

Towards a Structural Theory of Information Systems: a Substantive Case Analysis

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Abstract

This paper employs the analysis of an interpretive case study within a Regional Train Operating Company (RTOC) to arrive at theoretical understandings of Information Systems (IS). Giddens' 'structuration theory' is developed which offers an account of structure and agency; social practices developing and changing over time and space. The most common application of structuration theory to the IS domain is the analysis of empirical situations using the 'dimensions of the duality of structure' model. The best-known attempts to theorize IS concerns using this approach have come from Orlikowski from whom this paper draws particular attention. Structural concepts (system integration, time-space distancing and routinization) as well as Giddens' conceptualization of social change are further developed to help explain IS phenomena. Some fifty interviews were conducted at every level in the company (RTOC) from engineers and train drivers to the board of directors. Participant observation was also undertaken with the authors attending twenty-one meetings, workshops and presentations. The resulting theoretical model describes IS embedded in social practices, which evolve to display both regularity and change.

1. Introduction

Giddens' mature formulation of structuration theory is expressed in 'The Constitution of Society' [1]. Giddens' main claim for his theory is that it draws together the two principal strands of social thinking. In the structuralist tradition the emphasis is on structure (often understood primarily as constraint), whereas in the phenomenological and hermeneutic traditions the human agent is the primary focus. Structuration theory recasts structure and agency as a mutually dependent duality. Structuration theory has been used in the study of IS for some time [2-4]. The power of structuration theory concepts to illuminate empirical situations has already been well demonstrated [5-12]. In the theoretical realm, Orlikowski's [13] structural model of technology is the most convincing attempt to account for technology in terms derived from

Giddens' theory. She offers a model which relates institutional properties, human agents and technology: technology is both *constituted* by human agency, and helps *constitute* institutional practice. Much of this, and other thinking about IS in structural terms has revolved around Giddens' 'dimensions of the duality of structure' model [3], which considers the concepts of structure and interaction (agency). The inherent weakness of some of this theorizing, strongly criticized by Jones [4], is that it tends to reinforce the equation of technology with structure and structural constraint. In IS this tends to take the form: technology is built by human agency, thereafter it constrains what we do - characterized as the 'discontinuous separation of design and use' by Orlikowski [14]. Her notion of technology constituting institutional properties also resides a flavor of technological agency. However, the equation of technology with structural constraint or with agency is not consistent with structuration theory. As Jones [4] points out, the materiality of IT systems (hardware, software, silicon, plastic, metal, energy) is at odds with Giddens' consideration of the social in terms of human thoughts and actions. Giddens' own account of the role of technology in structuration, in so much as it exists, casts it as a resource to be employed by human agents. Structure (according to Giddens) exists only in memory traces, and agency is as uniquely human attribute, enabling the process of structuration which is enacted in the minds of human actors without being reified in material artifacts. However, IS researchers have often, in the manner of Orlikowski, viewed technology as a significant factor in social process. Herein lies a major problem for IS researchers working with structuration theory: how to account for the perceived influence of IS on social practice without invalidating the crux of Giddens' account.

This research project involved an extensive study of computer systems and associated information management processes at three different sites within a regional Train Operating Company (RTOC). Contacts with the company lasted over three years, with the main body of work being undertaken over the period September 1996 to October 1999. Some fifty interviews were conducted at every level in the company from engineers and train drivers to the

board of directors. Observation was also legitimate, with the researchers freely allowed in the control rooms, offices and engineering workshops. Participant observation was also encouraged, and the author attended twenty-one meetings, workshops and presentations. In addition, seventy documents were studied. The authors were allowed full access to the computer systems and were able to study screen-shots, and personally interrogate the reporting applications. Note-taking was generally via the diary method. Analysis used structuration theory and took two principal forms: the first was the conventional writing of thick description using the structuration concepts in the second a grid format derived from Giddens' models (following Orlikowski) was used to focus the analysis. The research was evaluated according to the principles set out by Klein and Myers [15] and the resulting theoretical discussion depended upon Walsham's [16] assumptions about generalizing to theory.

The paper is organized in the following way. The initial section describes the research method, research protocols and evaluative criteria. Then the theoretical principals which guide the analysis and theory development are set out. These are abstracted from structuration theory. They include a number of concepts such as system integration, time-space distanciation and routinization (as well as Giddens' conceptualization of social change) which have not been widely adopted in IS research. The case study is introduced, and two structural analyses are carried out

2. Structural Theory

This section of the paper sets out the concepts from structuration theory which will be used for analysis and theory development.

