



RESEARCH ARTICLE

# Trans-situated use of integrated information systems

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## Abstract

Practice-based perspectives have established the situated nature of how technology is appropriated, enacted, and improvised in organisations. Empirical studies demonstrate how the same technology produces different results in different contexts of use. However, practice-based research has, to date, less to offer in terms of accounting for the relationship between instances of situated use (i.e., work practices) that are separated in space and/or time. The term trans-situated use is intended to highlight this blind spot. We focus on one type of relationship, viz., significant degrees of similarities between technologically mediated, geographically dispersed work practices. This degree of similarity is achieved through a process of commensurability consisting of (i) standardisation (addressing interdependencies between multiple instances of the 'same' work practice at geographically dispersed sites); and (ii) heterogeneity (addressing the entanglement of one work practice with apparently unrelated work practices and modules). Empirically, we report on a longitudinal, interpretative case study (1998–2004) of a company strategically targeting an integrated information system as a principal vehicle to establish similar services globally. *European Journal of Information Systems* advance online publication, 20 March 2012; doi:10.1057/ejis.2012.8

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## Introduction

Interest in practice-based conceptualisations of technology use has been increasing as a response to earlier, predominantly structuralist, conceptualisations (Emirbayer & Mische, 1998, Schatzki *et al.*, 2001). A comprehensive list of contributions towards this 'agentic turn' (Boudreau & Robey, 2005, p. 5) is prohibitive, but they include appropriations of structuration theory (DeSanctis & Poole, 1994, Jones & Karsten, 2008, Walsham, 1993), activity theory (Engeström, 2001, Redmiles (2002), Virkkunen & Kuutti, 2000), and actor-network theory (ANT) (Berg, 1999, Hanseth & Monteiro, 1997, Walsham, 1997).

Practice-based conceptualisations of information systems underscore the inherently situated nature of the use of information systems: technology is appropriated, tweaked, or enacted in a local context (Gherardi, 2006, Suchman, 1987). Situated enactment implies that the use of any given technology may differ from context to context (e.g., site, organisation, group). This malleability of technology has also been empirically demonstrated (Barley, 1986, Orlikowski, 2000, Robey & Boudreau, 1999).

For all its merit, practice-based research could be considered to promote an overly atomistic account of the use of technology in the sense that it has little or nothing to offer in terms of accounting for the relationship *between* different instances of technology use separated in space and/or

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time (Leonardi & Barley, 2008, Timmermans & Berg, 1997). It is not that practice-based perspectives rule out limitations to human discretion as, for example, Orlikowski (2000, p. 409) writes: '[s]aying that use is situated and not confined to predefined options does not mean that is totally open to any and all possibilities'. It is rather that the relationship between instances of use has not been thematised with much energy (see Chu & Robey, 2008 for an exception in which the temporal dimension is analysed). Our term trans-situated<sup>1</sup> use is coined to highlight this blind spot of practice-based research. The purpose of our analysis is to contribute to the development of an empirically underpinned, theoretical account of one type of relationship between instances of use: how are interesting degrees of similarities across contexts achieved?

The relevance of and motivation behind this question stems from interest in Enterprise Systems (Volkoff *et al.*, 2005, Boudreau & Robey, 2005). As made perfectly evident within practice-based research, simplistic notions of establishing 'best practices' with Enterprise Systems are exactly that: simplistic (Wagner *et al.*, 2006). The notion of 'best practices' is geared towards identical practices, that is, an absolute level of similarity. Our analysis of trans-situated use acknowledges, in line with practice-based research, the futility of achieving an absolute level of similarity but, unlike practice-based research, explores interesting degrees of similarity (less than absolute).

Beyond explicitly identifying a blind spot of practice-based research, the main contribution of this paper is the analysis of *how* these similarities in work practice emerge, viz., through processes of *commensurability*. In line with our ANT-based approach, commensurability is a performed quality. Although empirically mixed, two parts of the process of commensurability are distinguished for analytical purposes: (i) *standardisation*, addressing the materially mediated interdependences of the 'same' work practices distributed across multiple sites; and (ii) *heterogeneity*, addressing the entanglement of one work practice with apparently unrelated work practices and modules. A secondary and more implicit contribution is how our analysis lends support to a growing criticism of practice-based research for having overstated the case for agency (Leonardi & Barley, 2008, Orlikowski & Scott, 2008). We also indicate the practical implications for management.

## Conceptualising the use of technology

### Malleable technology

One of the most significant research achievements in the discourse on the use of technology in organisations is

<sup>1</sup>The notion of 'trans-situated' has been used in feminist studies in connection with the flexibility of identity. We, however, owe our use of the notion to Vaast & Walsham (2009), who employ it in a manner similar to ours to denote degrees of commonalities across different communities of practices.

the documentation of the considerable discretion that is accorded human agency and the corresponding downplaying of structural or deterministic influences (Emirbayer & Mische, 1998). Practice-based research has played a vital role in establishing this (Schatzki *et al.*, 2001). The use of information systems, then, is malleable because 'every encounter with technology is temporally and contextually provisional, and thus there is, in every use, always the possibility of a different structure being enacted' (Orlikowski, 2000, p. 412). A user, accordingly, has substantial freedom to enact her practices with technology in different ways. For instance, Robey & Sahay (1996, p. 108; quoted in Leonardi & Barley, 2008) argue that the 'results ...[show] how nearly identical technologies occasioned quite different social meanings and consequences in [different but] comparable organizations'. This malleability in the use of technology enables us to resolve paradoxical or contradictory empirical findings regarding different outcomes of the same technology: seemingly contradictory outcomes are simply a result of contextual differences (Barley, 1986, Robey & Boudreau, 1999).

