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Carolyn Paris and Susan Scott

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Information Systems and Innovation Group
Department of Management
London School of Economics and Polical Science
Houghton Street
London WC2A 2AE
telephone +44 (0)20 7 955 7655
fax +44 (0)20 7 955 7385
e-mail is@lse.ac.uk
home page http://is.lse.ac.uk/

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Carolyn Paris and Susan Scott

Information Systems and Innovation Group
Department of Management
The London School of Economics and Political Science
Contact email: C.Paris@lse.ac.uk

Abstract

Throughout modern business history, contract has been used as an organizational technology that holds counterparties in formal or legally binding agreements. The proliferation of contract prompted the emergence of professional contract managers who played an important but relatively peripheral role applying situational awareness to the practice of compliance and business relationship management. As more complex organizational forms emerge (outsourcing, supply chains and enterprise IS), contract has come to be seen as a standard coordination device whose foundational assumptions are taken for granted. In this study, we draw attention to two different ways of designing the organizational technology of contract: a process-oriented approach and a market-based valuation of contract. Both approaches promise to provide management information by offering a form of calculability but we argue distort organizational awareness. Our conclusion is that a more developed notion of organizational awareness is needed supported by an alternative conceptualization of contract as a technology of connectedness.

Keywords: Contract, organizations, organizational awareness, financial markets, financial innovation, networks, design

Introduction and Overview

Throughout modern business history, contract has been used as an organizational technology that holds counterparties in formal or legally binding agreements. The proliferation of contract prompted the emergence of professional contract managers who played an important but relatively peripheral role applying situational awareness to the practice of compliance and business relationship management. As more complex organizational forms emerge (outsourcing, supply chains and enterprise information systems (IS)), contract has come to be seen as a standard coordination device whose foundational assumptions are taken for granted. In this paper, we explore the notion of organizational awareness and consider the role that contract plays in its constitution.

We begin by discussing the concept of organizational awareness, and then establish that awareness of contract is an important problem for organizations. Next we consider two different ways of designing the organizational technology of contract. Both approaches promise to provide management information by offering a form of calculability. The first is a process-oriented approach taken by packaged software solution, contract management software (CMS). The second approach relies on market-based valuation of contract and, as a recent example, we consider the case of credit default swaps entered into by the insurance conglomerate AIG, implicated in the financial crisis. We analyze these two approaches in terms of how they contribute to organizational awareness. Based on our analysis, we conclude that, with respect to contract, calculability may be difficult to achieve and in isolation does not ensure organizational awareness. We suggest that a more developed notion of organizational awareness is needed, supported by an alternative conceptualization of contract as a technology of connectedness.

Organizational Awareness

In their white paper describing the program of organizational design and engineering (ODE), Magalhaes and Rito Silva (2009) note that: "Increasingly the flow of work in organizations is being shaped by engineering forces emerging from the information revolution." At same time, they note, information existing within the organization has not been translated into intelligence. They describe the mission of ODE as the better use of organizational resources to build knowledge and intelligence, and view organizational awareness (citing Tribolet 2005) as an outcome of ODE. Awareness is the understanding by the organization of itself – its strategy, activities and routines, identity and goals. Magalhaes and Rito Silva argue that awareness correlates with organizational cohesiveness, responsiveness and adaptability. They link the relationship of organizational design and awareness to the theory of sensemaking (Weick 1995, 2001; Weick et al. 2005), "defined as the structuring of unknown contexts or actions and assigning them with meaning".

Sensemaking (Boland and Tenkasi 1995; Weick 1995) is also cited by Markus et al. (2002), with respect to their development of a design theory for systems to support emergent knowledge processes (EKPs). This work is cited as exemplary of design science research in Hevner et al. (2004): "Despite decades of research and development efforts, effective methods for development of information systems that meet the information requirements of upper management remain elusive." Though there are commonalities, we ground our enquiry in the concept of organizational awareness in distinction to the model of organizational knowledge implied by the concept of EKPs.

Markus et al. (2002) conceive of IS design for EKPs at the top of a hierarchy of IS design problems, building from transactions record-keeping and repositories, through expert systems and executive information systems. The IS requirements of EKPs are thus positioned as somewhat exceptional in nature, counterposed for example to management information systems (MIS) that support transactions processing and financial accounting. However, we will suggest that complex contemporary organizational forms (such as outsourcing, supply chains and enterprise IS) have intensified the connectivity of knowledge work to an extent that overflows this model. Our study illustrates that a standard coordination device such as contract holds relational value and informational potential beyond the transactions encoded in its terms.

Rather than focusing on knowledge practices in functional areas, we suggest a more complex challenge in which the organization *as a whole* is involved in an emergent process of deliberations with complex and distributed knowledge requirements and an unpredictable actor set (defining features of EKPs). In such an environment, risk, relationality, accountability and responsibility are important and are accommodated by the outward-looking orientation of "organizational awareness". We take up the problem of organizational awareness of contract and propose a conceptualization of contract that might serve as construct (Hevner et al. 2004 citing March and Smith 1995) or intermediate artifact (Magalhaes and Rito Silva 2009) in the design of IS for organizational awareness.

The Place of Contract in Organizational Awareness

In this section, we establish that awareness of contract is an important problem for organizations. We frame this issue analytically by drawing attention to way in which we 'snip away meaning' and make contacts calculable. Kallinikos (2005, 2006) refers to this as functional simplification and closure, involving process enclosure and standardization. Process enclosure and standardization in turn imply de-composition of the vertically integrated organization and the re-placement of organizational activities by way of contract. We suggest that this practice of reification is thoroughly entangled in and characteristic of contemporary organizational forms. The networked environment is a reciprocal or complementary development, where the ICT (information and communications technology) network or "grid technology" is envisioned as incorporating and enabling contract (Ciborra 2007; Shiller 2003). We argue that unexamined conceptualizations of contract embedded in this model can have unintended consequences and be unnecessarily constraining. For example, one of the primary intensions of contract is to 'keep track' and hold counterparties accountable to one another through the threat of legal enforcement and remedies. While we note the challenges involved in realizing organizational awareness in a connected world, we also note that ICT has raised the possibility of achieving an extended form of organizational awareness and alternative models of effective accountability.

