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ABSTRACT

This study explores intranets as information infrastructure and considers critically the stakeholders, who are responsible for updating the intranet, and the associated organisational impact of their activity, in three interpretive case studies. Previous research indicates 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.

As information infrastructures, numerous social arrangements are embedded or inscribed, giving visibility to the Information Infrastructure. This paper explores the nature of these inscriptions and considers either the influence of the IS function (top-down) versus the end-user (bottom-up) contributions. A number of authors propose cultivation as the desirable middle-ground between top down and bottom-up lead implementations. The findings are discussed from a critical theory perspective by considering the emancipation of the end-user versus domination via the top-down paradigm.

Keywords

Intranets as Work Information Infrastructure, Inscription & Cultivation

INTRODUCTION

This paper sets out to explore the nature of embedding social arrangements on Intranets as Information Infrastructure, in particular the roles of the individuals responsible for contributing to the intranet and their related organisational impact. Previous research has identified intranets, or web-based resources within organisations as information infrastructures. The literature review focuses on the infrastructure literature, with 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. Critical theory was not employed during the study, but the case studies are re-evaluated from this perspective, by considering the extent to which end-users are emancipated through their Intranet activities.

LITERATURE REVIEW

Intranets as Information Infrastructure

Stenmark (2004) claims that Intranets are far from understood, with little emphasis by IS researchers on the work context and organisational culture. Intranets, in this paper, are considered from an infrastructure perspective, focusing on the inscription and cultivation concept. Information Infrastructures are different from typical information systems, as they are shared by a large community across a broad 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. 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). This definition highlights the critical theory potential of Intranets as infrastructure to emancipate users (Brooke, 2002). In fact a large infrastructure is difficult to change and could be conceptualised as a powerful actor affecting its own future (Ciborra & Hanseth, 1998). This indicates the power of the status quo, which must be openly criticised by the critical theory tradition (McGrath, 2005). 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 extends, integrates into or improves an existing infrastructure (Ciborra, 1998). 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). More precisely, Infrastructures are not designed from scratch, but evolve as the "cultivation" of a shared, open, socio-technical, heterogeneous installed base (Monterio, 2003).

Inscription and Cultivation

According to the previous definitions of information infrastructures, infrastructure is only visible through embedded work practises and infrastructure cannot be deconstructed from these use practices (Star & Ruhleder, 1995). The mechanism, where work practices are embedded or 'frozen onto' an infrastructure (Ciborra, 2000). Translation is defined as the mechanism where multiple user interests become needs. These needs, developed through a design process set out 'a scenario of how a system will be used.' The embedding of the use scenario is the inscription act.

A key question in this debate is 'Does cultivation occur?' Cultivation is defined as a way of 'shaping technology that is fundamentally different from rational planning and constructing a technical system (Ciborra, 2000)'. Rational planning involves aligning and constructing a coherent system, while cultivation refers to a material that is dynamic and possesses growth logic of its own (Ciborra, 2000).
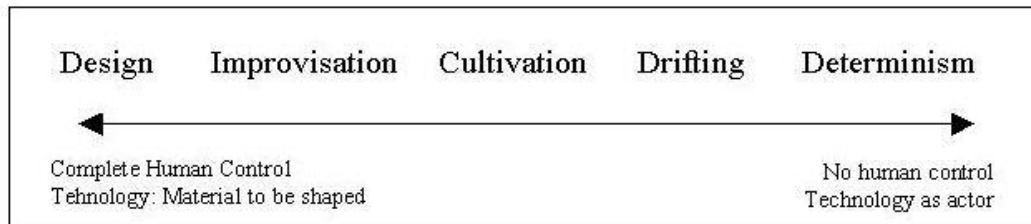

Figure 1 - Concepts for Technological Infrastructure Development

Hanseth (2004) proposes another infrastructure control model, which is similar to Davenport (1999). In this model the polar dichotomies of 'design' and 'technological determinism' are represented as a continuum (See Figure 1). This framework explores the nature of infrastructure and technological driven change, asking the question 'who is in control?' This framework includes what Ciborra (2000) refers to the as the drift. An infrastructure is drifting, when there is no conscious human control over the change process and improvisation and humans intervene by 'tinkering' or 'muddling along'. The pure design extreme implies complete human control and it is ruled out as the 'installed base' has a role to play. Improvisation involves some sort of design, but the installed base exerts pressure on the infrastructure. Hanseth (2004) claims that the installed base is an actor in its own right. Cultivation is proposed as a middle ground that captures the role of the technology and the interplay with human intervention (Figure 1).

