#uksnow: webscience weather watch

Abstract. This paper utilises the theoretical perspective of Orlikowski's materiality to examine and interpret the #uksnow Mashup - a real-time map of the UK showing where it was snowing, and where the snow was heaviest – based on the premise that enough users of Twitter would be sufficiently distributed across the country to accurately report snowfall. We identify the key technological and social phenomena that intersected in 2009 to provide the environment in which this web-based application was constructed. As an API driven Mashup that relies upon user-generated data, #uksnow problematises the relationships that are conventionally crafted between the user and the data they manipulate. We argue that #uksnow is an exemplar of a new paradigm in software development that is driven by web-based services shaped by APIs, with a relatively short lifespan, and versionless or 'permanent beta'. Equally significant is the way in which the #uksnow Mashup amplifies and visualises social knowledge and experience – without which no 'system' would exist. The authors conclude, with others, that a new web science is needed to theorise and understand this phenomenon.

Keywords: Web2.0, Twitter, social perspectives, Internet usage

1 Introduction

Internet usage in the mid-late noughties (2005-09) was characterised by a particular constellation of phenomena that is hallmarked in the #uksnow event of late 2008. This event comprised, in brief, the use of the Twitter microblogging service by a large number of individuals to post a rating of the quantity of snowfall at a particular location. This data was displayed on a map of the UK, which showed in real-time where it was snowing, and how heavily. There were two primary technical capabilities that contributed to the shaping of this event: the widespread adoption of Application Programming Interfaces (API) based development, and of the mobile internet (Sawyer et al 2003; Henning 2009; Wareham 2009;). These technical developments however were part of a complex social phenomenon (Wareham 2009:139) that included the creative use of multiple APIs that enabled construction of the 'platform' web (Tsai 2009; Weiss 2010) and with the specific socio-cultural circumstances of a massified blogosphere (and micro-blogosphere) (Song et al 2007; Silva et al 2009; Shamma et al 2009; Adams et al 2009;). This, coupled with celebrity and disaster orientated media (Katz & Liebes 2007; Babcock & Whitehouse 2005), the adoption of 'open' thinking (Chesbrough 2006:1; van der Meer 2007), and specific shifts in mainstream UK public funding priorities (Atkinson 1997:409), all coalesced as #uksnow.

In this paper we identify, describe, and present these varied elements of the #uksnow event, and through discussion of their impact and significance shed light upon the debate concerning the mutual social shaping of society and technology.

2 The #uksnow event

The #uksnow event was exemplary of these elements of contemporary internet phenomena that spans a combined range social and technical circumstances. Creative thinking by a leading figure in the blogosphere enabled utilisation of the potentials of new technologies and their application to an immediate and visible problem. The solution he offered involved clever and rapid application development using web-based APIs and the creation of a Mashup application that could deliver visual information using freely available online tools. Pivotal to the rapid implementation of the application was its use of crowd-sourced data. The result was a real-time map of the UK showing where it was snowing, and where the snow was heaviest – based on the premise that enough users of Twitter would be sufficiently distributed across the country to accurately report snowfall.

Opinion leader Paul Clarke (Clarke 2009), musing one wintry morning on his blog, envisioned what could happen with crowd-sourced data as snow began to fall in the UK. A few hours later, keen coder and opinion watcher Ben Marsh (Marsh 2009) had created the code needed for a Twitter-GoogleMaps mashup and #uksnow was available to the blogoshere. Following the instructions on Ben Marsh's website, thousands of people using the micro-blogging site, Twitter, tweeted two very simple pieces of information: the first three or four digits of the UK postcode of their current location and a rough gauge of the heaviness of the snow in their location as a mark out of five. People provided this information, (often while standing outside to accurately gauge the snow, and using their mobile internet device to provide the required tweet) to the #uksnow 'hashtag' on Twitter, and the resulting stream from the remote gathering of this hashtag provided the data to create a real-time snow-map of the UK at http://www.benmarsh.co.uk/snow/.