Implications of Functional Simplification and Closure: Calculability and Process Standardization

Kallinikos (2005, 2006 p. 22) maintains that a program of functional simplification and closure (from systems theorist Niklas Luhmann 1993) marks the transformation of the organization in a saturated ICT-enabled information habitat. In this way, organizations are mapped to the capabilities of computers (described by Dreyfus 1992) and correlated with computer "effectiveness" (as defined by Winograd and Flores 1986).

This is achieved through a strategy that begins with the logical process of functional simplification which demarcates an "operational domain within which the complexity of the world is reconstructed as a simplified set of causal or instrumental relations" (Kallinikos 2005). Through reduction to a set of rules and scheme of classification, the complexity of specific life-worlds (air traffic control,

manufacturing systems, financial trading) is rendered "inspectable and controllable" (Kallinikos 2005). This achieves "calculability" (Power 2007).

Next, the principle of closure is applied to set boundaries that serve as a "protective cocoon…around the selected causal sequences or processes to safeguard undesired interference and ensure their recurrent unfolding" (Kallinikos 2005). As processes within organizations become more defined, bounded and enclosed (encapsulated), lifted out of and stripped of relational context, they become easier to count and control, i.e. effectively calculable.

Contract and the Network

The same dynamic of process enclosure and standardization invites assignment of now well-defined and circumscribed activities to other organizations that specialize in those activities, levering expertise and scale (e.g. through outsourcing). Contract, as strategic and technology partner, is both a requirement and an enabler of this program. Stated another way, contract becomes a connector in a self-consciously "object-oriented" composition of an organization, featuring (ideally) "plug and play" modularity and encapsulation. The de-composition of the organization through contract corresponds to the model of the firm defined by transaction cost economics (TCE). In the TCE model, the boundary of the firm is negatively defined by identifying activities that cannot be efficiently contracted to others (Madhok 2002).

This de-composition of the vertically integrated organization entails as a reciprocal development a networked world in which ICT-enabled contract is a technology for the re-design, or re-placement, of work and risk. Ciborra (2007) notes the "overall trends in formalization of transactions" and describes "grid technologies" as "contract-enabling". He argues that this creates conditions where "buy" (for example, through outsourcing) would crowd out "make", and risk would be optimally dispersed in a more perfect market. In his 2003 book, *The New Financial Order*, the economist Robert Shiller envisions a "smart computer network" that would keep track of [individuals'] contracts "so that the system ensures that contracts do not conflict with one another. …[such a network] will make possible more effective and more extensive contracts" (p. 81). Van Heck and Vervest (2007) contemplate an ICT platform that supports the rapid formation of networks for trading of goods and services, including goods and services that are relatively complex and bundled. These visions of the networked world seem to assume the effective calculability of contract. In sum, a "grid technology" or smart network is conceived of as an intelligent risk- and work-dispersing network. Participating organizations all become virtual, to a lesser or greater degree; in other words, they essentially transform into information and contracting businesses. Ciborra (2007) cautioned, however, that such "grid technologies" might create risks that would be "new and surprising". Appreciating the potential for and nature of such risks is one of the challenges for organizational awareness in a connected world.

The Problem of Organizational Awareness in a Connected World

Thus far we have described how the functional simplification and closure entailed by ICT tends to define and circumscribe organizational activities in a way that can promote the de-composition of vertically integrated organizations into contract format. A reciprocal development is the growth of ICT-enabled networks for the dispersion of work and risk. Both inside the organization and in the network, this framework both creates and demands calculability.

We turn now to the implications of contract for organizational awareness. Within the framework we have described, contracting becomes a key knowledge competency for organizations (Argyres and Mayer 2007), moving from the periphery of organizational competencies to the center. But contract-related processes and issues have historically been managed on an ad hoc basis, fragmented across organizational lines and without the support of a designated organizing technology. Information systems designed for organizational awareness pertaining to *internal* production processes need to be extended in some fashion to ensure the continuity of organizational awareness with respect to those processes as they are re-placed outside the organization by way of contract. This problem has sometimes been framed as one of inter-organizational control (e.g. Caglio and Ditillo 2008).

The inability to maintain distributed business relationships and achieve inter-organizational risk management can have serious consequences for the organization. As just one empirical example, we note the case of The North Face, an apparel company, in its failed attempt in 1999 to outsource distribution. A typical apparel company such as The North Face is embedded in contractual connectedness, and its survival and success depend on its ability to understand and manage that connectedness. In July 1999, The North Face engaged a unit of FedEx to manage distribution. This outsourcing project apparently failed, resulting in numerous "delays and difficulties" during the critical fall season. For the year 1999, there was a net loss of $100 million on sales of $238 million. The stock price collapsed and The North Face, nearly bankrupt, was sold to VF Corporation in April 2000 for $2 a share (The North Face 1999 Annual Report). As a management narrative, it could be said that the inability to manage its supply chain through to retailers cost The North Face its independence; the lawsuit for damages after the fact did not compensate for the consequences of a lost selling season. A more recent example illustrating extended risk exposure and its consequences, in the context of cloud computing, is the reported loss of smartphone data by Microsoft's subsidiary Danger. Through a chain of blogs, it has been suggested that Danger "was cut down to a handful of people in Palo Alto managing some contractors in Romania, Ukraine, etc." (AppleInsider source reported in *The New York Times*, October 12, 2009).

Terms such as "enterprise" and "network", or even "supply chain", which suggest that organizations are discrete nodes with impermeable boundaries, linearly connected at defined and limited points to other organizations, may understate the nature of organizational connectedness through contract and the consequences of this connectedness. Connectedness through contract presents a clear challenge for organizational awareness, but we suggest that ICT has raised the possibility of achieving an extended form of organizational awareness and alternative models of effective accountability.