2.1 Agency

Human agency, in Giddens formulation, is the 'capacity to make a difference' ([1] pp 14) - (also known as 'transformative capacity'). It is intimately connected with power - in fact this is one of its defining characteristics, since the loss of the capacity to make a difference is also powerlessness. In practice, human agents almost always retain some transformational capacity - though it be small. Power involves the exploitation of resources. 'Resources (focused by signification and legitimation) are structured properties of social systems, drawn on and reproduced by knowledgeable agents in the course of interaction' ([1] pp 15). Resources are 'of two kinds: authoritative resources, which derive from the co-ordination of the activity of human agents, and allocative resources, which stem from control of material products or aspects of the natural world' ([1]). Power is not itself a resource as actions have both intended and unintended consequences.

2.2 Structure

Giddens defines structure as 'rules and resources recursively implicated in social reproduction; institutionalized features of social systems have structural properties in the sense that relationships are stabilized across time and space'. Structure can be 'conceptualized abstractly as two aspects of rules - normative elements and codes of signification. ([1] pp xxx1) Structure 'exist only as memory traces, the organic basis of human knowledgeability, and is instantiated in action' ([1] pp 377). Structure refers, in social analysis to 'the structuring properties allowing the 'binding' of time space in social systems, the properties which make it possible for discernibly similar social practices to exist across varying spans of time and space and which lend them a 'systemic' form. To say that structure is a 'virtual order' of transformative relations means that social systems as reproduced social practices, do not have 'structures' but rather exhibit 'structural properties' and that structure exists, as time-space presence, only in its instantiations in such practices and as memory traces orienting the conduct of knowledgeable human agents' ([1] pp 17). Giddens regards structure not merely as constraining, but also as enabling - an important distinction from the use of the concept by most writers.

2.3 Duality

Giddens recasts the two independent sets of phenomena (dualism) of structure and agency as a 'duality' - two concepts which are dependent upon each other and recursively related. 'The structural properties of social systems are both medium and outcome of the practices they recursively organize' ([1] pp 25). The 'dimensions' of the duality of structure are given in the following well-known diagram (Figure 1).

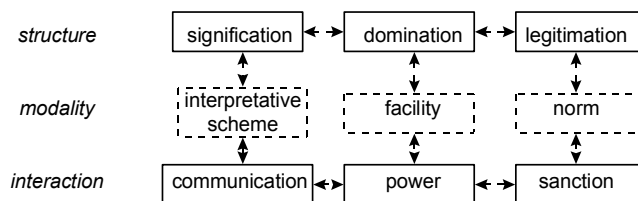


Figure 1. Dimensions of the duality of structure [1]

Social structure and human interaction are broken down into three dimensions (solely for the purpose of analysis) and the recursive character of these dimensions is illustrated by the linking modalities. Thus, as human actors communicate, they draw on interpretative schemes to help make sense of interactions; at the same time those interactions reproduce and modify those interpretative schemes which are embedded in social structure as meaning or signification. Similarly the facility to allocate

resources is enacted in the wielding of power, and produces and reproduces social structures of domination, and moral codes (norms) help determine what can be sanctioned in human interaction, which iteratively produce structures of legitimation.

2.4 Structuration

Structuration is therefore the process whereby the duality of structure evolves and is reproduced over time space. Agents in their actions constantly produce and reproduce and develop the social structures which both constrain and enable them. 'All structural properties of social systems.....are the medium and outcome of the contingently accomplished activities of situated actors. The reflexive monitoring of action in situations of co-presence is the main anchoring feature of social integration' ([1] pp 191). Thus a conference delegate giving a paper takes part in a social interaction in which ideas are communicated between speaker and audience. However, the participants bring with them the history of other presentations at conferences, codes of behavior, belief and value systems, dress codes, ways of organizing and proceeding and of interpreting the ideas. These constitute structure for the interaction. As the presentation proceeds it re-enacts the structure, thus replicating it and helping it to form part of a practice which will help determine how future presentations will be conducted.

