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2004

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Brian O'Flaherty
University College Cork, boflaherty@afis.ucc.ie

Jason Whalley
University of Strathclyde, jason@mansci.strath.ac.uk

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FROM INTRANETS TO WRESTLING INFORMATION INFRASTRUCTURES

O'Flaherty, Brian, Business Information Systems, University College Cork, Ireland. Email: boflaherty@afis.ucc.ie

Whalley, Jason, Management Science, University of Strathclyde, Graham Hills Building, 40 George Street, Glasgow, Scotland. Email: jason@mansci.strath.ac.uk

Abstract

This study explores intranets as information infrastructure and this conceptualization is supported by evidence from three interpretive case studies. If an intranet is considered as an infrastructure then it does not occur 'de-nouvo', it must wrestle with an 'installed-base' and over time extends as a new infrastructure. If this is the case what are the social arrangements that are embedded and give visibility to the Information Infrastructure? What are these existing 'installed bases' that an Intranet wrestles with? A qualitative analysis strategy exploiting qualitative analysis software enhances this research.

This study concludes that web-based information resources are in fact an information infrastructure, which do not occur 'de-nouvo'. They 'wrestle' with and extend the existing non-technical organisational communication structures, taking on their strengths and weaknesses. They also 'plug' into other technical infrastructures in a seamless way. Business processes are also inscribed on to the information infrastructure, but in a partial manner rather than full-automation. A model of this nature can help the IS professional to more purposively extend an Intranet to a business critical information infrastructure.

Keywords: Intranet, Installed base, Information Infrastructure.

1   INTRODUCTION

This paper sets out to elaborate on the internal corporate use of web technology within the organisation and addresses how it is conceptualised in terms of the corporate information infrastructure. The literature review focuses on the Intranet literature and an overview of the concepts in the corporate information infrastructure literature. Two research questions are identified and dealt with in separate section, drawing on the evidence from three case studies and the concepts from the information infrastructure literature.

2   LITERATURE REVIEW

This paper draws on two distinct bodies of literature, namely the intranet and the information infrastructure domain. The first section addresses the intranet, focusing on its capacity to embed business processes. The second section deals with the information infrastructure literature, with an examination of the role of the 'installed base'.

2.1   Intranets and business processes

The term Intranet was reputably coined by Eric Schmidt, the Vice president for technology at Sun Microsystems, to describe the application of Internet standards and systems to the management of internal corporate networks (Regli, 1997). Intranets are defined as 'a network based on TCP/IP protocols, belongs to an organisation and is only accessible by the organisation's members and others who have authorisation. An intranet looks and acts like other web sites but a firewall prevents unauthorised access. Like the Internet, Intranets are used to Share information (Denton, 2003).' According to Davenport (2000) 'Intranets a were popular vehicle for information distribution; Half of the companies planned to use intranet technology for access to common reports and two firms adopted the Web in place of previous executive information systems (EIS).'

Scacchi and Noll (1997) proposed the concept of a process-driven intranet and they eluded to the relationship with organisational structure, as 'designers of intranet or Web-based networked information systems are increasingly expected to model the organisational web so that an information systems can successfully support it'. Corporate intranets are proposed as a successful way 'to implement more effective systems' and distinguish between traditional intranets which 'have no explicit representation of the processes they support.' The study investigated how to formalise and redesign processes for managing research grants, while also adopting a 'corporate-wide' intranet (Scacchi, 1997).

This theme of business process re-orientation is also discussed by Grzech (1998), who refers to Intranets as 'not only a tool; but also a model for efficient, process oriented enterprises'. The Intranet has an impact on workflow as well as communication patterns (Newell, 1999).

Intranets are capable of making a profound organisational impact and can be described as an 'open-ended' or 'equivocal' technology (Newell, 1999). They can have a negative effect on organisations by 'encouraging fission not integration and tended to reinforce powerful centrifugal forces operating on the strategic development of the firm' (Newell, 1999). The lack of research into Intranets is highlighted by Blanning and King (1998), who claim that the literature 'tends to consist of anecdotes about particular intranets and these accounts appear on the web pages of certain companies offering Intranet-related products and services.' There is also a lack of 'any comprehensive framework for explaining Intranets, nor do we have any systematic studies of Intranet applications' (Blanning and King, 1998).