To further explore this proposition, in the next section we consider two existing approaches to organizational awareness of contract. The first is a process-oriented approach taken by a packaged software solution, contract management software (CMS). The second approach relies on market-based valuation of contract for financial accounting and risk management purposes. As a recent example of the second approach, we consider the case of a certain kind of derivative contract, credit default swaps entered into by the insurance conglomerate AIG, implicated in the financial crisis. Both approaches depend on making contract effectively calculable and thus presumptively knowable, but, as we discuss below, they differ in their foundational assumptions and operational aspects. We analyze these two approaches in terms of how they contribute to organizational awareness of contract.

Calculability through Process Standardization: Contract Management Software

As discussed above, functional simplification and closure invites process standardization within the organization. In this section, we discuss how a commercial off-the-shelf (COTS) software product operationalizes contract management as a standard process, thus making contract calculable, and knowable. The product is contract management software (CMS). CMS applications were brought to market within a few years after the International Association for Contract and Commercial Management (IACCM) was founded in 1999 by major IT and telecommunications companies to promote "contract management" as a profession and as a key organizational competency.

CMS envisions the contracting process as a kind of production line with two principal outputs: a contract document and associated contract metadata. A CMS package features workflow, automated document assembly, and a document repository, together with alerts, reporting and analytics capabilities. It was designed to support the entire contract lifecycle, from bidding, though negotiation and approvals, until the finalized contract is filed in an electronic document repository. Key contract terms constitute the document metadata for the document within the repository. These key terms can then be used to feed or test against other information systems internally and possibly external (counterparty) systems as well.

In 2008, one of the authors carried out a review of CMS sales literature and a series of interviews with industry participants. The author concluded that underlying vendor positioning of CMS were several key assumptions: (1) that contract management is principally a matter of *internal* control and standardization, (2) that the contract document is the source of contract information, and that such information can be represented as discrete datapoints, and (3) that a closed, process-oriented application can overcome fragmentation to centralize control over contracting and deliver an enterprise view (or organizational awareness) of contract. In this model, organizational awareness is assumed to arise as a by-product of process and document standardization and control, which create effective calculability.

The study identified several issues with respect to these assumptions. First, contracting as a technology (Suchman 2003) is developed and maintained at the supra-organizational level, within the contracting community. The organization participates in contracting communities by developing and maintaining expertise through internal compartmentalization. Importantly for IS design purposes, it is at the level of the contracting community, not inside the organization, that industrial scale standardization is mostly likely to be achieved. With respect to the second assumption: contract documents are written in a highly specific version of natural language that does not, except in commodified domains, easily resolve to discrete datapoints – a particularized version of a more general problem with respect to documents (Wakayama et al. 1998). Further, many contracts feature implicit (Campbell and Collins 2003) and relational (Macneil 1985, 2003) dimensions not reflected in contract documents (Bernstein 1992, 1996; Macauley 2003). Mithas et al. (2008), in their study of participation in reverse auctions, discuss the effect of non-data-discrete (and mostly non-documented) elements of contract as dimensions of "non-contractibility" (quality, supplier technological investments, information exchange, responsiveness, trust, and flexibility). With respect to the third assumption: the author concluded that because the process module approach of CMS seems to invite function-specific implementation, CMS could not be expected to overcome internal fragmentation in contracting. The further implication is that CMS-operationalized contract data would not necessarily aggregate to a strategic enterprise view, or organizational awareness, of contract.

To summarize: In its simplest form, the design model underlying CMS assumes that contract documents can be standardized, that the contract documents contain the relevant contract terms, and that the contract terms can be resolved to discrete operational datapoints. The program of

internal standardization and operationalization of contract, if achievable, would produce effective calculability, and thus, presumptively, an "enterprise view" of contract. We note above a number of reasons why calculability may be difficult to achieve for contract generally. Nevertheless, the types of issues encountered are unsurprising from an IS perspective: principally, managing scale and variability, extracting discrete datapoints from unstructured data and tacit knowledge, and deriving or structuring meaning from data. And some contract domains do not present these problems: We next consider organizational awareness of contract in a more limited domain where calculability is already given, that is, the financial markets.

Calculability Constructed Using Market-Based Valuations: Credit Default Swaps at AIG

We have considered an approach (CMS) which constructs organizational awareness of contract out of effective calculability derived from process standardization. In this section, we discuss contracts in a domain where calculability of contract for financial accounting and risk management purposes is generally derived or constructed using market prices, based on the assumption that trading prices in the market are singularly meaningful, that is, authoritative, as a source of organizational awareness. We will argue that reliance on market-based valuations to achieve organizational awareness ignores their fundamentally contingent and relational nature. We further raise a question as to whether calculability is a sufficiently comprehensive approach to organizational awareness of contract.

Trading in the financial markets would seem at first glance to present an "easy case" with respect to the first level IS concerns raised by CMS. The contracts are almost entirely data-discrete, the life-cycle is collapsed, documentation tends to be minimal and standardized, and data extraction and integration are self-executing. In other words, the financial markets seem to be an example of an already working and extremely powerful contract management system and smart network, which has overcome the most obvious problems presenting for organizational implementation of CMS, namely problems of scale and difficulties in creating calculability. However, the financial crisis has demonstrated that apparent calculability does not ensure organizational awareness. To illuminate this point from an IS perspective, we consider the case of credit default swaps at AIG – generally considered to be a focal point of the crisis. Before turning to the specifics, we discuss the role of contract in two key financial innovations (securitization and the use of derivative contracts to transfer risk or to achieve "classification arbitrage") and explain the derivatives relevant in AIG case, credit default swaps.

