, with staff becoming wary of scrutinizing transactions carefully. From the case, it becomes evident that a large number of characteristics affect how ML staff come to decide about whether a customer is suspect or not. These are not only their interpretations of customer behavior and transacting, but also personal, behavioral, psychological aspects of the staff themselves (their training, experiences, cases they've handled previously, etc). Ultimately, many different observer-relative elements converge into shaping the boundary between data and information. This deep nexus of observer-sensitive characteristics that have meaning for an observer and influence the process of information emergence, must face a necessary reduction in complexity if they are to be communicated. Without such a reduction, the observer would not have been able to depict what he/she perceives as information into a notational schema (in this case-example, ML staff submit an internal report to the MLRO, describing why a customer is suspected of money laundering). Of course, by default, the very use of a notational schema (like language), reduces the level and complexity of communication itself (a necessary prerequisite for its structuring). Ultimately, 👁 human analyst, information is reduced to data that can be communicable, and 👁 MLRO, such data is internalized as information based on another ecosystem of his/her own observer-sensitive characteristics and additional considerations. In the narrative of the case, Demetis describes an instance where 👁 MLRO, all the 'suspicious cases' that were communicated by members of staff to the MLRO, were passed on to the Financial Intelligence Unit of the country, as the MLRO felt that there was no way of knowing whether in a national context the case could be suspicious (👁 MLRO, the data 👁 human analysts were internalized as information by considering characteristics external to the system). In turn, 👁 FIU who became inundated with SARs, this became data at the environment of their own system that would be internalized based on organizational and individual/analyst conditions, requirements, decision making processes, and so on. But at any given stage, what is actually communicated is *not* information, not in the way this was generated within a human observing system within the cognition of the observer; what is communicated is a collapsed and simplified form of the observer-sensitive information. This then becomes part of a communication channel, to be then perceived as data at the environment of another observer before being re-internalized as information. While we admit that P_2 is counterintuitive, this is actually in agreement with Shannon's work [25] whereby the social context, the human element, and indeed, the concept of the observer do not come into the picture (in fact, the word 'observer' is featured just twice in Shannon's work to indicate an "auxiliary device" that "notes the errors in the recovered message and transmits data to the receiving point"); not a human agent as we would include that agent in IS research.

4.3. P_3: Data is always in the environment of a system

As we’ve noted in section 4.1., we have different levels of observing systems. However, regardless of what observing system perspective we may take, P_3 applies. We will look into this by following a sequence of how data becomes internalized from the system (the bank), the subsystem (the AML department), and the ML-analyst (the cognitive observing system), before being evaluated from the Money Laundering Reporting Officer (the MLRO) and sent to the Financial Intelligence Unit (FIU) at national level. The sequence is: Bank → AML Dept., → ML-analyst → MLRO → FIU. So, 👁 bank, data is at its external environment as raw transaction data. In turn, 👁 AML department (as a subsystem), according to the case study of Bank X, a subset of raw transaction data commensurate with ML-profiling practices would be the data at its environment. These enter first the boundary of the bank as raw transaction data and then are reduced in complexity by the transaction monitoring system of the bank. The output of the transaction monitoring system of the bank would in turn be internalized by money laundering analysts. As the cognitive observing systems, the ML-analysts have to decide whether a transaction is suspicious enough to be explored further, or not. Thus, 👁 human analyst, data at his/her environment includes the transactions that have been flagged by the software as potentially high-risk (as well as the raw transaction data that are at the environment of the bank as a system’s environment is also a subsystem’s environment). The human analyst would internalize such data and generate information that is observer-relative. In internalizing such data, the ML analyst connects it as an element to a nexus of other elements in his/her experience and previous knowledge. From this process, the human analyst generates information on whether the *potential* suspect for ML is truly suspect (again 👁 human analyst) or not. However, once the human analyst generates this information, P_2 applies (where information cannot be communicated without a necessary reduction in its complexity). Based on the case example, the assessment 👁 human analyst will be depicted in an internal report (an internal Suspicious Activity Report), and this will become new data, at the environment of other observing systems. In this case, the observing system is the Money Laundering Reporting Officer who is at the board of directors and responsible for the bank’s compliance. In turn, 👁 MLRO the data at the internal suspicious activity report need to be internalized by him/her so that another decision can be made. This re-activates the main distinction encapsulated within the internal activity report (between suspicious/non-suspicious customer) and the MLRO may decide to reinforce one part to the distinction (e.g. suspicion) or dismiss it. In turn, when the MLRO submits a Suspicious Activity Report to the FIU that is an intelligence agency at a national level, 👁 national authority, this is data again that has to be internalized and evaluated. Ultimately, as the primary distinction between any given system and its environment is relational and dependent on the observing perspective of a system, data is always at the environment of a system. How it becomes information is contingent on a series of interactions and boundary conditions and is down to individual cognitive observers and how they communicate.