The concept of top-down design versus bottom-up has emerged in the Intranet literature, where 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).

Two notable aspects of inscription highlighted by Ciborra (2000) are 1) who inscribes the use practices and 2) the strength of these inscriptions i.e. the effort required to oppose them. 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 paper will look at these two styles of Intranet development, in an attempt to establish evidence supporting the existence the 'cultivation' concept.

Wrestling Tensions and Domination

Critical Theory (Brooke, 2002) requires taking an emancipation point of view and, in this case, the key stakeholder is the intranet end-user. Championing the end-user implies examining the power or domination structures imposed by the top-down Intranet perspective. This emancipatory perspective is normally openly critical of the status quo, which according to infrastructure definitions is the installed base, a powerful actor in its own right (McGrath, 2005). This power struggle is evident in the Information infrastructure literature, as power struggle metaphors and tensions are common in the definitions. 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. These definitions elude to the domination and emancipation interplay in critical studies, in particular, emphasising the importance of the tension.

The research study will attempt to address a few questions. Firstly, what is the nature of these inscriptions (embedding of a work activity) and who is responsible (the inscriber) for inscription onto the Information Infrastructure. Secondly, what tension (power struggles) is evident and finally is there any evidence of cultivation? The existence of cultivation would indicate end-user emancipation.

RESEARCH METHODOLOGY

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), 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 EMC, a multinational computer storage manufacturer, Motorola, a software development company and Eircom, 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). Critical Theory is retrospectively applied in the discussion.

CASE DESCRIPTIONS

The following case study descriptions are organised into three sections focusing on inscription, power and domination and the evidence supporting cultivation.

The Nature of Inscriptions and Inscribers

The inscription of work activities goes beyond just automating an existing work practice to information sharing, which is achievable by the full range of development actors including end-user and IS developers. Information sharing is the lowest common denominator across the end-user and IS group contributions, and is widely evident on the Information Infrastructure. Many of the organisational oriented impacts are quite structural in nature, involving role alteration and transformation. Process automation is evident and each of the organisations studied had multiple examples of process embedding, including large-scale IS driven process-oriented systems. These are the work management system in Eircom, the revenue reporting system in EMC and the HRIS system in Motorola. The organisational implications of the work activities or practices are shown in Table 2, which is derived from the case data. Some of these organisational issues occur in all three of the cases; i.e., information sharing, process support, hierarchical reporting and community or group support.

Impact Themes	Eircom	EMC	Motorola
Resource Sharing			
Sharing Information	◕	◕	◕
Sharing Documents	◕	◕	◕
Customer Service	◕	◔	◔
Archival Resources	●	◕	◕
Command and Control			
Tracking Employees	●	◐	◐
Metric and Performance Indicators	◐	◐	●
Restricted Access Sites	◕	◕	◕
Task Allocation	◕	○	○
Organisation and Process Change			
Organisational Transformation	●	◔	◔
Process Automation	◕	◕	◕
Process Adherence	◕	○	◔
Remove Ad-hoc Administration Staff	○	◔	○
Reduce Head Count	◕	◔	○
Co-ordination and lateral Integration	◔	◔	◐
Lateral Migration to Different Functional areas	○	●	◐
Reporting			
Hierarchical Reporting	◕	●	◔
Real-time Reporting	◐	●	○