The exact scope of agency (i.e., degree of malleability) remains contested. Practice-based perspectives tend to grant significant discretion to situated enactment. For instance, in an explicit testing of the Orlikowski's (2000, p. 424) conjecture that 'integration is likely to reduce the degree of freedom', Boudreau & Robey (2005) investigated enterprise resource planning (ERP) systems. They report that users also have a significant amount of freedom when using ERP systems in their local environment. They conclude that their results strengthen the practice-based position by 'showing that such enactments apply [also] to an ostensibly less flexible technology, an ERP system' (*ibid.*, p. 14). Similarly, Pentland & Feldman (2007) introduce the notion of narrative networks to extend the practice-based perspective by pointing out how both 'use' and 'technology' need to be broken up into smaller, modular elements that can be used in different configurations.

Practice-based perspectives emphasise the local context of use, what Kallinikos (2004) calls the 'here and now'. This focus on local context should not be taken to imply that only local aspects of the context play a role in the enactment of technology. The context in practice-based research is open-ended and includes historical circumstances, distribution of skills, institutional arrangements, and perceptions (Gherardi, 2006, Orlikowski, 2000). In an attempt to delimit the wide range of *potentially* influential aspects of the context, Chu & Robey (2008) add a time dimension, thereby providing a more detailed, practice-based account of what specific elements of the context play a role and when.

Practice-based research demonstrates the significant malleability of the use of technology by, in a given context, identifying both intentional and unintentional changes resulting from local appropriation, workarounds, and situated innovation that go into users' enactment of

technology. What remains a blind spot is how – with interesting degrees of similarity in outcome – technologies work across multiple contexts. As Leonardi & Barley (2008, p. 161) note, the malleability of the use of technology is by now well-known and ‘more can be gained by asking why different [contexts] experience similar outcomes of the same technology’.

### Towards use of technology across contexts

Shapin (1995, p. 307) formulated the question about similarities in practices in the context of the ‘artefact’ of a scientific fact: ‘If, as empirical research securely establishes, science is a local product, how does it travel with what seems to be unique efficiency?’ Few have since pursued the theme of similarity across contexts systematically. Pollock *et al* (2007, p. 265) point out how practice-based perspectives on technology *de facto* tend to deploy ‘localist sensibilities’ by focusing on how ‘technologies are “imported” (“domesticated”, “appropriated” or “worked-around”) into user settings, while there is [a] comparative lack of emphasis on the reverse process through which an artefact is “exported” from the setting(s)’. They coin the term ‘generification’ to describe the process conducted by Enterprise Systems vendors when balancing the need for standardised solutions with sufficient attention to local appropriation.

To break with localist sensibilities, it is necessary to dismantle a strict local vs global distinction and instead trace out distributed and interdependent practices that unfold across multiple contexts in time and space. Orlikowski & Scott (2008, p. 461) make the same observation when complaining that ‘previous studies have concentrated on processes of translation between global ideas and [local] context’ but that ‘the analytic language is still one of separateness’. However, the research programme of sociomateriality they outline offers few detailed recommendations on what breaking with localist sensibilities entails.

Williams & Pollock (2012), extending their consistent critique of overly situated accounts (‘localist sentiments’), have suggested the notion of Biography of the artefact to emphasise a lifecycle perspective. This is a useful and relevant approach with especially compelling methodological implications, as they highlight largely neglected arenas (e.g., vendors’ user forums) and actors (e.g., the role of industry analysts in Enterprise Systems implementations). Vaast & Walsham (2009) studied distributed communities of practice (network of practice, NoP) in the field of Environmental Health. These authors emphasised the role of technology and coined the term ‘trans-situated learning’ to explain how people can communicate and exchange experiences with the help of technology, yet do not share an actual context of work (i.e., separated by a geographical boundary). Vaast & Walsham (2009) acknowledge the importance of studying degrees of similarities in practices, yet offer little detail concerning exactly how similarities materialise.

As practice-based perspectives make clear, efforts to create similar (i.e., standardised) work routines will regularly meet with processes of appropriation or even opposition (Boudreau & Robey, 2005). However, as Volkoff *et al* (2007) point out, it is likely that if standardised routines, as they are embedded in ERP systems (despite significant variation), had not *also* exhibited an interesting degree of similarity, they would have fallen out of favour. Timmermans & Berg (1997) similarly point out that users are anything but mindless slaves to standards. Rather, minor and not so minor tinkering is practised routinely, giving rise to users’ notion of ‘local universality’. A vital aspect of standards is that tinkering is not a failure of, but a prerequisite for, working technology. Tinkering accommodates leeway to adjust to unforeseen events (*ibid*, p. 293).

To summarise, the notion of trans-situated use of technology represents an ambition to embrace and ultimately extend contemporary practice-based research to also account for similarities in technologically mediated work practices across multiple contexts. Processes of commensurability are key to establishing these similarities. One group of scholars has studied the historical, cultural, and social conditions surrounding commensurability (Porter, 1995) or commensuration (Espeland & Stevens, 1998) implied in increasing the presence and scope of the quantification of quality (Poovey, 1998). From our perspective, processes of commensurability are tied closely to the standardisation of work practices. Our focus, as with the notion of generification (Pollock *et al*, 2007), is how degrees of similarities within the ‘same’ work practice are achieved across multiple sites. It is never identical sameness, but rather degrees of similarity that make pragmatic sense (Almklov & Hepsø, 2011). In contrast (Pollock *et al*, 2007), processes of commensurability become entangled, typically unintendedly, with the Other, that is, interdependencies with initially unrelated (heterogeneous) work practices and modules (cf. Star & Ruhleder, 1996, Vaast & Walsham, 2009, Hanseth & Ciborra, 2007).