2.5 Social integration and system integration

Giddens distinguishes between the cohesive effects of social interactions which take place when actors are physically present, and wider systemic effects of interactions across distance. 'The reflexive monitoring of action in situations of co-presence is the main anchoring feature of social integration' ([1] pp 191). 'Whereas social integration refers to face-to-face reciprocities between agents who meet in circumstances of co-presence, and therefore preserves a concern for *praxis in situ*, [social] system integration refers to reciprocities between absent agents, i.e. agents who are physically and/or temporally situated in different settings, which admits the possibility of intersituational articulations of systemic patterns' [17]. Our conference delegate may receive advice from a colleague in the next office on the form of a scientific paper, thus helping determine social practice. However, they may equally well pick up formatting instructions from the conference web site, written some weeks earlier by a colleague in another country. This helps replicate social practice on a wider scale than the face-to-face interactions permit.

2.6 Time space distanciation

Time space distanciation involves the 'stretching of social systems across time-space, on the basis of mechanisms of social and system integration' ([1] pp 377).

As the recursive and reflexive structuration of social interaction extends between people over geographical distance and over time, so the embeddedness or 'bite' of those practices increases. 'The structural properties of social systems exist only in so far as forms of social conduct are reproduced chronically across time and space' ([1] pp xxi). The delegate, equipped with conventionally written scientific paper and overhead projector slides, may expect to deliver his presentation successfully in most parts of the developed world - these practices have been widely accepted for some time. However, should (s)he wish to submit by email and employ a laptop computer for the presentation, then some inquiries are in order, these practices are less widely observed, but may, in the future become standard.

2.7 Routinization

If social practice becomes reasonably stable over time and space, then routines - practices in which actors habitually engage - develop. Routines constitute 'the habitual, taken-for-granted character of the vast bulk of the activities of day-to-day social life.' ([1] pp 376). The writing of a scientific paper and its conference delivery, once a social practice to be painfully acquired, may, with the years, become commonplace, a routine part of an academic's life. 'All social interaction is situated interaction - situated in time and space. It can be understood as the fitful yet routinized occurrence of encounters, fading away in time and space, yet constantly reconstituted within different areas of time-space. The regular or routine features of encounters, in time as well as space, represent institutionalized features of social systems' ([1] pp 86).

2.8 Social change

Giddens distinguishes between emergent regularities of social practice which constitute society via the process of structuration, and periods of marked societal change, as shown in Figure 2.

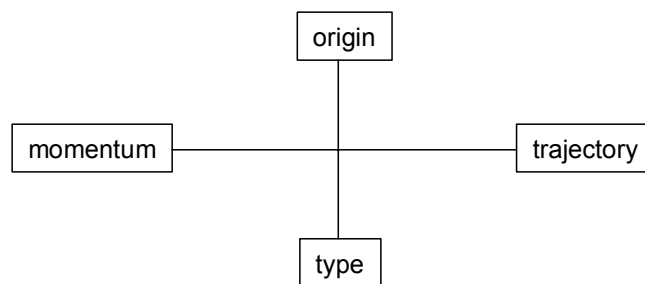


Figure 2. The dimensions of social change [1]

In considering episodes of change Giddens suggests the analyst should look at their origins: 'the expansion of the

time space distancing of social systems, the intertwining of different modes of regionalization involved in the processes of uneven development and the prevalence of historicity [using interpretations of history as a catalyst for change] as a mobilizing force of social organization and transmutation.’ Type indicates how extensive and intensive the change is: ‘how profoundly a series of changes disrupts or reshapes an existing alignment of institutions.’ Momentum refers to the rapidity at which change occurs, whilst trajectory defines the overall direction of change. The concepts outlined above provide the basis for the following data collection, analysis and theory development.

3. Case Study – Regional Train Operating Company (RTOC)

This section describes, in the form of a case study, a consultancy intervention into a train operating company. The company will be referred to throughout as Regional Train Operating Company (RTOC).

3.1 The railway industry

The July 1992 White Paper ‘New Opportunities for the Railways’ set out HM Government’s proposals for the restructuring and privatization of the railway industry in Great Britain. These included:

- separating the management of the railway infrastructure from the provision of train services;
- the creation of a new regulatory regime; and
- the transfer to the private sector of the ownership of the railway infrastructure and the provision of train services.