In order to address the lack of a comprehensive framework, the information infrastructure literature is explored. Can the multifaceted intranet be conceptualised as an information infrastructure or does the

information infrastructure give us a different perspective, with a more 'comprehensive and systematic' way of viewing the Intranet phenomenon?

2.2   Corporate Information Infrastructure Explored

The relationship between an IT platform and the emergence of a newer architecture is evident in the proposal of Inter-network Computing Architecture (InterNCA), which is loosely defined as 'all technological components and associated standards that organise internet based data transfer and computing, as well as the increasingly dense resulting interconnectivity between individuals and organisations' (Lyytinen, 1998). The InterNCA will have a profound impact on IS research requiring researchers to critically assess their methods and standards in order to scale up for InterNCA. Researchers should drop approaches and topics that do not meet the needs of InterNCA platforms, while emphasis must be placed on long-term evolution with a focus on the infrastructural nature of InterNCA and addressing emerging technological needs (Lyytinen, 1998).

Information Infrastructures are different from typical information systems, as they are shared by a large community across a large geographical area and require a holistic perspective (Hanseth, 2003). A more sophisticated definition and the first to describe infrastructure as a social and technical construct is presented by Star and Ruhleder (1995), who define a series of characteristics or emergent infrastructure dimensions which includes embeddedness, transparency, reach or scope, learned as part of membership, links with conventions of practice, embodiment of standards, built on an installed base and becomes visible upon breakdown. This study explored the worm community system (WCS), a geographically dispersed system supporting geneticists (Star and Ruhleder, 1995). This system, although developed with extensive user assessment, feedback and high user satisfaction, was under utilised.   Hanseth (2003) also supports the claim that 'establishing a working information infrastructure is a highly involved socio-technical endeavour'.

An alternative definition of an information infrastructure claims that they are larger and more complex systems, involving significant numbers of independent actors as developers as well as users (Hanseth, 2000). In fact a large infrastructure is difficult to change and could be conceptualised as a powerful actor affecting its own future (Ciborra & Hanseth, 1998). Infrastructures cannot be designed in the same manner as traditional systems as they have to extend an existing infrastructure or improve an 'installed base' (Star, 1996, Ciborra, 1998). Instead Infrastructure should be 'cultivated' in an organic way. There is never a 'new' infrastructure, as it either extends, integrates into or improves an existing infrastructure (Ciborra, 1998).

A very loose definition describing the information infrastructure as incorporating people, technology, content and the interactions between them' is proposed by Borgman (2000). This definition implies that the information infrastructure is more than the sum of its parts. Large infrastructure building takes time and the new elements must be connected to the old in an interoperable way, while the old element or 'installed base' has a profound influence on the new design (Ciborra & Hanseth, 1998). In fact, the installed base is a powerful actor, which becomes more visible through time (Rolland, 2000).

Monterio and Hanseth (2003) are also slow to provide a precise definition of information infrastructures and instead opt to listed six aspects or characteristics; Infrastructures have a supporting or enabling function, by a large community, open, socio-technical networks, heterogeneous and influenced by an installed base.   Infrastructures are not designed from scratch, but evolve as the "cultivation" of an shared, open, socio-technical, heterogeneous installed base.

A key question in this debate is 'what is an infrastructure'? And to this end, Monterio and Hanseth (1995) are critical of the 'IT enables/ constrains' position and call for greater technical specificity in the exploration of an information infrastructure. They propose the information infrastructure is the 'interwoven relationship between new organisational forms and their IT-based backbone' and they propose Latour's actor network theory as a framework to explore this phenomenon (Monterio, 1995). Infrastructure is conceived as 'something that emerges for people in practice, connected to activities

and structures' and 'it only becomes infrastructure in relation to organised practices' (Star, 1996). It is not a 'substrate which carries information on it, or in it and the discontinuities of the infrastructure are not between the system and the person, or technology and organisation, but between contexts (Star, 1996). Ciborra (1998, 2000) suggests that the Roche case study shows that intranet/internet are examples of infrastructures.