### Method

We employ an interpretative approach that is geared towards ‘an understanding of the context of the information system and the process over time of mutual influence between the system and its context’ (Walsham, 1993, p. 14). We held a deep-seated conviction that a longitudinal case study was crucial for providing the level of detail that we sought regarding the process of organisational dynamics (Pettigrew, 1990, Robey & Boudreau, 1999). In line with Eisenhardt’s (1989, p. 537) advice for facilitating generalisations from case studies of single organisations, we relied on a theoretical sampling of the case site. We were actively seeking an organisation with a high degree of geographically distributed yet interdependent work practices that were supported by information systems. The selection of the organisation for the case study was also influenced by pragmatic concerns of access because, prior to embarking

**Table 1 Key phases of the implementation of the GAIS system in MCC**

<i>Phase</i>	<i>Focus of integration</i>	<i>Main technological components</i>	<i>Scale</i>
I (1998)	Local pilots, not integrated	GAIS v.1.0	5–6 local offices
II (1999–2000)	Integrating local work practices and legacy systems	GAIS v.1.5/v.2.0, legacy system, at HQ, Software Component, various local databases	50+ offices
III (2001–2003)	Increasing integration with IT infrastructure and corporate-wide strategies	GAIS v.2.1/v.2.5 Legacy system, at HQ, Maintenance tools, Win NT infrastructure, various corporate-wide IS	120+ offices
IV (2004–)	Increasing integration with customers	GAIS v.3.0, Web-based system for customers, Maintenance tools, Win NT infrastructure, various corporate-wide IS	150+ offices and customers Ca. 2000 users

on the research reported here, one of the authors had worked as a consultant for the organisation and thus had contacts we drew on in recruiting informants.

### Case context

Our case organisation is a maritime classification company<sup>2</sup> called MCC, which is more than 150 years old with 6000 employees in over 300 offices in more than 100 countries worldwide. MCC is a so-called class company, performing audits of ships according to international rules and regulations and issuing certificates if the audits' findings are satisfactory. During an audit, a detailed technical inspection of a vessel is conducted and an audit report is produced. If the vessel is found to be compliant with regulations, the vessel's certificate is endorsed. Otherwise, a deviation is issued, which has to be amended within a given date. Class companies thus act as a trust-based brokering agency between shipyards, owners, manning agencies, insurance companies, and national or supranational regulating institutions.<sup>3</sup> With the expanding reach and scope of auditing in business and society, a stream of critical perspectives demonstrate the symbolic (ritual) and rhetorical aspects of how audits are performed and presented (Power, 1997). These insights also pertain to MCC, but are not the focus of this paper.

To cope with intensified global competition, MCC formulated a strategic vision that emphasised customer-sensitive, high-quality, and standardised services worldwide; for example, an audit in Rio de Janeiro was to result in the same deviations and compliances as one in Dubai. To this end, a large-scale, integrated information system (called in this paper the 'Global Auditor Information System', GAIS) was developed and deployed (see Table 1 for an overview). GAIS was a significant investment, with direct costs exceeding US\$100 million over a 5-year period. It was designed to support the work of MCC's

geographically dispersed auditors. More specifically, GAIS aimed to (i) eliminate all paper-based routines by introducing a centralised, up-to-date database; (ii) structure the reporting of audits by having predefined report templates for different audits; and (iii) guide and partly automate the generation of the audit report from pre-defined checklists. Before, audits relied on paper-based checklists that were later written up electronically using a word processor and subsequently sent off to a centralised, mainframe-based database archive at company headquarters.

### Data collection

Our longitudinal case study (1998–2004) relied on three types of data collection that ran in parallel: semi-structured interviews, participative observations, and document studies. Data were collected in three stages. The analytic themes evolved at every stage, as did the role, type and geographical location of the informants. Table 2 presents an overview of the interviews and includes the number, role, and location of informants.

The first stage of interviewing (1998) was broad and explorative and consisted of in-depth semi-structured interviews with management, GAIS implementers, and auditors. The purpose of the interviews was to determine historical background, organisational roles, nature of work tasks, and sources of frustration with existing routines. The interviews lasted for 1–2 h and were all recorded and transcribed. Geographically, the auditors were predominantly those involved in the GAIS pilot (cf. Table 1).

The second stage of interviewing (1999–2000) was aimed at unpacking the micro-practices of using the GAIS. We also traced the nature and background of GAIS software changes. A broader sample of informants was included, such as super-users and local IT support involved in the training employees on and configuring the GAIS at local sites. This demonstrated a varied repertoire of workarounds by users in appropriating the GAIS.

The third stage of interviewing (2001–2003) supplemented earlier stages by covering more geographical sites, thus gaining insight into the trans-situated aspects of the GAIS. For example, both authors visited a local office in London

<sup>2</sup>The real names of the company and its information systems, projects, departments, and employees have been changed.

<sup>3</sup>The International Association of Classification Societies and the International Maritime Organization (IMO) are the most important regulating agencies. IMO is a specialised agency of the United Nations that is responsible for improving maritime safety and preventing pollution from ships (<http://www.imo.org>).

**Table 2** Overview of the different categories of (i) informants interviewed and (ii) local offices visited during the case study

Informants	Sites					Total
	HQ	Norwegian office	Danish office I	Danish office II	U.K. office	
Software developers	7					7
Super-users		1		1		2
Implementation project managers	2					2
GAIS managers	6					6
Business managers	2	1	1	1	1	6
Auditors		5	6	1	1	13
Support personnel	5	1				6
Total	22	8	7	3	2	42

where the increased dependencies between clients and their auditors' practices were underscored.