The White Paper also recognized that some passenger services would continue to require subsidies. The legislation necessary to enable the implementation of these proposals became law in November 1993. The restructuring of Britain’s railway industry has split British Rail into a number of new industry participants. These included:

- Railtrack who own the railway infrastructure
- Passenger train operating companies (TOC’s)
- Freight train operators
- Rolling stock companies who own the rolling stock (ROSCO’s) and
- heavy maintenance suppliers who maintain the rolling stock.

The activities of the industry participants are overseen by:

- the Rail Regulator who grants licenses to operators of railway assets, monitors and enforces compliance with the terms of those licenses and regulates the access to track, stations and light

maintenance depots, including the level of access charges; and

- the Franchising Director who awards passenger rail franchises and monitors the performance of the services provided by the franchisees. He is also responsible for paying subsidies to franchisees.

3.2 The company

RTOC was one of 25 new passenger train operating companies. British Rail continued to take overall responsibility for these companies until franchising was completed in March 1997. Essentially RTOC operated as a private company in a regulated market, leasing rolling stock and buying services from the other industry parties. It was structured in a conventional way in functional directorates, and continued to run its own maintenance depots under the control of the Director of Technical Engineering. The personnel, structure and management of the company continued without major changes until it was franchised. The new franchise holder immediately replaced the managing director and several of the board and the company’s name was changed to a Regional Trains (RT).

3.3 Defect and maintenance management at RTOC

The maintenance effort was largely concentrated at the depot, situated in shabby premises in a poor district of the city. Maintenance took the form of regular exams (like a car service) and much unscheduled work. Fitters at stations helped to resolve faults (defects) that arose on trains in service. Maintenance controllers (situated at the much smarter city center headquarters) organized the response to problems in service with the aim of keep the trains running. Information collection was very complex: defects could be reported in a number of paper forms, verbally, or by radio or telephone via a number of distinct routes. However, defects reported were not necessarily those which had caused the problem (poor diagnosis by non-specialist staff). Terminology relating to delays in service was also complex: ‘incidents’ were sometimes a ‘technical failure’ to distinguish them from non-technical causes of delay (such as vandalism); a technical failure causing more than five minutes delay became a ‘casualty.’ The depot’s principle reporting parameter was a statistic called ‘miles per casualty’ - a ratio of how far a type of train unit had traveled against the number of casualties. Completed maintenance work was largely recorded on pieces of paper which were entered into a computer system, often weeks later. Maintenance supervisors at the depot were responsible for allocating work and entering some data into the computer systems, with clerks following the paper trail and entering the backlog of detail. A number of computer systems were in operation - mainly

dating from the pre-privatization days of British Rail. The principal systems investigated were GEMINI, the system at the hub of managing operations, and RAVERS, a system designed to help record maintenance data. Although apparently independent, these pre-relational menu-driven mainframe databases were designed to interface and update each other. A totally independent system, TRUST, operated by Railtrack, contained data about incidents and delays. In some cases, Windows style front ends had been, or were in the process of being developed. The systems were built, improved and maintained by companies which had once been the computer systems wing of British Rail, but were now independent. The mainframe computers were physically located in another town, some forty miles away, at one of the new computer company's headquarters. There were at least a dozen other related computer systems. Although these systems produced a number of standardized reports, data linking delays with defects was not available - delay data was in TRUST, defect data in RAVERS and there was no way of interfacing the two systems. The designing of ad-hoc reports was exceptionally complex. Analysis of defects was dependent upon the system of coding used; an additive coding system was available, but it was not used in any depth, and much of the coding was done by clerks with limited technical knowledge. Relationships between data providers (train crew) and data users (maintenance engineers) were poor, with little feedback. RTOC was not in the habit of costing defects, and little relevant financial information was available.

The most visible sign of the new franchise was the replacement of several of the directors, including the managing director. The technical engineering director, responsible for maintenance, survived. A new focus on customer service was advertised. The focus at Rail headquarters changed. Railtrack (the company operating the rail infrastructure) was allowed to charge penalties for delays on its tracks which were caused by train defects - the bills were large and management wanted to reduce them. Much effort went into tracking the delays and challenging their attribution. However, analysis showed that there was no simple relationship between penalties and defects. The amount of the delay, and therefore the size of the penalty, was affected by many variables, including how many trains were stacked behind the failed unit, and how close to a competent fitter the unit was. A further computer system (ROBIN) was purchased which was designed to sit on top of RAVERS and TRUST, and to integrate data about delays and defects. Unfortunately, its operation required a minor change to a database field in RAVERS. This change required the authorization of the committee of representatives from all the train operating companies which supervised the work of the independent

company developing RAVERS, and proved difficult to effect. A Windows style front end for RAVERS was available (but not adopted because of its more limited functionality), and more modern Oracle based databases were under development. Year 2000 was an acknowledged problem. The only member of the Information Services staff with technical knowledge of RAVERS and GEMINI left the company. Problems perceived by the consultancy team included lack of motivation, lack of understanding of RAVERS and how to use it, and a general lack of direction.