2.3   Towards a Web-based Corporate Information Infrastructure

Some high quality previous research has highlighted new intranet roles (Scheepers 1999) and the end user orientation of intranets (Lamb, 2000). The identification of new end-user roles has led to the portrayal of Intranet as user driven, with predictions of significant shifts in information provision. Findings have emerged that differing types of intranet supported applications exist, where Intranet development can be classified as 'top-down' or 'bottom-up' and 'centralised' or 'decentralised' (Newell, 1999).

This raises two prime questions that will be addressed in this paper. Star and Ruhleder (1996) propose a set of characteristics for an Information Infrastructure, which imply that infrastructure is embedded and only visible within social arrangements or tasks. Therefore, what 'social arrangements' are becoming embedded in the Intranet as to the corporate information infrastructure? Infrastructure does not emerge 'de novo', as it wrestles with an installed base and interconnects to other infrastructures (Star, 1996). In particular, if Intranets are information infrastructure 'wrestling' with an installed base and not occurring 'de novo', what are these 'installed bases'?

3   RESEARCH METHODOLOGY

Intranet (Lamb, 2000, Scheepers, 1997, Damsgaard, 1999 & 2000) and Information infrastructure research (Star, 1996 & Ciborra, 2000) has been exclusively interpretive and qualitative in nature. A similar interpretive strategy is adopted here. The evidence for this study was collected from three case studies using purposive sampling criteria (Patton, 1990). The criteria is based on O'Flaherty (2000) and defines information rich cases, where Intranets are in place for more than three years and organisations are in the software, manufacturing and hi-tech services sectors. Three case studies where undertaken in StoreCo, a multinational computer storage manufacturer, SoftCo, a software development company and TelCo, a telecommunication service provider. Thirty-six semi-structured interviews were administered in the three organisations, with selected candidates including IS department managers, Intranet managers, general management and end-user content providers. Triangulation was facilitated by pattern matching from these multiple informants as well as using multiple data types (Patton, 1990).

Qualitative data by its nature is voluminous (Yin, 1994) and in an effort to overcome this difficulty computer aided qualitative analysis software (CADQAS) is used (Fielding, 1998). The specific CADQAS system used is called Nvivo (Richards, 2000) and provides coding analysis tools as well as model display features. Qualitative analysis (Miles, 1994) consists of three concurrently occurring phases namely data reduction, data display and conclusion drawing. Coding features of the software facilitated data reduction, while hierarchical coding diagrams were used for data display (Richards, 1995). Walsham's (1993) synthesised context/process framework forms a broad coding framework aiding the analysis phase. The adoption of CADQAS can enhance the construct validity, internal validity, external validity and reliability logic tests for judging the quality of research (Yin, 1994).

4   A TYPOLOGY OF INTRANET SITES

The mechanism for classifying the various system types poses a challenge and this classification should occur in terms of organisational role of the identified systems. These embedded activities have flow characteristics and span levels and functions of organisations, both horizontally and vertically.

The seminal organisation structure literature of Henry Mintzberg (1979) proposes a model that can facilitate the explanation of the emerging and disparate 'embedded work practices'. Mintzberg set out to assimilate the literature concerning the functioning of organisations as a precursor for developing an understanding of the strategy process. A section of this work that could help in the classification of the broad range of information infrastructure 'embedded work activities' is the metaphorical representation of the organisation as a system of flows. These flows, which provide a varied and complex mechanism that interconnects the functioning components of the organisation, are defined as flows of authority, work material, information and decision processes (also informational). The emerging 'embedded work practices' are described in terms of these organisation flow systems. The Mintzberg model is relevant to infrastructure research, as infrastructures need to be examined in a holistic manner (Hanseth, 2003).

The diverse range of sites is emerging and poses a challenge in classifying these activities. The different development approaches, specifically whether the site was developed by end-users, IS or another individual, is a differentiating factor. The nature of process support on an information infrastructure was proposed by Scacchi and Noll (1997) and it emerges that process plays a significant role in organisational life. But the extent to which they are embedded with the CII is not straightforward. The categorisations proposed here gives rise to the following list of site types namely; 1) departmental, 2) corporate, 3) confined sites supporting work groups or projects, 4) Process oriented sites and 5) business tools.