At the same time that the interviews were being conducted, we collected data through participative observations at the GAIS project management office (which was located at MCC's headquarters) and two local sites where auditors were working. One of the authors visited the project management office 2 days a week from March to August 2000. A corporate e-mail account and access to the office's Intranet facilitated interviewing and also provided a sense of everyday routines, including tensions arising from working with management.

The same author conducted 1 week of participative observation with auditors at two local offices (at the Norwegian and Danish Office I in Table 2). The observations were directed at the everyday practices of auditors and covered all steps taken, from the planning of an audit (collecting and reading relevant information, e.g., from earlier audits on the vessel) to the onboard inspection (physically inspecting the hull, machine, navigation, rudder and cargo compartment, as well as formal and informal interactions with the captain and ship owner's representative), to the measures taken before the final drafting of the report (possibly consulting with colleagues). These observations (with parallel interviewing) of the auditors' appropriation of the GAIS demonstrated interdependent practices across multiple contexts. For example, one auditor was frustrated by a colleague at another site who had forgotten to enter the necessary information into the GAIS and then gone on vacation, which effectively blocked access to relevant information in the GAIS for two weeks.

We also collected data by studying documents, both in electronic form and hard copies. These included more formal documents such as GAIS project plans, evaluation reports, requirements specifications, design documents, strategy plans, and corporate newsletters. We also collected more informal documents such as memos detailing experience reports from local offices on the use and implementation of the GAIS. These reports showed what users in different local offices found problematic with the GAIS.

### Data analysis

We alternated between data collection and analysis. Following van Maanen's (1988) suggestion, we made extensive use of field notes, making sure to separate 'raw' data from our own comments, reflections, and questions. As both researchers were involved in both data collection and analysis, we were able to conduct numerous sessions comparing, contrasting, and challenging each other's (preliminary) interpretation, thus enjoying the benefits noted by Eisenhardt (1989, p. 538).

Beyond internal discussions, our data analysis relied on a series of workshops, meetings, and informal discussions with MCC managers, GAIS implementation team members, and auditors, in which we presented our findings and preliminary data analysis. This made important contributions to an external validation of our analysis. The feedback was at times critical or even antagonistic. To illustrate, when presenting results that documented local workarounds, we indicated a potential 'failure' of the GAIS. GAIS implementation team members objected heatedly, arguing that these instances 'were marginal relative to the overall changes in practices', that is, that we had exaggerated the significance of local appropriation. In our data analysis, we strived to adhere to Klein & Myers' (1999) principle of multiple interpretations. This hinges, crucially, on an ability to discern distinct, potentially diverging, voices among the actors. An example of the results of our efforts in this direction is that participant observation revealed complaints by auditors that the managers lacked an appreciation for operational dilemmas, thereby highlighting the contested or political aspects of the GAIS implementation.

We utilised the added flexibility in data collection, which results from overlapping data collection with analysis (Eisenhardt, 1989). Influenced by our earlier ANT-inspired studies (Rolland & Monteiro, 2002, 2007) and thus anything but a clean slate (Suddaby, 2006), our data analysis has clear deductive elements that are present in our resulting interpretative template (Table 3). We started out with analytic notions from practice-based research, such as workarounds and local improvisation, and documented the situated and varied appropriation

**Table 3 Our interpretative template builds on the theoretical construct of a *workaround* but extends this to cover (attempts at) *standardisation* over multiple sites and interdependence between the GAIS and other modules (*heterogeneity*)**

Interpretative template	Example
Workaround	Conducting an audit following the standardised, imposed form but having to improvise when an item 'has absolutely no meaning here'.
Standardisation	The standardised GAIS was made to fit selected, local sites. This simultaneously made GAIS unfit at other sites which received 'patches' (attempted fixes) to maintain standardised work practices but 'if it does not work we get lots of new patches – and it is still not working'.
Heterogeneity	Entanglement of GAIS with modules/services other than its core functionality, for example, services to generate specialised reports that resulted in cascading effects as 'We managed to correct some errors – but while doing that, we also introduced new ones'.

of the GAIS corresponding to the first construct in Table 3. However, inductively emergent instances of non-local implications of workarounds triggered a more systematic focus on the interdependence of technological modules across space and time (Perrow, 1984). By using temporal bracketing and graphical process maps, which are two strategies for data analysis that were proposed by Langley (1999), we generated visual illustrations that categorised the intentional and non-intentional consequences of GAIS appropriation relative to stakeholder groups, much in the same way used by Orlikowski (1996). Two forms emerged: one around ongoing efforts of standardisation of the work routines of GAIS across sites (leading to the second construct in Table 3) and the other regarding the entanglement of GAIS with other work practices and modules initially perceived to be unrelated to efforts standardising work practices (producing the third construct in Table 3). Table 3 lists our interpretative template with all three constructs.

### Case study

We formatted our findings according to the interpretative template shown in Table 3. The empirical material was drawn from all phases of the study (cf. Table 1).

### Working around imposed constraints

The change efforts in MCC were strongly motivated and driven by a commitment to defend the company's perceived reputation for high-quality audit services. Because MCC originated from a high-cost area of the world (Scandinavia), it was prohibitive to meet intensified global competition solely on price, and thus MCC was trapped in a situation where audit services degenerated into a mere commodity. Management, therefore, enjoyed widespread support for its ambition to defend the relatively high fees the MCC charged for its auditing services, the motivation being to secure the MCC 'brand'.