Securitization: Decontextualization, Encapsulation and Detachment by Way of Contract

Securitization is a financial technology which creates or organizes "detachment" of financial investors from real economy lending transactions such as loans to homeowners, students and consumers. It is intended to substitute for or eliminate the need for specific credit analysis, and to create industrial scale in lending. In securitization, information and contract technologies are deployed together to encapsulate or wrap complexity. Statistical models applied to an aggregation of debt instruments (contracts to pay money) are used to structure a tiered package of derived securities, representing horizontally layered, as opposed to vertically defined, rights to payments from the debtors. Credit analysis is *displaced* to mortgage originators, securitization sponsors and credit rating agencies. In a sense, securitization is a strategy of functional simplification and closure applied to lending, and is intended to simplify the problem of organizational awareness for investors.

The technology of securitization has been used successfully for decades in the United States to provide liquidity for standard, conservatively underwritten 30-year fixed rate mortgages and other

relatively homogeneous, conservatively underwritten loan pools. On an aggregated basis, and using historical data going back years for statistical analysis, these loans could be treated as if they were commodified transactions, and they were then processed, through securitization, to manufacture market-ready securities.

More recently, the mortgage securitization industry (technology) *extended* to accommodate new style mortgages (subprime and Alt-A), which were not as conservatively underwritten, and commercial mortgages, which are not standard and cannot be made approximately standard through aggregation. Starting in 1998 (O'Harrow and Brady 2008), CDOs (collateralized debt obligations) bundled various debt instruments, including prior securitizations, into new securitized assets. The assumption was that any group of financial assets could, based on statistical modelling and without knowing (having to know) the particulars of the underlying assets, be sufficiently homogenized to produce another generation of market-ready financial assets. The sponsors of and investors in these late generation securitizations relied on the strategies of information reduction – decontextualization, encapsulation and detachment – that had served well enough in the past, *extending* the technology of securitization with its attendant information reduction strategies into ever more complex domains. Importantly for what was later to transpire in terms of liquidity dynamics, multi-tiered securitizations (securitizations of securitizations) enabled a particular underlying financial asset to appear in multiple places, potentially borrowed against by the investors at each level.

From Price Arbitrage to Classification Arbitrage; Transferability of Risk via Contract

Arbitrage can be characterized as the exploitation of simultaneous "commensurability and disjuncture" (Caliskan and Callon 2009a, citing Guyer 2004) whereby differences in valuation open up opportunities for profit across trading zones. The strategy of *price* arbitrage (MacKenzie 2007) requires an information infrastructure that supports opportunistic price discovery and very fast trade execution capabilities. But recent financial activity (and financial contract innovation especially) has been to a significant degree self-consciously targeted toward the arbitrage of various classification schemes, such as accounting rules, tax rules, capital adequacy requirements, national regulatory jurisdictional rules, exchange listing requirements, and risk management schemes. Contracts and related valuation technologies are designed to touch the appropriate bases within, or navigate the interstices between or within, various and often multiple classification schemes. Classification is thus performative, giving rise to contractual relationships that might not otherwise exist, and creating frameworks that may shape or constrain organizational awareness.

As an example, contractual risk transfer through hedging (using derivatives) has been enlisted to mitigate real business risks but also to exploit classification arbitrage opportunities, e.g. to achieve certain accounting or regulatory ends. Fully matched hedging – a perfect hedge – makes valuation moot as risk sums to 0, or "disappears" so far as accounting and risk management may be concerned. But a hedge always entails a new exposure, that is, exposure to the hedge counterparty, and, through that hedge counterparty, to *its* other counterparties. One result of the chaining of risk transfer means that risk can become concentrated without the participants, each looking at its own position vis-à-vis its named direct counterparties, being aware of the extended risk profile of its position. Hedging enables risk-taking that would otherwise be viewed as unacceptable and can convert what was a negligible or manageable contingency into a significant real cost incurred on the hedge side. Effective hedging depends on the availability in the market of appropriate hedging instruments, on market access and on counterparty creditworthiness. As a strategy, hedging is thus fundamentally contingent. A change in circumstances can cause latent risk to suddenly appear in many places where it was previously, under relevant classification schemes and rules, suppressed. The sudden appearance of the risk may cause "surprise".

Credit Default Swaps: Contract as Risk Transfer Technology

The particular derivatives implicated in the case of AIG were credit default swaps. Under a credit default swap (CDS), one party agrees to pay the other party if a payment default occurs on reference debt, by paying the amount of the reference debt or by purchasing the reference debt. Credit default swaps need not map one-to-one to outstanding debt and thus may have in the aggregate a notional amount that is a multiple (multiplier?) of the underlying debt. A CDS can provide a way to hedge long (owned and funded) positions generally against a company. For example, an investor owning X Corp. securities might "hedge" its exposure to X Corp. by buying CDSs on X Corp. debt: if the price of X Corp. securities goes down the price of the CDS may be expected to go up. The price of a company's credit default swap is taken to be an index of its creditworthiness. Importantly, CDSs have (until recently) generally been traded "over the counter" (OTC), meaning that they have not been traded on exchanges and thus have not benefited from standardization and centralized clearing. From its beginnings about a decade ago (Tett 2006), the CDS market has grown exponentially, reportedly covering $62 trillion (notional amount) of underlying debt in 2008 (Morgenson 2008).

From the outset there has been some confusion about the nature of credit default swaps. An interest rate or currency swap on a "notional amount" of $100 of underlying debt involves variations that are usually a small percentage of the notional amount. A credit default swap, on the other hand, stands behind the entire amount of the debt and acts more like a guarantee. Indeed, the Financial Accounting Standards Board (FASB), which is responsible for setting accounting standards in the US, in 2008 began to require some CDSs to be treated as guarantees. Some proponents say that a credit default swap is like insurance, but that term has a prudential (impliedly regulated) aspect that would make it misleading. Efforts in the late 1990s to gain regulatory oversight over the credit default swap market were defeated (O'Harrow and Brady 2008). Again, classification is performative: There is a question, for example, whether the career of the credit default swap would have been the same had it been called a "debt put" and invented by commodity traders rather than derivatives experts at a bank (JPMorgan).