Note: ○ No evidence   ◔   ◐   ◕   ●   considerable evidence

Table 2 - Cross Case Comparison of Organisational Impact

The summary Table 2 of the various impacts of embedding systems on the information infrastructure shows the variety of the organisational oriented implications. Eircom is clearly more customer-oriented, when compared to the other case study sites and this is due to the national service provision nature of its business, Eircom also exploits the web-based technology to track employees, or specifically technicians. Process adherence is another feature of the Eircom work management system, where technicians must use a specific system in order to carry out their day-to-day work and by doing so adhere to new work practices. The main driver of the process transformation in Eircom is increased competition due to the liberalisation of the telecommunications market in Ireland, which has also forced Eircom to rationalise, reduce cost and head count. Global

hierarchical and real-time reporting is a key element of the Web-based systems in EMC, with sales and finance information available to top-level managers in real-time. Eircom has a hierarchical reporting system, but not to the same extent as EMC. Motorola exploit metric and performance web-based systems for personnel appraisal in a company-wide manner. EMC use the Intranet for lateral coordination among peer groups, with Motorola adopting a similar approach, but not in such an organised manner. EMC have also allowed web-based systems to organically migrate from one functional area to another. Table 3 confirms the rich range of patterns and discontinuities of organisational impacts of Intranet inscription. It also highlights subtle difference between the organisations, which are either a consequence of the company specific technology use pattern that has emerged and organically spread within that specific organisation.

System	Organisational Implications, or Change Process
General Web Sites and all systems	Information Sharing
EMC BRIO, Eircom Complaint system	Process Automation Informational, Process Automation, Standardised reporting, Functional Integration, Automation efficiencies, Decision Support reports to CEO level, Improved learning & Reporting Structure.
Eircom WMS, Motorola HRIS	Role Alteration Role Alteration, Role Bypass, Process Transformation & Reporting capability
Eircom WMS	Process Transformation
Eircom WMS, Motorola HRIS	Resistance to Change, Information Space.
Motorola Compass	Common Repository

Table 3 – Web-based Systems and Summary of Impact & Change

Two discernible types of Intranet development emerged from the interview data, differentiated by the nature of technology used and the type of user that developed the Intranet or web-based system. The nature of technology used refers to the static or dynamic characteristic of the system, whereby static systems use HTML web pages and dynamic systems integrate into a database or some other data driven operational system. The actors responsible for developing Intranet and web-based information systems are classified as 1) end-user groups, which were either a formal content provider or an actual end-user providing Intranet content, and 2) IS groups. This correlates to the top-down versus bottom-up alignment aspects of the Information Infrastructure literature (Ciborra, 2000). The emergence of functional specific IS, for example HR and Finance, is evident in the research data and these are classified as functionally focused IS groups, for the purpose of this study.

	Static	Dynamic
User Developed (Bottom-up)	Information Sharing, Process diagrams with hyperlinks	
IS Developed (Top-down)	Information Sharing	Informational, Automation, Process Automation and Support, Role Alteration, Process Transformation, Horizontal Co-ordination, Process adherence, Hierarchical Reporting, Productivity increase, Cost Reduction, Quicker Turnaround Time, Real-time reporting to senior management, Reduce head count needs, Group or community support

Table 4 - 'IS vs. End-user Developed' Cross Tabulated Against 'Static vs. Dynamic'

The organisational impact of inscribing work practices onto the Intranet infrastructure is cross tabulated, in Table 4, against the static or dynamic nature of the system and the class of developer (namely, end-user developed or IS function developed). The Intranet inscription of end-user developed systems is limited to static content web sites in predominantly information sharing roles. In the case of Eircom the end-user administrative staff in the corporate service centre use Intranet published

process diagrams in a very novel manner. This was described as instructional process knowledge in a previous section of this chapter. None of the end-user groups have the development skills necessary to implement a dynamic or 'data driven' system. The IS groups use static content inscriptions, but again these enhance information inscription. The matrix in Table 4 shows most significant organisation impact is the IS group intervention, which exploited dynamic or data driven technologies and produced thirteen distinct structural organisation changes.

Process automation is evident and multiple examples of process embedding, including large-scale IS driven process-oriented systems is clear in the case study data. These are the work management system in Eircom, the revenue reporting system in EMC and the HRIS system in Motorola.

There are subtle implications of this inscription, but this data highlights that no concise unintended consequence common across the three case study sites. Therefore the unintended consequences are not generalisable across the organisations studied. Central to all of these is the issue of harmonisation, including the social inclusion or exclusion nature of the media, cross-functional signification problems (infrastructural communication disharmony) and lack of system integration (infrastructural technical disharmony).   EMC implemented measures and policies to restrict unintended consequences and the unintended evolution of reporting model from finance function to sales occurred in an organic manner. An attitude change in Eircom due to the availability of information and a new way to calculate commissions are also examples of unintended consequences.