When MCC tried to implement this strategy, however, it generated divergent perceptions regarding what exactly constituted 'high' quality. Management argued that a vital aspect of high quality was to provide services of equal quality, regardless of geographical location. The

trust-based relationship that MCC has with its clients relies on MCC complying uniformly with international rules and regulations. To this end, the GAIS v1.5 came equipped with detailed checklists to support standardised audit procedures and audit reports. However, while the level of detail embedded in these checklists may have been appropriate for auditors at one site, it was not necessarily appropriate for auditors under different circumstances at other sites. To illustrate, consider a situation in which an auditor used GAIS v1.5 to inspect the rudder of a ship. When he returned to his office after completing his on-board inspection, he struggled to follow the checklists provided. He suspected that the procedures stipulated by the checklists did not make much sense for the vessel in question. 'Should I categorise this as "Not applicable" or "Not inspected"', he pondered as he explained his dilemmas to us while sitting in front of the GAIS screen:

In this [GAIS] system, it's quite hard to tell because you cannot just say 'No'. Consider this one [pointing at the screen] called 'Propeller nozzles and/or tunnels'. This vessel does not have one so I've selected 'Not Applicable'. But it could just as well been 'Not inspected'. [...]. It's very tricky. Our procedures do not specify that we have to take the rudder down, which means that this [pointing out one procedure] '02.09 Dismantling of Rudder' is not a requirement. It's only supposed to be executed if I find something that indicates that I need to. There [pointing] you can write 'Not applicable', but then a number of items become irrelevant, as you simply can't see the rudderstocks when the rudder is not dismantled. Here [pointing] it makes sense to put 'Not inspected'. This is also true for '02.11 Rudder shaft and bearings' and '02.12 Max. bearing clearances after repair'. Since the rudder is not down, it is impossible to inspect these things. And 'Max. bearing clearances' has absolutely no meaning here – these measures are only relevant when the vessel has been repaired. In which case I, of course, would have categorised it as 'Repaired/Rectified'. (Auditor)

This workaround underscores the interdependence between two auditors and their work routines because it is *exactly* the detailed fitting of the checklist to one context that *simultaneously* makes it unfit in another

context; there is an interdependence between the two contexts of auditing, which are materially mediated by the GAIS's ambition towards standardised routines.

### Standardisation: interdependence across sites

The new, standardised procedures for conducting and reporting audits that are embedded in the GAIS were initially intended as a rapid ('big-bang') replacement of previous, paper-based routines. However, quite early in the process, management acknowledged the scale and scope of the changes that were required and shifted their stance to a more gradual and regionalised approach (cf. Table 1). As we document below, this had far-reaching, poorly charted repercussions because it entailed maintaining a legacy database<sup>4</sup> (located at headquarters) that had previously been used to archive audit reports, in addition to the archive component of the GAIS. To avoid inconsistencies, the GAIS implementation team was forced to develop a new synchronisation module that would conduct a two-way synchronisation between the legacy database and the GAIS every 24 h.

The substantial resources that were invested in developing the synchronisation component to maintain the old mainframe alongside the GAIS far exceeded the implementation team's capacity to address bugs and enhancements. As a result, the users suffered. For example, revised and updated information could not be entered after the audit report's deadline:

Because the system did not support the modification of reports, for instance adding digital images in reports as some auditors tended to do, a local copy of the report was stored outside the [GAIS] database. (Manager implementation project)

In stark contrast to the initial ambition of promoting 'one MCC' through GAIS, local offices started to use their own locally designed systems to store reports digitally:

I know it's not part of the official procedure – but we store all reports electronically anyway. We have developed an automatic document handling system that gives a report an index and stores it in a local database. I think most regions use this or similar systems. (Manager, Office II, Denmark)

The interdependencies between work routines at the central archive and the auditors' routines proved unwieldy because, as one manager complained to us, the material mediation through the GAIS/synchronisation module/legacy database integration was 'always underestimated'. Owing to the fact that certain updating transactions were conducted more effectively by the legacy system than by the GAIS, the accumulation of backlogs threatened the consistency of audit information,

which spawned compensating moves between the central archive and auditors:

Suddenly the backlog started to grow and grow. The most pressing problem was that printing and updating in the new [GAIS] system took much longer time compared to the old [legacy] system ... We had to tell our customers that we had a problem with backlogs. ... We also had to ask our auditors in local offices whether they had pending audits not yet reported to avoid problems with data quality. (GAIS Project Manager)

The ambition of standardising the work routines of the auditors to a significant degree was recognised as an ongoing effort. The GAIS, which is a crucial element in achieving more uniform MCC audit practices worldwide, was developed, released, and distributed in numerous versions in response to requirements, concerns, and issues raised by local auditors. Table 1 lists only the major versions of the GAIS. In addition, there were smaller upgrades and still more informal updates in the form of software 'patches'. Modifications to the GAIS were typically triggered by a decision to accommodate demands from auditors at one site. However, this often produced side effects for other auditors at other sites, some of which generated the need for subsequent updates and so forth.

The challenge of establishing standardised routines via the configuration of the GAIS is illustrated by the interaction of the GAIS with the Microsoft-based communication infrastructure (Windows NT configuration, service packs).<sup>5</sup> This whole 'bundle' had to be standardised because '[h]ow Windows NT is configured locally is very important for how [the GAIS] works', one manager at the IT department explained. The GAIS implementation team struggled constantly to standardise the whole bundle because the nature and type of interactions between the GAIS and the Microsoft infrastructure were highly non-transparent. The resulting stream of patches was received among auditors with a mix of humour and frustration:

What happens is that they [i.e., new patches] very much fall from the sky – and if it doesn't work we get lots of new patches – and it is still not working. And we think did they not test this thing before they sent it out? Anyway, you find that things don't work – and you get another patch and they say it has all been fixed, and all you have to do is to click that box twice, stand on your left leg and drink a cup of tea. (Auditor, UK)

Moreover, the stream of patches triggered the time-consuming task of reinstalling or reconfiguring the GAIS on all corporate computers:

My impression is that every time we are supposed to get updates or a new version there is something that stops the planned process. There's also a practical problem with

<sup>4</sup>The legacy system in question was an old database running on an IBM mainframe computer from the early 1970s. The system was used by a small group of engineers at headquarters to maintain information concerning audits, ships, and ship owners.