4. Structural Analysis

The company is analyzed in two ways using Giddens' concepts. The first analysis concentrates on the emergent regularities of the situation and uses Giddens' 'dimensions of the duality of structure model' (Figure 1). The second analysis focuses on change, using Giddens' 'dimensions of social change' model (Figure 2). The analysis highlights the different interests at work and the political nature of the intervention carried out in the aftermath of privatization prior to a franchising exercise. The analysis of change (Figure 4) is undertaken according to the 'dimensions of social change' model (Figure 2). This analysis highlights difficulties in the information management decision-making process (largely consequent of the post-privatization situation and the franchising exercise) which made change unusually hard to effect.

4.1 Case discussion

There are two sets of reflections on the preceding analysis. The first set concern the analysis of RTOC, whilst the second set reflect on the role of IT in the social practices at RTOC. At RTOC, the combination of inflexible technologies, and IS management that lacked the ability to modify the technologies even in small ways led to a particularly static and constraining situation. The technology appeared to be well embedded (enabling information practice over time and space); however, the designers' intended practices had only been partially understood, and developments in organizational and business practice had led to increasing dissonance between the practices that the computer systems were designed to support and the evolving business practice. Because the technologies imposed a particular set of interactions, actors resorted to increasingly desperate remedial information practices, which tried to bridge the gap with bricolage - improvised and temporary solutions. New systems, or substantial modifications were urgently required, but the post-privatization organizational situation made them particularly hard to achieve.

structure	<p>signification</p> <p>Commercial motivations replace nationalised industry, profit + cost cutting replaces safety as key driver. Meanings attached to pre-privatisation events less relevant in commercial environment. Survive in commercial jungle or go under.</p>	<p>domination</p> <p>Conventional hierarchical divisional power structure. Researchers considered to have expert power+ message delivering (access to authority) power. Managers at the top of the pile, then engineers, then train crew, then clerical staff.</p>	<p>legitimation</p> <p>Rhetoric of legitimisation by cost cutting - not always born out in practice. 'Quick wins' and fast solutions to external problems valued.</p> <p>'Oily hands' (heavy engineering) work legitimate, whereas information work less so.</p> <p>Researchers draw legitimation from their academic background.</p>
modality	<p>interpretive scheme</p> <p>Managerial schemes (macho + commercial) distinguished from engineering schemes (craft skills) and information working schemes (little appreciated or valued). Many of the schemes (e.g measuring maintenance performance) need rethinking in the new environment.</p>	<p>facility</p> <p>Resources allocated after long decision-making periods. Technical director appoints researchers to re-establish authority - therefore sub-ordinates have to outwit them, rather than collaborate. Small investments available for reactive problem solving.</p>	<p>norm</p> <p>Poor information management practice accepted, or un-noticed. Rhetoric of co-operation and harmony normally maintained, even if the practice is different. Maintenance controllers engaged in the work of keeping the trains running, rather than prioritising information work reactive approach to problem solving. Nobody really accepts responsibility for IS initiatives.</p>
interaction	<p>communication</p> <p>Political and affected by rivalries rather than truly co-operative. Maintenance depot scapegoated and consequently trying to establish clean bill of health through consultants. Outdated computer systems heavily implicated in maintenance communications. Workarounds common where computer systems don't offer suitable help. Poor communications with system developers. Poor communications with drivers.</p>	<p>power</p> <p>Weak technical director's authority openly flouted on occasion. Maintenance manager withdraws co-operation, (but not rhetoric of co-operation) with researchers. He sets tone for co-workers who follow.</p> <p>Researchers exercise power to report to directors</p>	<p>sanction</p> <p>The ultimate sanction - dismissal - very much in prospect as a result of franchising, and heavily influencing other perceptions. Sanctions with researchers take the form of withdrawal of co-operation.</p>