A number of these second order organisational issues occur in all three of the cases; i.e., information sharing, process support, hierarchical reporting and community or group support. This collective list will be further analysed in terms of the role of the end-users and IS functions role. The three case study sites derived some similar organizational benefits, with significant evidence showing common themes of sharing resources, command and control, organisation and process change and reporting.

Eircom is clearly more customer oriented, when compared to the other case study sites and this is due to the national service provision nature of its business, Eircom also exploits the web-based technology to track employees, or specifically technicians, a feature not evident in EMC or Motorola.   Process adherence is another feature of the Eircom work management system, where technicians must use a specific system in order to carry out their day-to-day work and by doing so adhere to new work practices. The main driver of the process transformation in Eircom is increased competition due to the liberalisation of the telecommunications market in Ireland, which has also forced Eircom to rationalise, reduce cost and head count. EMC use the reporting system to redeploy ad-hoc administration staff, who were previously involved in manual report generation. Global hierarchical and real-time reporting is a key element of the Web-based systems in EMC, with sales and finance information available to top-level managers in real-time. Eircom has a hierarchical reporting system, but not to the same extent as EMC. Motorola exploit metric and performance web-based systems for personnel appraisal in a company-wide manner, while EMC and Eircom use limited metrics for performance appraisal. EMC use the Intranet for lateral coordination among peer groups, with Motorola adopting a similar approach, but not is such an organised manner. EMC have also allowed web-based systems to organically migrate from one functional area to another, where functional groups observe the benefits derived from a system by another unit and, in turn, request an implementation. Table 5 confirms the rich range of patterns and discontinuities of organisational impacts of Intranet inscription. It also highlights subtle difference between the organisations, which are either a consequence of the business environment or a company specific technology use pattern that has emerged and organically spread within that specific organisation.

Tensions and Domination

Tensions and adoption resistance is evident in each of the case studies, which highlights the domination or power imposition of the top-down paradigm from a critical theory perspective (Brooke, 2002). Technicians in Eircom 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 EMC 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 development of applications by interns in Motorola is a cause of tension, where the ITS group are not willing to maintain the new systems, if they are not correctly documented. Again in Motorola, computerisation of the Personal Commitment System implied a change in work practice, creating a tension that was met with resistance by users and managers. In EMC, tensions occurred when 'renegade' web site owners were 'encouraged' to come onboard the central corporate Intranet. Significant tension was also evident in adoption of the revenue forecasting system, and requiring a top-down senior management corporate directive to 'force' end-users to adopt the system. In this case, the autonomy of the sales staff was

undermined and potential for 'under the counter' and non-standard reporting was eliminated. Sales staff resisted due to the 'visibility' nature of the system, which produces real-time hierarchical reports right up to senior level.

Tensions are evident in the deployment and roll out of the Eircom Work Management System, with issues described politely by the Customer Service Manager as '*a particular blockage, due to the mind-set of some individuals.*' This resistance is seen as undermining the position of individuals and the information produced was perceived as a threat. The customer service manager, to work with and 'bring these people along' made every attempt. The next step in dealing with this '*blockage*' involved '*unfreezing it*' or described metaphorically as '*the train is coming down the track.*' The Customer Service Manager, who was growing more impatient, as the regulatory requirement was not being fulfilled, also refers this to as a cultural blockage. This is a clear example of the 'installed base', status quo exerting itself on the new emerging infrastructure and becoming evident as a tension.

Many of these cited tensions are inter-personal in nature. Contextual issues, however, also provide the causal drivers for initiation of a web site and these are classed as 'non-interpersonal' tensions. Such causal drivers create tensions that are resolved partially or in total by an organizational intervention, which could consist of Intranet site or web-based information systems implementation. These examples of resistance are primarily associated with the process oriented web based information system implementation and provide clear evidence of tensions.