4.1   Departmental or Unit Sites

The most visible and one of the first groups of sites published in the intranet is the departmental web sites, which are generally static in nature, consisting of end-user published HTML pages with text and embedded images. All of these sites are full disclosure and available to everyone with access to a computer with a web browser in the organisation. The sites are maintained in a haphazard way and they can go out of date very quickly. Much of the information on these site is of a non-critical nature, including trivial information such as 'meet the team', 'our mission statement and strategy' and details of social events. These sites are found typically in the lower levels of the organisation. The hyperlinks between departmental sites tend to be from the bottom-up and horizontal between departments. Department sites will link to corporate sites, but this is not reciprocated. Departmental sites link to other departmental sites and project sites. But, in general, these links depend on day-to-day tasks required to fulfil the department's organisational role.

These inter-linkages may not always be satisfactory and as one end-user content provider, whose main function is in a customer care administrative role remarked:

> *We link to Marketing but to be honest they don't really fulfil our information needs.*

This quote alludes to a broad issue of information provision by end-users between functions and the sensitivity required by content providers to the information needs of other parties. It highlights the issue of cross-functional communication barriers or the signification structure (semantics or meaning) of the recipients of the relevant information. Every interaction between functional end-users, such as marketing and finance, could be fraught with tension and an inability to understand the motivation and position of the other party.

Some sites share resources or include repository applications, which use web-enabled databases. An example of this includes out of stock parts and equivalent replacement part details in a manufacturing environment. This provides consultative information for peer-to-peer communication, in this case between technicians in the manufacturing floor. Softco uses a web based document repository for storing, controlling and facilitating sharing of software release documentation. This system has information control structures embedded and in line with organisational information policy.

The department sites follow the organisation chart, which represents a clear picture of the division of labour, range of units of departments that exist within the organisation and the formal authority among

these groups. The information use pattern is also horizontal in nature, acting as lateral coordinating linkages or a liaison device (Mintzberg, 1979, Galbraith, 1979).

The links follow organisation flows and the manner in which departments or groups operate, or more specifically interoperate. If manufacturing deals with marketing then you can expect resources and web pages supporting this interaction. This information production and use is horizontal in nature involving exchange between peers or peer groups. Ad-hoc links and information use is also evident, but this is difficult to detect and can change dramatically over time. The main formal uses and linking are dependent on the nature of cross-functional and interdepartmental information flows.

4.2 Corporate Sites

Another classification based on the position within the organisation is the corporate site, which has fundamentally different interactivity characteristic to the departmental site. In this case the corporate and functional head quarters, including the chief information officer (CIO), the finance group, chief finance officer, human resource manager, information technology and CEO office can broadcast via the web environment. The corporate sites are broadcast in nature, with fixed information being made available on a full-disclosure basis across the organisation. The nature of linking via hyperlinks differs from the departmental sites as there are limited interlinks between the corporate sites, but there is absolutely no link to the lower organisational structure.

4.3 Regulated Work Flow and Business Processes

Scacchi and Noll (1997) propose that web technology is ideal for process support and claim that process driven intranets are the next generation. A process is defined as a 'structured and measured set of activities designed to produce a specified output for a particular customer or market' (Davenport, 1993). There is clear evidence that business processes are becoming embedded within the Information Infrastructure. Some of these systems are specific to individual companies, while others are common across all of the cases studied.

In the case of StoreCo, process oriented web based applications are used to check inbound orders and invoices via an invoice discrepancy and receiving order discrepancy system. All incoming orders and invoice details are stored in a web-based accessible database and used to reconcile orders as they are delivered to the company. This represents a control and reconciliation process system ensuring that the items ordered match those that are delivered.