In 2004, the UK Financial Services Authority observed a sectoral transfer of credit risk from the banking sector to the insurance sector (FSA 2004, pp. 55-56) in part through credit default swaps. They reported that notwithstanding significant concentration of the credit default swap market (the ten largest global banks and broker-dealers accounting for 70%), the rating agency Fitch had "concluded that the growth of the market is a positive development, as it assists the diversification of credit risk and results in improved liquidity in underlying credit markets." There seems to have been an idea on the part of proponents that credit default swaps would disperse risk, presumably in a kind of engineering sense, as a net or grid absorbs and disperses a physical impact – comparable to the efficient risk-dispersion imagined by Shiller (2003) and Ciborra (2007).

With respect to portfolio credit default swaps (linked to a basket of credits), the FSA noted potential problems with valuation, sounding an early warning about organizational awareness: "The market in portfolio trades is still new and relatively illiquid, so banks usually rely on models to re-value and risk manage the transactions on a day-to-day basis. Valuing and risk-managing complex and illiquid structures like the portfolio trades described above presents challenges for even the largest and most sophisticated of banks."

Organizational Awareness of Credit Default Swaps at AIG: 2007 versus 2008

In the previous section we discussed securitization and credit default swaps. Global insurance giant American International Group (AIG) sold credit default swaps for classification arbitrage and for substantive credit substitution, i.e. acting as a guarantor. What did AIG know about what it was

doing? In this section, we trace the trajectory of organizational awareness, as indicated in AIG's 2007 and 2008 annual reports filed with the Securities and Exchange Commission.

AIG Financial Products (AIGFP), a unit of AIG, wrote credit default swaps to earn "revenue on credit exposure in an unfunded form", focusing on a "super senior" layer of exposure in CDOs and other securitized debt, above other AAA-rated layers. Terms were "negotiated by AIGFP for each transaction to provide that the likelihood of any payment obligation by AIGFP under each transaction is *remote, even in severe recessionary market scenarios*. The underwriting process for these derivatives included assumptions of severely stressed recessionary market scenarios to minimize the likelihood of realized losses under these obligations" **(**AIG 2007 Annual Report, pp. 121-122) [emphasis added].

Put in terms of price arbitrage, the premium AIGFP earned, even if it was very low, was more than its funding cost, which was 0. AIGFP was run as a trading desk, not as a credit underwriting business, and they relied on statistical risk models, not analysis of the underlying credits. An AIG executive is reported to have said: "The models suggested that the risk was so remote that the fees were almost free money" (O'Harrow and Brady 2008).

Of the $527 billion in notional exposure of the super senior credit default swap portfolio (SSCDSP) at the end of 2007, nearly $380 billion consisted of a "regulatory capital relief" portfolio written specifically for purposes of lowering capital charges for (mostly European) banks under Basel I capital adequacy rules, "rather than risk mitigation". That is, this portion of the portfolio supported classification arbitrage.

Just over half of the remainder of the SSCDSP related to "multi-sector CDOs", most of it involving some exposure to US subprime mortgages. As of year end 2007, AIG booked $11.25 billion of unrealized market valuation loss on the multi-sector CDO portion of the SSCDSP, but "continue[d] to believe that the unrealized market valuation losses recorded on the AIGFP super senior credit default swap portfolio are not indicative of the losses AIGFP may realize over time" (AIG 2007 Annual Report, p. 33).

However, AIG's accountants identified a material weakness in internal control over financial reporting and oversight relating to the valuation of the SSCDSP. For 2008, AIG booked an additional $28.6 billion of unrealized market valuation loss on the SSCDSP, most of which related to the multi-sector CDO swaps. This unexpected significant increase in the loss attributed to these contracts is a clear indication that AIG lacked "awareness" with respect to what these contract could mean for the organization.

Due to degradation of the underlying CDOs and AIG ratings downgrades, there were collateral calls on the SSCDSP portfolio that (together with collateral demands in AIG's securities lending program) precipitated a liquidity crisis by mid-September 2008. The US federal government, determined that a collapse of AIG threatened unacceptable systemic risk and rescued AIG with emergency financial assistance. By the end of 2008, a majority of the multi-sector CDO swaps (face amount $62 billion) had been liquidated in a transaction funded by the US government. The underlying CDOs and the associated CDSs were terminated for a total purchase price of $59.3 billion, or nearly face value. (To put this figure in perspective, shareholders' equity at year end 2007 was $95.8 billion, net loss for 2008 was $99.3 billion, and shareholders' equity at year end 2008 was $52.7 billion (US government equity purchases amounting to over $60 billion).)

Through credit default swaps, major financial institutions were exposed to AIG in an amount at least equal to the CDS payments it made to them in 2008. This effective risk-shifting was in addition

to the capital support (for regulatory purposes) that AIG was providing to banks under its regulatory capital relief book. The exposures appear to be in some respects reciprocal. At year end 2008, AIG identified as a risk factor its continuing concentrated credit risk exposure to financial institutions, particularly money centre/global banks (160% of shareholders' equity; 65.6% attributable to the top five). From a systems perspective, AIG was a critical point of failure in a small and tightly interdependent network, operating in an information environment characterized by hedging, netting and other information-hiding accounting conventions.

Participants in the network assessed their positions principally by reference to market-based valuation techniques. AIG's 2008 annual report includes extensive discussion of its valuation methodologies, including detailed explication of their modified version of the BET (binomial expansion technique) model used to value the SSCDSP. BET was originally developed by a rating agency in 1996 to generate expected loss estimates for CDO tranches. The modified BET model implied default probabilities and cash flows from price estimates on the individual securities comprising the portfolio of a CDO. AIG obtained prices from CDO collateral managers where these prices were available, but for 2008 CDO collateral managers provided these prices for only 61.2% of the underlying securities. For the rest, AIG derived the price based on a "matrix pricing" technique by comparison to similar securities. The BET model created calculability but not on the basis of knowledge of the "real" underlying assets that AIG had guaranteed.