4.4. P_4: Data entails a multiplicity of information potentialities

As we’ve noted, the bank itself is set up in order to receive a specific kind of data from its environment; in this case study, 👁 bank, this is *financial transaction data* from its customers (while there are other data in the environment of the bank like media and social networking services). In transacting with the bank, the customers essentially create the data that will cross the systemic boundary of the bank and find its way into the bank’s databases. This is where different information potentialities can be realized and redirected to different observing systems (before they are internalized as information by members of staff). From the case study of the bank that discusses how money laundering is profiled from different sources, we find examples of marketing and fraud related data that are used for money laundering profiling, while other data from the environment like enquiries from law enforcement agencies are also used. Here, the multiplicity of information potentialities that data holds is expressed in two ways in the bank. First, a more general observation is that the exact *same* data from the environment (i.e. raw transactions by customers) is used by different departments of the bank; in that way, transaction data are selectively reduced to different information potentialities. For example, the same (raw transaction) data can be used to: a) profile money laundering 👁 AML subsystem, b) market new products or services like pre-paid cards, loans, etc, 👁 marketing subsystem, c) find new sales opportunities 👁 sales subsystem, d) monitor fraud related activity 👁 anti-fraud subsystem, e) assess human resources required to handle new lines of business based on volumes of transacting and customer preferences 👁 HR subsystem, and many more. Data itself holds a multiplicity of information potentialities depending on what observing system will attempt its internalization. However, it only becomes information when a cognitive observer internalizes this data and generates the information that has meaning for that particular observer.

Quite often, as Demetis points out in the case study, the organizational structure and the hard divisions between departments will make it difficult for some observing subsystems within the bank to realize this multiplicity of information potentialities. We would argue that this is because they misconceive what they have as 'information' that has already been internalized for the purpose of the subsystem, instead of 'data' that holds a multiplicity of (external to the observing system) information-potentialities. An example comes from the AML department that wanted to enable its members of staff to generate information (and thus, internalize it for their own purposes, meaning, and subsequent decision making) regarding suspicious behavior for ML from demographics data used in the marketing department. This data was originally only used for - strictly - marketing purposes by marketing staff. Initially, when AML staff approached marketing staff with the idea of using marketing data for money laundering investigations, this did not register at all with the latter as they could not see the potential at all. This was until AML staff asked marketing staff: "How would you market a product to a money launderer?" [7:100] This illustrates further that for any given human observing system within a subsystem (say members of staff within the AML department), data at its own environment entails further information potentialities even if it has been internalized by another observing subsystem. There is no limit to how this can be realized as the system/environment distinction is replicated internally within the system and can be realized as the distinction between information/data across different levels. One can draw parallels here with John Searle's work with computation that must be *observer-relative* and that the one and the same process can be interpreted as different computations by different observers, a principle that he calls *multiple realizability* [23].

4.5 & P_5: Information presupposes the existence of an observing system; data is what exists before observing

These two principles are complementary and express the primacy of the observer in relation to information. For data to exist, some observing system has created it. For instance, in our example, the ML-analyst creates an internal-SAR that is submitted to the MLRO. The ML-analyst uses data to generate information about the suspect and then communicates that as data in the form of the internal-SAR (that will in turn be internalized as information 👁 MLRO). Thus, if we take the internal-SAR as the data being communicated 👁 analyst to 👁 MLRO, then *data is a duality of both post-observed information* (👁 ML-analyst who created it) *and pre-observed information* (👁 future consumer of it that will internalize it in turn, in this case, the MLRO).

4.6. P_6: Data can be data for one observing system and information for another

Either by choice, or because the data that an observer attempts to internalize is not relationally connected with and transformed into information by an observer, data may remain data for one observing system and information for another. An example from the AML case study comes from how staff demotivation affects SARs submissions. While the data from the transaction monitoring system ought to be internalized 👁 ML-analyst so that an evaluation can take place about suspicious behavior, this does not always happen due to fatigue, demotivation, and a 'pre-judgment' that the customer would not be a suspect because the software has such a high false positive rate (originally > 99%). In this case, the distinction between information/data may collapse to a data/data distinction when 👁 ML-analyst, data are not internalized, however 👁 MLRO, this data is post-observed information and will need to be internalized so that a final reporting decision can be made. Also, the exact same data may not be internalized by one observer but they could be internalized by another.

4.7. P_7: Information systems support themselves by consuming data from their environment

Within the AML department, members of staff use a transaction monitoring system that flags and risk-scores the suspects based on their transactions (this is built into the functionality of the software and adjusted by the bank). While it is beyond the scope of the present paper to explore how technology shapes the boundary between information/data, we can think of technology as a common background against which data/information distinctions are communicated and shaped. In this example, 👁 AML department, information systems emerge by an observer within the marked space that includes: the AML organizational structure, the software applications used by the AML department for supporting its *raison d'être* and, of course, the human agents within the department (in this ML-analysts and the MLRO). This marked space that we denote as the information system of our example, is demarcated and distinguished from its data environment (e.g. raw transaction data from customers and data that is filtered down for use from the AML department by the bank). However, without a data environment as a 'source of energy' to support its existence and its function of monitoring and reporting suspicious transactions (despite the many challenges in the effectiveness and AML compliance perceived as a cost-center within the bank), such an information system would not have been able to maintain itself. The information system is not only supporting itself by consuming data from its environment. It is structurally coupled with its environment; as we've noted, the environment is not a residual category but constitutive of the information system's existence [16].

5. Conclusion

While the nature of data and information is challenging, we argue in this essay that the best way to reflect on them is by exploring them *relationally* and by including the central role of the *observing systems* in shaping the distinction between them. To the degree that IS upholds the relevance of human agency (even when that becomes restricted and confined [6]), and to the degree that we're talking about socio-technical systems, we believe that systems theory can yield considerable insights [5]. Within systems theory, second-order cybernetics that switches the emphasis from observed systems to observing systems [10] can provide a very rich theoretical platform upon which our field can rest for exploring its foundational concepts.

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