Probably one of the most surprising process oriented systems that has emerged in this study are the hierarchical reporting oriented systems. This contradicts Hanseth (2003) who claims that traditional IS is hierarchical in nature, unlike Infrastructures. All three cases have major IS developed systems with broad geographical scope and a hierarchical reporting structure. In StoreCo this system is the revenue reporting system, which uses web-based business intelligence reporting tools to take daily reports from sales personnel and aggregates these up to vice president level within the organisation. This reporting structure has migrated from the finance to the sales function and the next phase will involve customer service. This reporting model has become critical to StoreCo's business functioning.

TelCo have developed a work management system to support the mobile technician work force responsible for provisioning and repairs. This system has a partial process component implemented in the web environment, with the other relevant task embedded within a work management system. This system fulfils a number of organisational activities including task allocation, role transformation and bypassing chain of command. Hierarchical reporting is also evident, with aggregation of provisioning, repair and scheduling information from across the organisation presented in reports to management. These reports show performance details at an individual and group level.

The SoftCo case again shows examples of hierarchical reporting implemented within the human resource information system (HRIS) and personal commitment system. Both of these systems have

been developed by the human resource function within SoftCo and involve report aggregation and workflow process embedding. The personal commitment system collects individual commitments and goals for every employee within the organisation and on a quarterly basis these are evaluated by collecting appraisal details form a range of personnel.

Business Process	Description	Case examples
Instructional process knowledge	The process diagram and links to resources are displayed on the internal web.	SoftCo's software processes, TelCo Customer service.
Pre-process validation	A web based front-end is used to validate the data entry for a form.	SoftCo expense claims
Embedded and representation Process	The web based system provides data input and publishes report, but the concept of the workflow is embedded in the system	StoreCo revenue reporting system.
Process Access	The workflow is implemented in a work management system, but is accessible by a mobile web device.	TelCo WMS, SoftCo HRIS,
Full Process Automation	The process is implemented in its entirety on the intranet.	Invoice discrepancy system (StoreCo), StoreCo Sales forecasting system

Figure 1   Taxonomy of workflow process supported on web technology.

There is a varying level of process inscription or embedding in the web technology. This is evident across all of the organisations studied and examples of process inscriptions are shown in figure 4.1.

The various classifications of process inscription or embedding show that the technology will not always support a fully automated process approach, with a partial inscription a more likely occurrence. A full automation approach for every possible business process is not feasible from a resource perspective, but clearly some partial approaches work well despite the minimal development expertise and level of automation. This range of 'degree of embeddedness' is shown in figure 4.2 as a continuum ranging from full automation to no evidence of process inscription. The process access example refers to different technical infrastructure or enterprise systems that are seamlessly integrated into the web technology and use it for data input and report or information distribution. Davenport (2000) predicted that the 'combination of enterprise systems as the primary platform for organisational information and Internet technology for providing access to it will be the hallmark of leading organisations in the new century.' The continuum supports this prediction, but more significantly highlights the dangers of adopting an overly technological deterministic perspective on business process support and the socio-technical nature of processes.
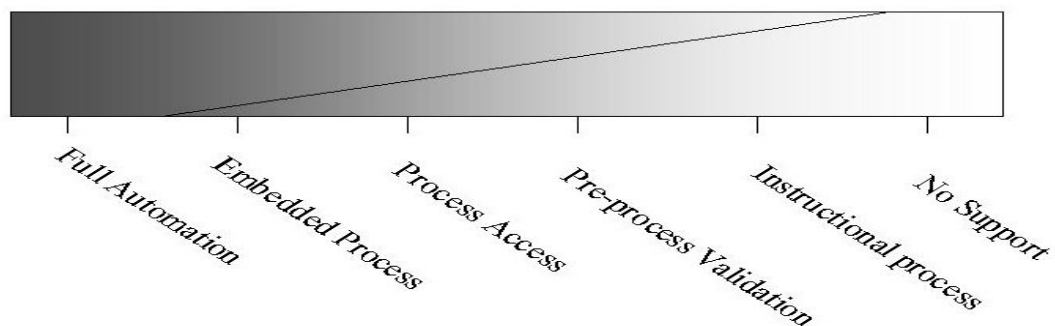
Figure 2   Continuum of Processes embedded in the Information Infrastructure

4.4   Work Constellations, Group or Community Sites

The prediction that full disclosure information systems will be evident in new organisational forms (Miles & Snow, 1989) is naïve, as only a partial element of the information infrastructure is full-disclosure, but a significant element is restricted and related to organisational structure. These can be perceived as an inscription of organisational spatial boundaries and represent a conceptual information space. There are two forms of restricted access based on membership of a group or project and, alternatively, position within the organisation.