Over the course of 2008, and continuing into 2009, the FASB issued a series of releases relating to securitizations and derivatives. These releases effectively recognized that valuation of many financial assets had become problematic and that disclosure has been inadequate. In its 2008 annual report, AIG acknowledges a number of issues around valuation: counterparty disputes; problems in reliance on historical data; unanticipated high correlations; concentration of risk; and the possibility that loss of market access could prevent the execution of hedging strategies. It opens a discussion on risk factors by noting: "Many of these risks are interrelated and occur under similar business and economic conditions, and the occurrence of certain of them may in turn cause the emergence, or exacerbate the effect, of others" (p. 21). In other words, valuation was both contingent and relational. A principal advisor on AIG's risk models commented on the effective tainting throughout the financial system caused by the "dispersion" of risk: "You have this very, very complicated chain of the movement of the risk, which made it very opaque about where the risk finally resided. And it ended up residing in many places. So the whole infrastructure of the financial market became kind of infected, because no one knew exactly where the risk was." (Gary Gorton, Yale University School of Management, transcript reported in *The Wall Street Journal*, October 31, 2008).

Analysis: Contracts, Calculability and Organizational Awareness

CMS represents a strategy of internal process (and document) standardization, based on diminishing or eliminating variation and context, to create calculability. The study discussed above suggests that contract, or at least certain types of contract (such as services outsourcing or IT development), may resist calculability and thus elude calculability-based approaches to constructing organizational awareness. A corollary is that if relational context is eliminated in order to force contract into a standardized process, important meaning may be lost. We conclude that process standardization is unlikely to succeed in rendering all contracts calculable and thus is not, by itself, sufficient to generate meaningful organizational awareness of contract – assuming awareness can be based on calculability. The case thus illustrates the perennial IS design problem of how to derive or construct organizational awareness, or meaning, out of heterogeneous and ad hoc processes, tacit knowledge and unstructured documents.

The case of credit default swaps at AIG on the other hand illustrates a comprehensive loss of meaning, at both the organizational and systemic levels, in an environment (paradoxically) characterized by standardization and structured data, i.e. apparent calculability. Calculability did not correlate to, indeed may have confounded, organizational awareness. We argue that such loss of meaning is not extrinsic to but instead a latent quality inherent in the network, by virtue of the features of information-hiding and performativity of its incorporated information and contract technologies. In the case of credit default swaps at AIG, contract calculability was based on an assumption that trading prices in the market were singularly meaningful, that is, authoritative, for organizational awareness. It was further based on constructions which we define as transactionalizing technologies. We argue in the following sections that reliance on market-based valuations, incorporating or dependent on transactionalizing technologies, to achieve organizational awareness ignored their fundamentally contingent and relational nature. The case of credit default swaps at AIG raises the further question as to whether calculability is a sufficiently comprehensive approach to organizational awareness of contract. As an alternative, we propose as intermediate artifact or construct a conceptualization of contract as a technology of connectedness.

Calculability Entails Transactionalizing Technologies

The financial markets have been especially subject to ICT transformation (Lucas et al. 2009; Weber 2006) and run on calculability. The apparent seamless flow of commodity units belies the existence of embedded transactionalizing technologies. By transactionalizing technology, we mean a technology that derives or produces discrete variables for the purpose of generating or resolving to instrumental calculability. Transactionalizing technologies employ two principal strategies: information-reduction through the stripping away of context, and modular, encapsulating construction. In the first case, informational complexity that would distract from ease of calculability is simply deemed irrelevant, and discarded; in the second, informational complexity is encapsulated within calculative processes or managed away.

Credit ratings are an example of information-reduction. "Triple-A has almost a religious connotation in finance. If you call it a Triple-A, you don't have to analyze it – that is why it's a Triple-A." (Stephen Schwarzman, head of private equity firm Blackstone, quoted in *The Wall Street Journal*, March 10, 2009).

As an example of how informational complexity can be managed away using contract, Millo et al. (2005) describe the clearinghouse function as an organizing technology for "detachment", in this case of trading from settlement. It enables parties to a trade to assume execution and go on to make further trades without concerning themselves with the technicalities of settlement. The authors describe how, notwithstanding the apparently mechanical nature of settlement, information analysis, in the form of counterparty risk assessment, has become part of the clearinghouse function. So counterparty risk was not eliminated from the system, it was effectively *displaced* by contract to an organization that was in a position to scale risk assessment, to design and implement control parameters, and to coordinate response to failure.

Transactionalizing technologies are instrumentally enabling, to a powerful degree. They are among "the institutional and technical arrangements that enhance the capacities of human agents for action and cognition" and thus agents in processes of economization and marketization (Caliskan and Callon 2009a). In particular, these technologies are enlisted to "pacify" things in order to value them and bring them to market (Caliskan and Callon 2009b). Things thus pacified are "passive" in that they can be transferred as property, but more fundamentally because they become "incapable of

expressing novelty or unexpected characteristics", in other words, inert. It is these "inert" packets (of goods and services) that trade and travel most easily across the network.

Transactionalizing Technologies and Information-Hiding

Transactionalizing technologies present potential issues well understood in the IS research community. Resolving information to discrete datapoints requires the creation and maintenance of classification systems (Bowker and Star 1999), and entails loss of meaning through decontextualization (Dreyfus 1992). Errors in calculation subroutines produce errors in the larger operations from which they are called. Modularization is instrumental fragmentation, or isolating distantiation, by design, with consequences for organizational awareness. In fact, through their propensity for encapsulation and detachment, transactionalizing technologies acquire a key characteristic of layered interdependency, resisting understanding and interrogation.