Figure 3. Analysis using 'dimensions of the duality of structure' model

<p>origin</p> <p>History of change entangled with privatisation, monolithic legacy systems, separation of IS wing of British Rail and private companies, cumbersome management arrangements for IS provision between competing rail operating companies. De facto outsourcing of information system provision leading to: low status and visibility of IT, reactive IS management, IS skill shortages leading to poor understandings of good information practice, lack of close working relationships between developers and users, lack of expertise in specifying or evaluating new IT systems.</p>	<p>trajectory</p> <p>Direction of change hard to distinguish - reactive to external events. Problems solved piecemeal with each solution leading to another problem. No formal strategy, and little strategic thinking or forward planning. When this occurs it tends to be overshadowed by jockeying for political position in anticipation of franchising exercise.</p>
<p>type</p> <p>Privatisation was a major change, touching all aspects and practices. However (perhaps as a result) subsequent changes rather local and inconsequential, fiddling with minor problem solving activities whilst leaving major issues untouched</p>	<p>momentum</p> <p>High premium put upon speed of change, but superficial decision making as a result. Cumbersome and slow decision-making process, which has to be ratified at senior levels. Political considerations interfere with decision-making, making consensus difficult. Therefore little discernible progress on major issues.</p>

Figure 4. Analysis using 'dimensions of social change' model

RTOC experienced a catalogue of information management problems. It did not have the necessary structures for articulating or achieving computing requirements. There was no relevant technical expertise, no experience in managing contracts, no awareness of computing possibilities. Management tended to work around the information that was laboriously provided, rather than specifying its information needs. Bad data management practices went unrecognized and there were no effective practices for making changes to existing systems. Nor was there recognition of problems with the existing systems which would have served as a platform for learning about requirements for new systems. Though many actors' interpretive schemes included the idea that they should have a new computer system, they also assumed it was someone else's responsibility to make it happen. There were no understood practices for specifying a new system, or developing criteria for choosing an off-the-shelf solution, had such a thing existed. There was no board member with overall responsibility for IT, and no formal or informal decision-making and consensus-building IT communities. There was no in-house system development practice in the relevant area, and no functioning development interactions with the software supplier companies.

As part of British Rail, RTOC had always had its IT needs supplied internally. Now as a newly privatized company, it found itself a partner in a de facto outsourcing arrangement. However, there is little evidence that that arrangement was benefiting the company. Rather, it seems likely to perpetuate and exacerbate the company's existing difficulties. These difficulties can be summarized as follows:

- *Low status and visibility of IT* - The low status and low visibility of IT was reinforced by the outsourcing arrangement. IT was confirmed as a non-essential service and a cost burden, contracting as an administrative burden, and skilled IT professionals were left out of the company's core decision-making processes. Key operating systems (keeping the trains running) were afforded only minor importance.
- *Reactive management* - management responded to problems rather than setting agendas. IT was employed to help solve a problem, rather than aligned with business strategy to gain competitive advantage. Outsourcing reinforced the non-strategic characterization of IT systems
- *Skill shortage leading to poor information management* - information management practice at the maintenance depot was poor. These practices went unrecognized largely because there were few skilled IS practitioners available to challenge them. Outsourcing reinforced the skill

shortage by taking the skilled practitioners off-site and making their time chargeable.

- *No close working relationships between developers and users* - outsourcing degraded the already poor communication between developers and users. The systems users developed many poor uses of the systems simply because they had no way to change the systems as their needs changed. Similarly the systems developers built systems which were of no great value to the company because they did not investigate the users' business needs.
- *Difficulties achieving new systems* - new systems, or substantial modifications were urgently required, but the outsourcing situation made them particularly hard to achieve. Staff at the company depot lacked the expertise to specify or evaluate new systems. The development companies were too remote to recognize these needs or provide useful systems. Outsourcing took IT-skilled staff out of the decision-making and agenda-setting loops.

RTOC's problems were directly attributable to the company's history; no serious criticism of managers or staff is implied. By and large they simply struggled with the legacy of privatization and the difficulties inherent in their situation. However, the end result as can be characterized as dysfunctional paralysis by outsourcing. RTOC found itself an outsourcer by the historical accident of privatization, and struggled to deal with the unfortunate consequences.