Confined or restricted sites need specific justification, normally based on a strong business case or the nature of the information being used or shared, before they are allocated by the IS department. The degree of sensitivity of information is relevant too, as secure sites could include information relating to product and trade secrets, financial information, personnel information and customer details. These confined sites provide evidence of organisation domination structures and norms, as well as spatial structure. Access security technologies facilitate the development of spatial entities or boundaries, with all three cases exhibiting evidence of hierarchical reporting structures. These structures embed the organisational regulated line of command and as one interviewee referred to this as '*maintaining the organisational roll up structure*'.

4.5   Automated Tools

Another class of site is described as 'automated tools', which consist of calculation or process oriented standalone systems that perform functions such as euro currency conversion, staff location, employee locator, lab booking, conference room booking and a facility for filling out time sheets. These systems in SoftCo were typically developed by intern students and are 'nice to have' systems which are not part of the portfolio of mainstream operational systems. Another common automated tool is the internal telephone directory, which in the case of TelCo has saved significantly in update costs and the online version is the institutionalised phone contact source. The automated tools are generally available to every employee in a full disclosure manner.

4.6   Combined Overlay

The combined overlay is an abstraction of the functioning of the information infrastructure, however incomplete, shows the complexity and diversity of the characteristics of differing 'embedded work activities' (See Figure 4-3). This complexity poses clear problems for IS professionals attempting to manage the information infrastructure. Their difficulty is compounded by the broad scope of the information infrastructure, the involvement with end-user content developers, lack of control of development and the multiple perspectives of the user base.

A number of examples of external information capture have emerged. Examples of this include StoreCo's revenue reporting system, where the potential sales opportunities in the field are entered and reported in real time to VP level within the organisation. Again in StoreCo, the sales group share competitive information and intelligence from the field in a confined site.

This is a 'snapshot' of a 'working information infrastructure' and is proposed as clear evidence of an evolving organisational oriented information space. The combined overlay is a conceptual representation of the inscribed or embedded flows, rather than a formal representation of process.
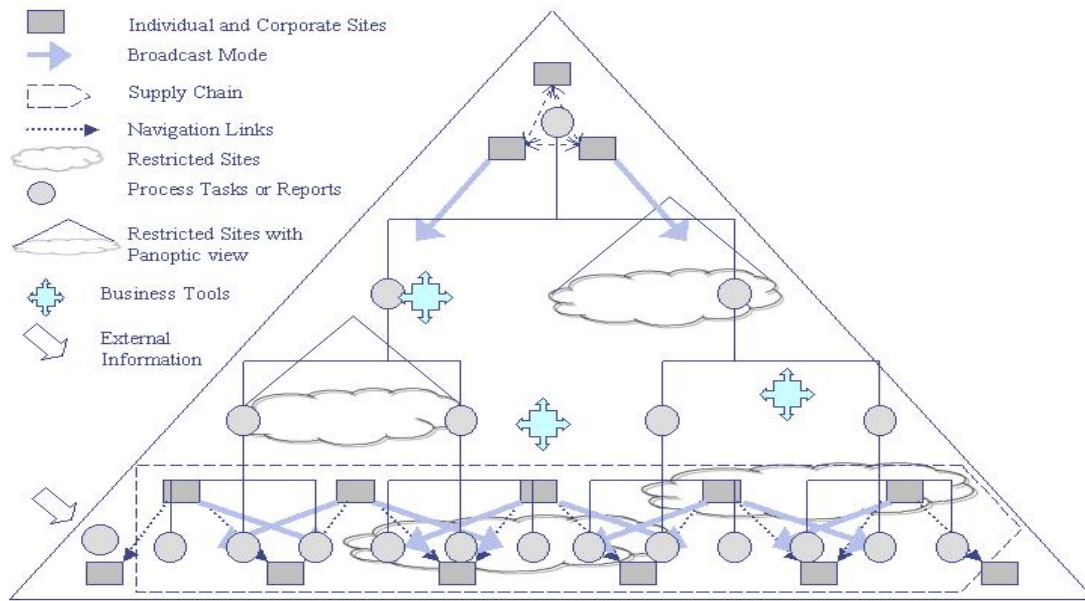
Figure 3   Combined overlay of the functioning of the Intranet as Information Infrastructure