March and Simon (1993, p. 186) describe the "absorption of uncertainty" that occurs through reification of classification schemes within the organization, which provide us with "inferences rather than evidence" and can severely limit our ability to make informed judgments. We extend this notion to say that the reduction or encapsulation of information, complexity and uncertainty through processes and strategies that cannot be easily interrogated generate opacity. In other words, information systems become information-hiding. When information reduction leaves out too much or encapsulation hides but does not actually contain and suppress complexity, the information system may fail. Failure can include apparent successful operation within a limited, self-referential domain where that domain is decoupled from the pertinent reality. Surveying the history of artificial intelligence, Winograd and Flores (1986) and Dreyfus (1992) conclude that success in solving problems that feature discrete data and explicit rule sets can not be simply extrapolated to predict success with more complex, context-dependent problems – a kind of "principle of non-extendibility".

In the case of credit default swaps at AIG, the technology of the trading desk was *extended* through credit default swaps into a complex domain, that is, to credit underwriting. Apparent *but only apparent* calculability was constructed using layers of new and relatively untested transactionalizing technologies, such as BET. These technologies were effectively information-hiding, not only between but *within* organizations, creating internal opacity. Organizational awareness, and the capacity for organizational awareness, were lost. At the same time, the assumed contractual "detachment" or immunization from the underlying risk was imperfect. Indeed, the technologies of detachment intended to protect against risk were worse than imperfect. The intended risk-dispersing technologies which had left too much information behind disabled ring-fencing or quarantine strategies; instead they spread contamination.

Amplification Effects: Perverse Performativity and Self-Referentiality

Contractually created interdependence in the network can generate amplification effects, which in the case of AIG posed a threat to many other financial institutions. An important predecessor case involved the hedge fund Long Term Capital Management (LTCM). In 1998, LTCM experienced a liquidity crisis judged by US federal regulators to entail excessive systemic risk, and they orchestrated a bailout. The crisis demonstrated that the hedge fund industry, positioned to exploit arbitrage opportunities using borrowed money (leverage), no longer stood outside the markets but was capable of moving them. MacKenzie (2005) has analyzed the events leading up to this crisis as the "creation of a superportfolio", where a relatively small group of hedge fund arbitrageurs, using similar risk models, ended up with similar positions on macro-economic events. As the macro-portfolio played out, adverse events in Russia and Asia propagated and amplified across the holdings

of many financial institutions, affecting asset prices and liquidity in apparently unrelated (and supposedly uncorrelated) markets. In particular, the effects of contract provisions in loan documents were significant; margin calls on losing positions forced the liquidation of "good" assets at distressed prices. The liquidity dynamics of mark-to-market accounting and leverage thus quickly transmitted distress across firms and markets, as contract technologies which operationalize information inputs (e.g. ratings downgrades, asset prices) converted them into legal and financial effects that in turn triggered a further chain or cascade of consequences.

In moments of stress, such as that occasioned by LTCM, the systemic quality of the financial markets as made up of interdependent information and contract technologies is revealed as potentially problematic. But in fact, these technologies construct and produce financial markets (MacKenzie et al. 2007). ICT-enabled financial trading, far from being an aggregation of discrete market exchanges, overlays and generally masks a complex and layered network of transactionalizing technologies. These information and contract technologies have their own attributes (or agential qualities) that come variously into play but in the ordinary course may be latent, or at least non-obvious. Transactions can have non-linear cumulative and interactive effects not easily anticipated through simple aggregation but which look more like features of high-risk technologies as described by Perrow (1984).

More problematically for organizational awareness, the technologies produce a self-referential domain. Up to the point of collapse the CDS business at AIG was highly productive in its own terms, i.e. in generating revenues for AIG and achieving various results for its counterparties. As well as being highly profitable, the transactionalizing technologies involved in the AIG CDS case could also be said to have shown "effective performativity" in MacKenzie's (2006, p. 18) sense since as a concept, a set of interacting models, and economic contract they made this area of business possible, thus "making a difference". Risk management at AIG exhibited what MacKenzie refers to as Barnesian performativity constituted by "self-validating feedback loops" that can give the impression that reality is conforming to its economic model. However, if this was ever achieved it was disrupted when the composition of the CDSs broke down. Breakdown occurred when their artificial domain became increasingly decoupled from the relevant real domain at which point latent mechanisms in the contracts became operational and there was "overflow" (Caliskan and Callon 2009b).

Locating Contract in Topological Space: A Technology of Connectedness

The story of credit default swaps at AIG prompts a new perspective on contract. CDOs and CDSs, along with their associated information technologies, were not merely instrumentally enabling in an impliedly objective or neutral sense of "creating liquidity" for the underlying assets. Nor can they be understood solely or principally by reference to valuation. The CDS book at AIG was managed, or located, only from a quite unstable valuation standpoint, mostly by reference to the market for the underlying reference debt. That is, AIG as effective guarantor with respect to the underlying assets did not analyze them but depended on market valuations to imply loss estimates, with reliance on market price discovery substituting for actual credit underwriting. This is a closed informational loop that does not go out to test against the subject reality. The relevant market became increasingly dysfunctional, and counterparty disputes on valuation of the underlying CDOs were common. While the location of the CDSs proved to be indeterminate along the dimension of valuation, they also existed, and assumed different forms, along other dimensions. Critically, contract as the technology of connectedness created extended interdependencies, producing and transmitting adverse events through latent contract mechanisms: In concrete terms, AIG does not seem to have modeled the

contractual effects of its own credit downgrades or of collateralization requirements, i.e. liquidity dynamics.

Mol and Law (1994) proposed the concept of "social topology", by analogy to the branch of mathematics which "articulates *different rules for localizing* in a *variety of coordinate systems*", and they described "mutable mobiles" (defined in contrast to Latour's (1990) "immutable mobiles") that transform as they change location, while maintaining continuity of existence. A credit default swap may be said to have the character of a mutable mobile in topological space; it "morphs" (may be designed to "morph") as it traverses the universes of financial accounting and disclosure, regulatory oversight and management controls within and across organizations. The credit default swap performs various turns as a risk-shifting mechanism, a regulatory hedge or capital substitute, a way to bet on a company, a tradable asset in its own right, or an index of company risk (informational tool). It seemed to have operated as a transactionalizing technology with respect to at least some CDOs (O'Harrow and Brady 2008; Tett 2006). The CDO technology, incorporating models, ratings and contracts, in turn brought various (relatively) illiquid "goods" to market. Like (and together with) CDOs, credit default swaps enabled some potential risks to be more or less invisible during a period or conditions of latency but then appear in many places at once, spreading contagion.