<sup>5</sup>A service pack is a collection of updates, patches, and enhancements to the Windows operating system.

installing the software on numerous PCs – and making sure they are correctly configured. (Auditor, Denmark)

As a result, MCC was forced to follow what one manager called a ‘very conservative approach to upgrading the infrastructure’. All upgrades had to be coordinated and synchronised carefully from the central IT department, thus undermining the ability of local sites to respond to local needs.

### Heterogeneity: interdependence with other modules

Expanding the scope and relevance of the GAIS (using it for new purposes) was part of the growing institutionalisation of the GAIS within MCC. These modules and systems include, as we noted above, the legacy database, with its synchronisation module, as well as the Microsoft infrastructure. As its use widened and deepened, the GAIS was also integrated with the corporate intranet, accounting systems, and customer relationship management systems. We analyse the way the GAIS became entangled with other modules and services.

The challenges related to the implementation of the synchronisation module illustrate the many, largely unforeseen, interdependencies resulting from integrating the GAIS with other functions embedded in the legacy database. The legacy database had been extended and modified over several decades. As a result, it proved less transparent and more difficult to substitute than planned. A number of services (functions) in the form of scripts, tags, and administrative information had been added to the original database schemes. For example, the users had added different tags to the initial tables in the database to generate specialised reports for local engineering departments at headquarters, reports that were unavailable through the GAIS. Moreover, the date formats in the legacy system were often different from the ones used in the GAIS. This triggered errors in the GAIS because the GAIS scheduled dates for upcoming audits of ships automatically. For example, it was not possible to report a specific audit through the GAIS if the vessel had not already been categorised as needing a ‘Due audit’ at the present time.

The interdependencies between the GAIS and the legacy database that were created by the synchronisation module have already been noted. The resulting sequence of interactions resulted in a situation where both the errors in the synchronisation module and all the *consequences* of the first errors had to be corrected. This resulted in frenzied campaigns to correct cascades of errors in a race against time before the next synchronisation took place, maximally 24 h ahead. The non-transparency of the interactions between the GAIS, the synchronisation module and the legacy database, together with stringent time pressure, undermined adequate testing. As a result, new errors were generated by the very act of fixing known errors:

We had problems with data quality that had increased since the first version. This was, to a large extent, caused by the migration from [the legacy database] to [GAIS] – which we

never managed to control, and that we always underestimated the seriousness of. *We managed to correct some errors – but while doing that, we also introduced new errors.* (Business manager, HQ, emphasis added)

The cascading effects of integrating other modules were made painfully evident when one site in southern Europe was integrating their new accounting system with the GAIS. This required the newest service pack for Windows NT. The problem, however, was that this new service pack included a new version of a DLL<sup>6</sup> that was incompatible with the one used by the GAIS client to communicate with the GAIS transaction server. This resulted in a breakdown of the GAIS server, effectively shutting down the entire global GAIS in MCC. MCC’s production system was, effectively, the GAIS. A breakdown implied that throughout its global network of offices, MCC had to work without electronic access to relevant background documents; for audits, reports, and the issuance of certificates were delayed. The direct cost of the breakdown was (as far as we are aware) neither calculated nor estimated; however, the biggest concern was the potential damage to MCC’s reputation and brand.

## Discussion

### Characterising trans-situated use: commensurability through standardisation and heterogeneity

Practice-based research consistently underscores the prevalence of extensive and elaborate workarounds (Gherardi, 2006, Orlikowski, 2000, Schatzki *et al*, 2001). Building on this, trans-situated use demonstrates how distributed, standardised work practices, so elusive in practice-based research, involve cross-contextual, interdependent workarounds. Fitting, appropriation, or local improvisations in one context of use *simultaneously* entails unfitting (with corresponding workarounds) in another (Hanseth *et al*, 2006). This is evident in MCC, for example, when the fitting of the checklists of the GAIS for a specific type of vessel and audit is exactly what makes the checklists unfit for the auditor conducting a different type of audit on a different vessel. Fitting and unfitting are mutually dependent or implicated in achieving standardisation, as ‘[they] are engaged in a spiralling relationship – they need and embody each other’ (Berg & Timmermans, 2000, p. 37). An illustration of the mutual dependency of fitting/unfitting is provided by the case reported by Ellingsen & Monteiro (2006) concerning a standardised module that serves multiple laboratories in a hospital. The modifications made at one laboratory (Biochemical) to facilitate making quick overviews (e.g., having lists) and recording (e.g., using only check boxes) laboratory results were simultaneously making the laboratory module less

<sup>6</sup>DLL stands for Dynamically Linked Library, which is a piece of software that is added dynamically to a larger system during runtime.



appropriate for another laboratory (Microbiology), which required free-text fields for the presentation of results, not only check-boxes.

In our analysis, trans-situated use results from processes of commensurability that consist of efforts to make situations similar (i.e., standardisation, though with due attention to interdependencies between 'same' work practices across sites) and entanglement with heterogeneous, complementary (to the GAIS) work practices and modules. In our view, standardisation is more about creating degrees of similarities in work practices than creating the same (e.g., 'best practice') work practice. As practice-based approaches invariably reveal, every context is unique. Historical, social, and technological circumstances vary infinitely. Two contexts that are separated in space and time can never be the same. What commensurability qua standardisation within trans-situated use does is to underscore the essential *pragmatic* concerns involved in answering what degree of similarity in use is required to count (for customers, management, colleagues) as the same. Similarity 'results from the work of the [users] in the field trying to establish equivalence and connections in problem solving' (Turnbull, 2000, p. 190) and is ultimately subject to empirical and pragmatic testing. In line with an ANT-based background, commensurability qua standardisation within a trans-situated use perspective becomes an acquired, performed quality rather than any fixed configuration of work practices and technology (see also Pollock *et al*, 2007).