5   THE WRESTLING 'INSTALLED BASE' OF AN INTRANET

Star (1996) states that infrastructure does not occur 'de-nouvo', but wrestles with and extends an existing infrastructure. The information infrastructure literature highlights that an infrastructure occurs 'when the tension between global and local are resolved (Star, 1996, Rolland, 2000).' Ciborra (2000) claims that the implementation of an infrastructure can lead to resistance from end-users and, without the resolution of their concerns, 'angry orphans' can emerge. Metaphorically the phrase wrestle implies that tension occurs and requires resolution. With this in mind, it is worth posing the question 'what existing infrastructures does an Intranet wrestle with?'

Tensions and adoption resistance is evident in each of the case studies. Technicians in TelCo felt isolated by a mobile web-based work management system. The implementation of this system was also used to 'drive out' a business process re-engineering initiative. Sales personnel in StoreCo resisted adoption of a revenue forecasting system, but were forced by senior management with mantra, such as, 'Brio is … the figure … the gospel'. This system forced discipline on the sales staff. The web master in SoftCo tried to resist taking responsibility of automated tools developed by intern students on work placement. These examples of resistance are primarily associated with the process oriented web based information system implementation and provide clear evidence of tensions.

The inscription of organisation communication structures is an organisational intervention, which can profound structural changes to the organisation. The range of organisational impacts includes greater information sharing, process automation, role alteration, process transformation, horizontal co-ordination, process adherence, hierarchical reporting, productivity increase, cost reduction, quicker turnaround time, real-time reporting to senior management, reduction in head count needs and group or community support. This highlights the profound impact that these inscriptions make have, with the emergence of new organisational work patterns.

The combined overlay framework of information flows and information based organisational work practices (Figure 3) highlights that a broad range of differing activities are inscribed or embedded in the intranet and this bears a remarkable similarity to the model of information flows functioning of an

organisation proposed by Mintzberg (1979). What is the implication of assuming that the non-technical information flows are in fact the installed base of the Intranet or web based information systems infrastructure? It would imply that these flows emerge and become more visible, because the 'installed base' is a powerful actor (Rolland, 2000).   There is a direct mapping between the classification of intranet web sites, outlined in the previous section, and Mintzberg's (1979) flow classifications are presented in Figure 4.

Mintzberg (1979) Information flow types	Intranet examples
Regulated operating, control and staff flows	Departmental, corporate, process and hierarchical sites.
Informal Communication flows	Supported by other technologies, such as e-mail.
Work Constellations	Community, confined group and discussion sites.
Ad-hoc Processes	End-user sites and lead tracking process sites

Figure 4   Mapping of Mintzberg's Information flows and intranet sites.