We observe in CDSs a fluid quality (Mol and Law 1994) that has differential "hydraulic" effects in multiple systems; they are hardly the "pacified" or inert things deemed market-ready by Caliskan and Callon (2009b). They illustrate that contracts and the associated information mechanisms can trigger, delay, transmit, amplify or mask conditions or effects. A folding or collapse of the network can create sudden, unanticipated proximity in terms of risk and consequences, as the extended enterprise discovers extended vulnerability, such as supply chain risk (Dvorak 2009). Significantly, these effects are not described *per se* in the contract documents but are effects of how the contracts work (*do* things) in a larger social and material environment, and are thus performative, not only in Austin's (1962) original sense but in the extended sense as applied with respect to the financial markets MacKenzie et al. (2007) or more generally (Barad 2003). From this perspective and based on the preceding analysis, we propose that a productive working conceptualization of contract for IS design purposes would be contract as technology of connectedness.

Conclusion and Implications

We have argued that ICT-related functional simplification and closure (Kallinikos 2005, 2006) within the organization and the reciprocal development of networks (e.g. Ciborra 2007; van Heck and Vervest 2007) entail implications for contract and for the importance of organizational awareness with respect to contract. That is, information systems designed for organizational awareness with respect to *internal* production processes need to be extended in some fashion to ensure the continuity of organizational awareness with respect to those processes as they are re-placed outside the organization by way of contract. We considered two approaches to incorporating contract into organizational awareness. Both approaches depend on making contract effectively calculable and thus presumptively knowable, but they differ in their foundational assumptions and operational aspects.

The first is a process-oriented approach taken by a packaged software solution, contract management software (CMS). In its simplest form, the design model underlying CMS assumes that contract documents can be standardized, that the contract documents contain the relevant contract terms, and that the contract terms can be resolved to discrete operational datapoints. The program of internal standardization and operationalization of contract, if achievable, would produce effective calculability, and thus, presumptively, an "enterprise view" of contract. The case of CMS indicates

that a model of contract as commodifed, data-discrete transaction, removed from its relational context, cannot be *effectively* generalized or *extended* to cover all types of contracts. Indeed, an attempt to force calculability onto certain types of contract may entail significant loss of meaning. The case of CMS suggests that several well-understood albeit difficult practical IS issues have bearing on the problem of organizational awareness of contract: managing scale and variability, extracting discrete datapoints from unstructured data and tacit knowledge, and the deriving or structuring meaning from data. In sum, we suggest that there are substantial practical difficulties in achieving calculability, and thus organizational awareness based on calculability, with respect to contract generally.

The second approach relies on calculability in the form of market-based valuation of contract for financial accounting and risk management purposes in the more limited contract domain of the financial markets. We considered as our example the case of credit default swaps at AIG in the recent financial crisis. The approach to making contract calculable in this case assumes that trading prices in the market are authoritative for organizational awareness. However, we argue that reliance on market-based valuations, incorporating or dependent on transactionalizing technologies, to achieve organizational awareness ignores their fundamentally contingent and relational nature: We note that transactionalizing technologies are information-hiding by design and can create self-referential but performative structures, with substantial (non-virtual) consequences. Because of their instrumental power, there is a tendency for transactionalizing technologies to *extend* their reach into complex, context-heavy domains, and thus a possibility that they will become decoupled from the pertinent underlying reality. This risk may be acute where contract is designed to meet the requirements of, escape or evade various classification schemes, and is especially problematic where the participating organizations look to these same information systems (such as financial accounting) to create awareness.

We conclude that, with respect to contract generally, calculability may be difficult to achieve, and that calculability, whether constructed from process standardization or market-based valuation, may entail potential loss of meaning and thus does not ensure organizational awareness. We suggest that a more developed notion of organizational awareness is needed, supported by an alternative conceptualization of contract as a technology of connectedness. Further research is warranted in order to identify the relevant (multiple) dimensions and qualities of contract as a technology of connectedness. These would include, for example, scale and variability, but also the nature of performance (such as interdependence (discussed in Caglio and Ditillo 2008)), as well as systemic attributes (e.g. transmission, absorption, redundancy, interchangeability, amplification). Calculability is certain to be an important element of a more comprehensive conceptualization of contract, but might, for example, incorporate multiple, alternative values, whose contingent and relational nature are so far as practicable expressly identified.

One possible outcome of viewing contract as a technology of connectedness – highly relevant to IS design – might be that we can identify dynamics of substitution or equivalency between contract and information (noting a possible parallel with the substitution effect between money for information (e.g. Power and Laughlin 1996: "Like Parson, Habermas follows the cybernetic insight that money encodes information and releases agents from the burden of communication."). Such a substitution or equivalency we would argue is hinted at in the research literature regarding inter-organizational control (Caglio and Ditillo 2008). A focus on connectedness might also rationalize observations of so-called "non-contractibility" in what are clearly contractual relationships (Mithas et al. 2008). Such research might produce insights relevant not only to IS design for contract, but for contracting practices and possibly systems design more generally. With respect to the last, for example, it may

be that loss of meaning is so substantially entailed by functional simplification and closure that design should generally incorporate parallel, meaning-preserving channels more often than not.

We make a contribution to IS design for organizations by explaining how ICT-related functional simplification and closure within the organization and the reciprocal development of networks entail implications for contract as a technology of connectedness and for the importance of organizational awareness with respect to contract. The study in this paper draws attention to reasons why calculability of contract generally may not be feasible and further suggests that calculability may not be sufficient to create organizational awareness with respect to contract. Our findings provide particular insights with respect to organizational awareness and identify issues for further research.

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