One implication of our position is that it helps explain the sense in which Enterprise Systems 'work'. There is more to Enterprise Systems than, as practice-based research does, pointing out that users improvise around imposed constraints, and thus develop different patterns of use (Boudreau & Robey, 2005, Wagner *et al*, 2006). Surely, managers, project leaders and business owners would have noticed if Enterprise Systems, after more than a decade, had consistently failed to contribute to an interesting degree of similarity in work practices. From a trans-situated use perspective, this is explained through the emergent, interdependent and ultimately pragmatic concern for establishing *sufficiently* similar patterns of use. The use of the GAIS, despite the undeniable variations in local appropriation, allows auditors at one site to collectively work on audits to produce the 'same' audit to customers (Power, 1997). The auditors' GAIS-mediated work practices differ, yet are similar enough for the involved parties *for the purpose at hand*. A trans-situated use perspective is thus more robust to variation in working technologies. Standardised technologies, for example, Enterprise Systems, accordingly 'work' despite significant variation in local appropriation (Boudreau & Robey, 2005, Volkoff *et al*, 2007). Trans-situated use of technology portrays workarounds not as failed technology (Azad & King, 2008), but as *constitutive* features of working technologies (Timmermans & Berg, 1997).

Our focus on commensurability qua standardisation builds on the performative aspect of ANT/informa-

tion infrastructure (Pollock *et al*, 2007, Vaast & Walsham, 2009, Timmermans & Berg, 1997). Our focus on commensurability qua heterogeneity has links to the 'embeddedness' of information infrastructures (Star & Ruhleder, 1996). As Vaast & Walsham (2009, p. 540) point out, 'a defining dimension of information infrastructures is that they are embedded with other infrastructures'. Our analysis adds to this notion by tracing out in more detail and over time how this embeddedness operates by identifying interdependencies.

Conceptualising trans-situated use as commensurability makes the question of exactly how much variation it is possible to accommodate in processes of commensurability both explicit and open to empirical scrutiny. The answer, from our analysis of MCC, is that a rather large extent of variation can be accommodated. Practice-based research may very well have underestimated the collective capabilities of distributed users to cope with significant variations, thereby achieving commensurability (cf. Czarniawska, 1998). Some researchers have, perhaps provocatively, taken this still further and argued how incoherence and inconsistencies across contexts and communities are common and only resolved in an infrequent and *ad hoc* manner (Mol, 2002). This is a radical break from prevailing understandings of boundary objects, in which a defining aspect is precisely how identity remains undisputed (Star, 2010) and the translations involved remain ongoing and continuous (Carlile, 2004). The benefit afforded by the concept of trans-situated use is that it allows us to discuss the scope of commensurability in a non-dogmatic and empirically grounded way, without making strong *a priori* assumptions.

The notion of trans-situated use has implications for the notion of a context. Few notions are more slippery than 'context'. It is more often than not left as a largely unspecified or open-ended influence on practice (Chu & Robey, 2008, Orlikowski, 2000). The question is how to specify how local practices interact with the surrounding context. The trans-situated perspective offers a way to avoid dichotomising the global/local distinction by loosening the strong geographical connotation of 'global'. Closeness and distance, as a trans-situated use perspective suggests, are less about physical space than the type, length, and topography of networks of materially mediated dependencies (Amin & Cohendet, 2004). For instance, Lam (1997) describes how Japanese and English engineers were 'closer' to each other than to their respective geographically local management due to commensurability in vocabulary, methods, and practices.

### Implications for the conceptualisation of technology

How to conceptualise the role of technology has a long history in information systems research (Jones & Karsten, 2008, DeSanctis & Poole, 1994, Walsham, 1997, Hanseth & Monteiro, 1997). In an attempt to revitalise this agenda under the heading of sociomateriality, Orlikowski & Scott (2008) outline a position avoiding the extreme positions

of both social and technological determinism. What may the trans-situated use perspective have to offer to the debate about technology?

Trans-situated use should be understood as a reminder of the essentially *collective* connotation of the concept of 'practice'. Rather than the individualistic connotation employed by Orlikowski (2000), which highlights the individual user's actions, the notion of practice has always been firmly based in collective work practices (Schatzki *et al*, 2001, Leonardi & Barley, 2008). The interdependencies around which commensurability unfolds are inherently collective.

Trans-situated use clearly sides with a growing disenchantment with what we have described above as the blind spot of practice-based research, viz., overstating the case for local variation in the sense of not (to date) being concerned with relationships between instances of use (Leonardi & Barley, 2008, Pollock *et al*, 2007, Vaast & Walsham, 2009). The networked perspective of trans-situated use – explicitly looking at interdependencies mediated across sites and between disparate modules and work routines – shares an affinity with Leonardi's (2011) concept of imbrication. Imbrication is used by Leonardi (2011) to denote the interweaving of material (technology) and human agency. A crucial issue in imbrication is treating flexibility (i.e., ability to change) in both technology and work practice symmetrically. In other words, imbrication avoids treating technology as largely fixed while emphasising flexibility in work practices (e.g., workarounds) and the flexibility of technology (e.g., organisational routines, institutional theory). The symmetric treatment of the flexibility of technology and work practices shared by both imbrication and trans-situated use is an immediate result of a shared affinity for the influence of ANT/information infrastructure. The notion of imbrication draws on the metaphor of interlocking roof tiles, in which identical tiles are supplemented with orthogonal ones used to lock the tiles into a fixed grid. This resembles the standardisation/heterogeneity distinction found within our trans-situated use perspective. Unlike imbrication, the heterogeneity aspect of trans-situated use is not a fixed form, but is more open-ended and geared towards detecting the 'embeddedness' of infrastructures in whatever form emerges (cf. Vaast & Walsham, 2009). Leonardi (2011) acknowledges his grounding in ANT but distances himself by underscoring, in a somewhat exaggerated manner in our opinion, the ontological rather than epistemological or methodological aspects of ANT. The difference lies in determining whether human and material agencies 'are' the same (the ontological claim) or, as we favour but Leonardi dismisses, whether human and material agencies may be interpreted (by the researcher i.e., an epistemological claim) to perform the same role in designated practices.