Cultivation

From an information infrastructure management perspective there are two distinctive classifications of work activities embedded upon the information infrastructure. The role of IS and end-users in developing Intranet content and web-based information systems is considered in the context of the 'concepts for technological development' continuum proposed by Hanseth (2004), an amendment of which is shown in Figure 6. The IS developed system oriented applications, which exert a greater organisational impact ranging from role alteration to process automation are dominant in the research data. These systems are predominantly design based and involved a formal systems analysis and design approach. There is a limited amount of ad-hoc improvisation or 'tinkering' allowed in these large-scale web-based information systems development. In contrast the end-user based approach to infrastructure 'drifts' and is responsible for the generation of a large volume of content, with limited organisational impact. But if you consider the infrastructure as an actor, which in the words of one interviewee 'it took on a life of it's own' then the infrastructure can be perceived as deterministic and drifting. This presents us with a dichotomy of infrastructure management with end-user 'drifting' and IS driven top-down 'design' and 'improvisation', as suggested by Davenport (1999) and Lamb (2000).

Cultivation is presented as a middle ground (Hanseth, 2004) and defined as where 'technology is shaped by humans although humans are not in complete control.' The outcome of the research indicates that cultivation is presently unattainable, because the types of applications that the two distinct groups, namely IS and end-user content provision, develop are mutually exclusive. The IS groups are developing web-based information systems in the design paradigm (Figure 5), while the end-user groups share static content in the drifting paradigm. Cultivation would require greater contribution by end-users in the IS driven system development initiative than presently reported in the research case studies. It would require empowering the end-user groups and facilitating ad-hoc intervention, while, also, dealing with facilitating infrastructural decay and enabling greater infrastructural harmony. The cultivation chasm is represented as a dark line in Figure 5.
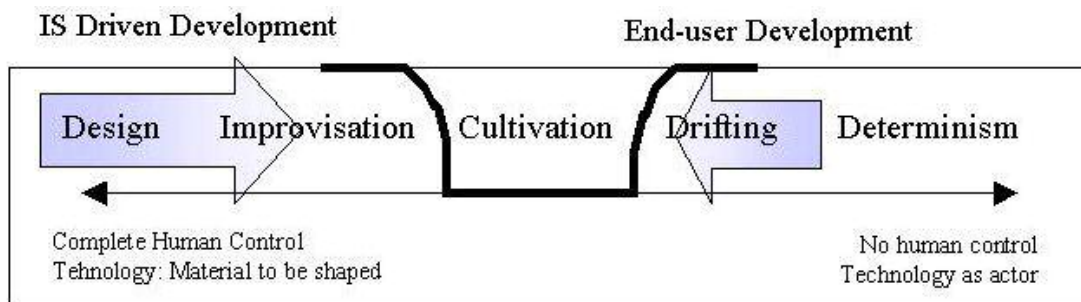

Figure 5 - Cultivation Chasm - The Dichotomy of Information Infrastructure Management (extending Hanseth 2004)

CONCLUSIONS

To summarise and answer the original research question, the top-down IS group led Intranet inscriptions have a greater organisational impact. The end-user static page type development facilitates information sharing. This is clear indication that end-users are far from 'free' (Brooke, 2002) and the Intranet is mirroring the domination structure of the organisation. The technical expertise required to develop data-driven web-based systems presents a barrier for end-user led development. From a critical theory perspective the end-user stakeholders are not emancipated, but contributing to the intranet infrastructure in a trivial or limited manner, where the infrastructure is acting a domination structure in its own right.

Tensions and power structures are also evident, which highlights the domination imposes by the top-down paradigm. The fundamental wrestling metaphor that is so prevalent in Infrastructure literature is symptomatic of the domination of the status quo. The inscription of existing organisation structures and the likelihood that they will become more visible through time, again reinforces the power struggle and the inevitability of the installed base or status quo emerging victorious.

To conclude, the cultivation chasm (Figure 5) and emancipation of end-users (McGrath, 2005) will be addressed by the development of disruptive innovative technologies to facilitate process inscription and infrastructure management with greater end-user involvement. The issue of content ownership will have to be enforced, either by a system, procedure or human intervention, and organisational information space management facilitated. The centralised role of the IS function will have to be undermined as the current resource bottleneck is not conducive to infrastructural harmony. This devolution need not move the management issues right out to the individual end-users, but could occur within the functional area. These measures may empower the end-user, but it will more than likely prove an insufficient measure that will not stem infrastructural inscriptions of the all powerful status quo!

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