We propose that it does not take a leap of the imagination to see that the combined overlay of work practices embedded in intranets, accepting the limited number of examples of this phenomenon, is representative of the organisational non-technical information flows. The role of the non-technical communication infrastructure is shown in Figure 5 as the 'installed-base'. This figure shows the interplay between the overlay of the organisation as information flows (Mintzberg, 1979) and the information flow that are embedded within the Intranet.
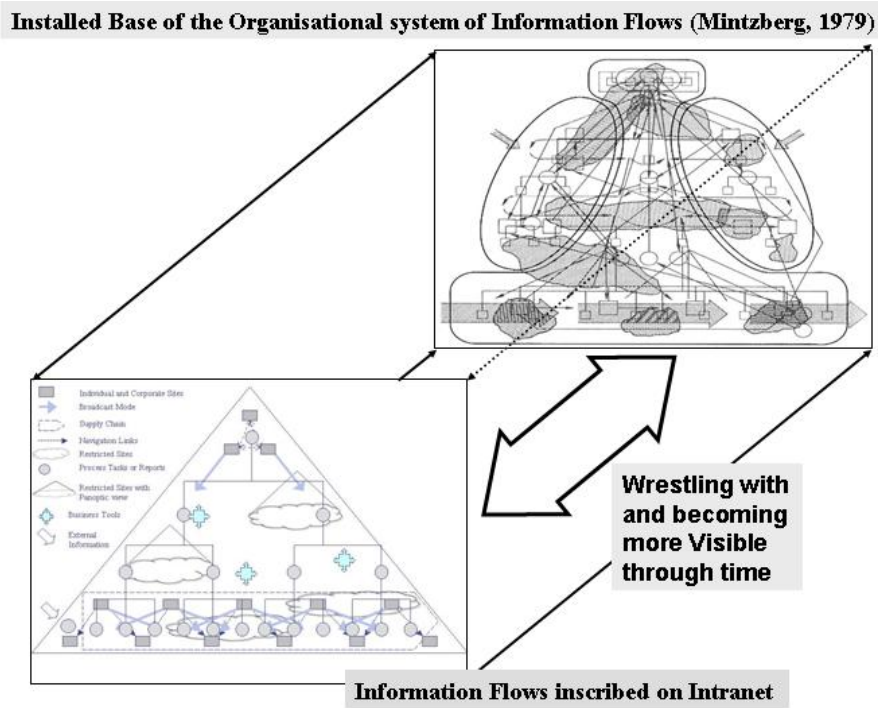

Figure 5   Wrestling infrastructures – Organisational communication interplay with Intranet as information infrastructure.

6   CONCLUSIONS

The point of departure of this paper is centred on applying the information infrastructure literature to intranet case study data. To conclude, we have portrayed Intranets as information infrastructure, with a rich array of work practices embedded in the infrastructure (Star, 1996). Intranets are shared by large communities, evolving and open (Hanseth, 2004). They have, also, emerged from the conflict with an installed base (Rolland, 2000 & Ciborra, 2000), which is becoming more visible with time.

This research shows that business processes are in fact becoming inscribed upon the corporate information infrastructure, but rarely does this inscription involve a full-automation implementation of the business process. The partial embedding of some aspect of a business process is associated with the availability of development resources and this continuum of process embedding shows the socio-technical nature of the Intranet.

The empirical evidence of web sites and web-embedded activity presents an array of differing technology 'use' roles. Hierarchical structures are also becoming embedded in these information infrastructures, which contradicts some descriptions of information infrastructures (Hanseth, 2004).

Organisational spatial perspectives show that these web-based activities span a broad range of organisational levels, both horizontally and vertically. These information flows and structures have a definite spatial dimension, with characteristics based on structural position within the organisation and the role of the user. This model is relevant to the IS professional as it confirms the diversity of the interaction between non-technical infrastructure components and the information infrastructure. The power of the installed base should never be underestimated, as it is an actor, which has a profound impact on the nature of the newer emerging infrastructure. We propose that the non-technical organisational information flows are the installed base of an Intranet. The conclusion of this paper establishes that a combined overlay of embedded work practices makes the 'installed-base' of the non-technical organisational communication infrastructure more visible through time.

The confirmation of the diverse range of work practices gives the intranet developer a broader choice of system types. The three case studies exhibited a passive approach to 'work practices' inscription or embedding, with the end-user requesting the development of a web site. This model should broaden the Intranet developer's perspective and facilitate a more purposive identification of business critical application opportunities.

The extent to which an IS function or the end-user development groups are responsible for the inscription activities is worthy of consideration. More research into infrastructural decay and 'garbage collection' is necessary in order to stop the information infrastructure becoming a victim of its own success or a legacy infrastructure that, in turn, restricts and 'wrestles' with newer infrastructure extensions. More work is required to develop a better understanding of the wrestling interplay between the older and emerging infrastructure, particularly since the organisational non-technical communication infrastructure will always exist and can also change with time.

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