The perspective of trans-situated use highlights the material interdependencies within the GAIS, as well as with other modules and services such as the Windows backbone, the legacy database with scripts, the account-

ing system, and the intranet. One way to understand this is to see it as promoting a more systematic analysis of the qualifier 'integrated' in the context of integrated information systems. Information systems research has been critiqued for an overly monolithic concept of technology and rightly so (Orlikowski & Iacono, 2001). Highlighting the integrated qualities of information systems is helpful in dismantling such misconceptions, as the interdependencies within and between distinct modules of information systems ecology are made explicit.

### Implications for management

The picture that emerges from considering trans-situated dynamics has clear yet poorly charted implications for traditional modes of control, governance, and management because it threatens to undermine the modular decomposition of tasks and projects and its associated division of labour. Traditional project management assumes that complex tasks may be broken up or decomposed into less complex ones to be delegated to groups/individuals. Trans-situated dynamics challenge this root assumption. The primary elements of processes of commensurability underpinning the trans-situated perspective, standardization, and heterogeneity demonstrate precisely how and why local concerns (attempted decomposition) interact and become entangled with non-local concerns. When 'behaviour cannot be reduced to the behaviour of its constituent parts' (Tsoukas, 2005, p. 4), the conditions for learning from prior experience or prototypes are eroded. Perrow (1984, p. 9) makes a similar point related to complex technologies when he argues against the possibility of (successful) decomposition due to entanglement (in Perrow's mechanical vocabulary, 'tight coupling') and deems interactions 'not only unexpected, but (...) *incomprehensible* for some critical period of time' (emphasis in original).

Through the notion of mindfulness, Weick & Sutcliffe (2001, 2006) develop a defence of the possibility of management in the face of the dynamics portrayed by a trans-situated perspective. Drawing heavily on insights from High Reliability Organisations (cf. LaPorte & Consolini, 1991), mindful management (or 'organising') involves a continuous, conscious interpretation of events to avoid 'tunnel vision', and thus 'preserve the capacity to see the significant meaning of weak signals and to give strong responses to weak signals' (Weick & Sutcliffe, 2001, p. 4). Clearly, the qualities of mindful management are attractive and helpful features for the management of complex projects or situations. The challenge, however, with mindfulness is the practical realism of maintaining the assumed level and intensity of awareness required for it to prevail. If unanticipated events emerge, as a trans-situated use perspective suggests, in principle anywhere and anytime (as a result of one work task's entanglement with other tasks and technologies), the level of awareness prescribed by mindful management seems to us quite unsustainable. Insights from complexity science would,

for similar reasons, challenge the aspiration of mindful management (Hanseth & Ciborra, 2007).

### Conclusion

We live, Hannertz (1992) explains, in a world that is increasingly interconnected, mobile, and distributed. As Appadurai (1996) suggests, our present stage of conceptualisation lags behind empirically unfolding phenomena. The trans-situated use of integrated information systems represents an explicit attempt to conceptualise practices that are distributed but interdependent across space and time. Undoubtedly, in business organisations there are empirical instances of space/time- distributed work practices that are related. The challenge is to extend current practice-based perspectives to accommodate this aspect of organisational dynamics (cf. Feldman & Pentland, 2003). The notion of trans-situated use of technology supplements the practice-based perspective's analysis of practices themselves with an analysis of the materially mediated relationships that obtain *between* practices. It responds to the challenges posed by the research programme regarding sociomateriality (Orlikowski & Scott, 2008) by providing an analysis of the materially mediated processes of commensurability.

A trans-situated use perspective is a contribution towards fleshing out the agenda of sociomateriality. It underscores the empirically undetermined concern at the core of the process of commensurability of when work practices are similar enough. Similar 'enough', in a trans-situated use perspective, is not a fixed measure. It is a pragmatic issue inherently tied to the purpose of the work practices in question. To assess whether two work practices are similar enough, for example, the reporting from periodic audits of oil tankers at two sites in MCC hinges on whether MCC auditors at other sites understand the reports well enough to build on them in their own audits, whether the clients of MCC were comfortable

with the reports and whether the quality control at MCC headquarters deems the reports to be in compliance with rules and regulations.

A number of issues remain unaddressed by our study. We have begun to specify processes of commensurability, but much detail remains to be added. Clarifying in greater detail the structure, form, and content of commensurability (including its limit, i.e., *incommensurability*) is important from a theoretical and a practical point of view.

MCC, with its 300 sites in 100 countries, provides a case with rich potential, and much of that potential remains to be tapped. For example, we have not pursued the possibility of addressing aspects of globalisation in any real sense; instead, we rely on empirical data from Europe.

Our perspective on trans-situated use has been largely based on empirical examples of processes of commensurability with distinctive material/technological elements. It would have been interesting to explore the extent to which our analysis holds with less technologically dominated empirical material. The ostensive aspects of organisational routines, Feldman & Pentland (2003) point out, mediate action in much the same way as technology does, an immediate result that grounds the concept of a routine in structuration theory.

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