Clearly the computer systems played a significant role in the information and work practice at RTOC. They were heavily implicated and embedded in the social practice, and a factor in the routinization and time-space distanciation of interactions. Giddens theorizes computer system as resources used by agents, and as organizational memory. Both of these functions are apparent at RTOC. However this interpretation rather underestimates the role of IT, since the computer systems appear, to a certain extent, to stabilize and enable certain interactions and structures, and to constrain or make difficult others. This is a more structural explanation of the role of IT. Of course, these enabling and constraining factors can largely be traced back to the programmers of the systems, who interpreted structures and interactions in the industry, and designed the systems with particular social practices in mind. Part of the impression of constraint is caused by the serious difficulties in effecting changes to them. However part may also be caused by inherent characteristics of the technology itself, such as the programming language and database management system. These characteristics may themselves be seen as the result of a wider societal social process, though there may be some features of the

technology (such as the speed a silicon processor can run at) which may be absolute. Orlikowski's [14] portrayal of IT as 'constituting, and constituted by' the institution, (itself inconsistent with structuration theory) offers a larger estimation of the role of IT in structuration, which might include some elements of structure and agency. It is easy to see how the computer systems at RTOC were constituted (designed and built by developers in accordance with their perception of desirable practice) by their programmers and analysts. It is less easy, however, to see the computer systems constituting social practice. Certainly they had an impact on practice, but the number of workarounds and deviations from the designers' intentions demonstrates social practice evolving around the inflexible systems. There were few constraints imposed by the computer systems that the agents could not evolve a practice to avoid or workaround. Thus the degree of 'interpretive flexibility' [14] was considerable.

5. Conclusion

When practical applications are in mind, computer and communications technologies cannot usefully be studied in isolation from their social contexts. Organizational practice is only a particular variety of social practice, with its own structures and interactions. Since well-developed social theory is available, it makes sense to appropriate it to help in that study, in the manner of Orlikowski's structuration model of technology. However, theory concerning IS which is avowedly structuration should remain faithful to the main thrust of Giddens' thinking. There remains the opportunity to develop other coherent and convincing theoretical accounts which are based on social theory, but these should not be called structuration. The principal problem for a structuration account of IS is to account for the influence of material technology without attributing to it properties of agency or structure.

Structuration analysis of a UK rail company helped clarify the multi-faceted relationship between the technology and social practice. The technologies were deeply embedded in the social practices of the work situation, sometimes helping people to achieve their purposes, sometimes hindering them, but always part of their daily routines. Where the situation changed, but the IT systems did not, (and in many other circumstances), the more flexible human agents altered their practice, or tried to modify the systems in what Pickering [18] has called 'the dialect of resistance and accommodation.' Much of the way that the IT systems were organized was the consequence of human design decisions (some of them appropriate, some less so), but the systems' users were not necessarily very aware of those decisions, nor did they normally have the means to change them. As a consequence of the static nature of the IT systems and the improvement in practices that new systems might have

precipitated, seemed unachievable without major organizational rethinking.

The structuration theory of IS developed in this paper offers an account of IT heavily embedded in social practice. Human agents re-enact that practice, using the technologies at their disposal as resources, according to the structures (rules, conditions, contexts) available to them. In doing so they modify the evolution of that practice. Practice operates at many levels, disseminating over time and space, from the local to the societal, interwoven in ways which are hard to analyze. Much of that practice is routine; purposeful, but not necessarily heavily considered action. However, the materiality of the technology, and the effort needed to construct and alter it, means that it can hold a residual resistance – promoting the practices envisaged by its designers, hindering others. A specialized social practice is that of ISD, subject to its own evolving interactions and structures, and highly partial and fallible. New technology may be the catalyst for social change (the evolution from one discernible set of practices to another), but it may also ossify practice and hinder change.

Future research should concentrate on the implications of the structuration theory of IS for IS development. A structuration starting point for systems analysis and design might be the analysis of social interactions mediated by existing computer systems, rather than process, data, object, entity. Deviances between intended and actual interactions could be studied. Key aspects of all relevant social systems might be analyzed, rather than a narrow concentration on supposedly objectively observable business system. Decisions about sets of social practices to be routinized could be encouraged. Social practices which are well stabilized can be leveraged with IT. These ideas hold some promise for promoting development strategies which better balance the technical and the social systems environment.

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