By the end of the first day Microsoft had created – albeit briefly – a clone (see http://twitpic.com/1boki for a screengrab of what had been posted at http://estc.msn.com/br/intl/twitter/uk/snow.html. Ben Marsh uploaded the image of this clone helpfully annotated with the internet cliché; "FAIL"). The application lived on for several more days, as the snowfall continued, but it was in the first 36 hours that the application gained a critical mass of tweets and user acceptance. The Baseball World Series was taking place simultaneously in the United States, but was briefly eclipsed in terms of Twitter traffic volume by the number of people tweeting about (and to) #uksnow.
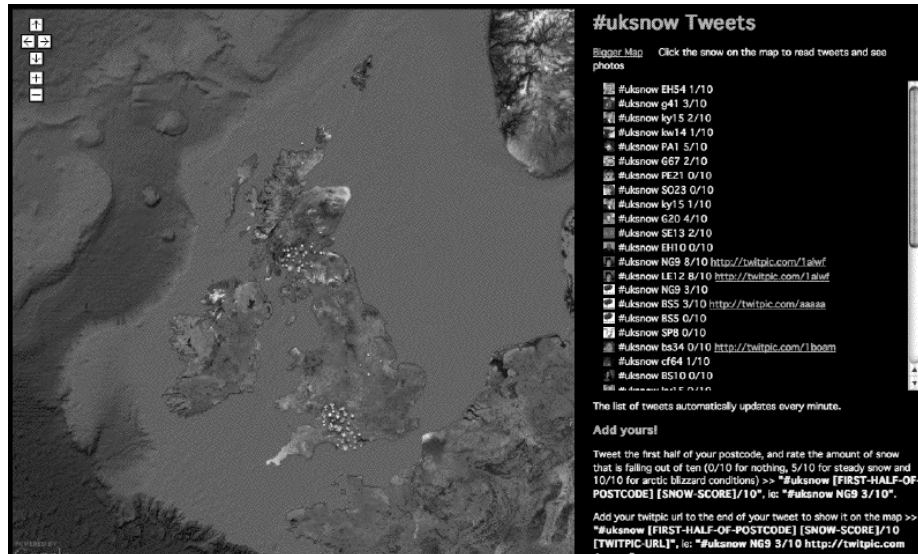
Figure 1 Screengrab of #uksnow at Ben Marsh's website 4-2-09

3   A Socio-Technical Mashup

The technical and social developments that come together to form the #uksnow event deserve attention, prior to our discussion of their impact on social shaping theories.

3.1 Technical Capabilities

Application Programming Interfaces (APIs) became, during this period, a common-place and essential element of mainstream programming languages (de Souza et al 2004). All modern programming languages offer some form of API to developers. Importantly both Java and PHP, two of the most important internet-oriented languages, offer their APIs freely and directly through the Web. However, all APIs including those of Java and PHP, are notoriously obtuse to the casual observer and even programmers familiar with one API will often struggle with a different language (Fletcher 2004). Despite these concerns APIs offer an important service by encapsulating much of the complexity, subtleties and details of a language in a way that emphasizes the essential details of implementation to a developer. An API enables the developer to focus on rapidly and effectively solving the problems with which they are faced (Bakker et al 2000). By taking the API beyond the sole domain of programming languages allows application of the same approach to web based services that can be readily drawn up and deployed by developers (Benslimane et al 2008). The key catalyst for wider use of API based development was its adoption by major internet and web companies including Google, Yahoo, Microsoft (Kulathuramaiyer 2007), as well as many other smaller organizations and individual developers creating innovative

systems. As a free service, hundreds of Application Programming Interfaces (APIs) became available for general use by web developers (Kirkpatrick 2008).

3.2 Open thinking

It is important to emphasise that offering an API for third party developers to utilize a service requires a particular corporate mindset that understands how intellectual property rights can be maintained in a framework of open information and sharing. The adoption of this mindset is arguably at the core of the global success of Google, and difficulties with adoption and incorporation of this mindset is behind the corresponding decline of Microsoft, whose significance as a guiding organisation for the use and adoption of new digital technologies continues to fall (Chesbrough 2006). As Chesbrough (2006) points out open innovation should not be conflated with the Open Source movement. Although they share many characteristics, the former is very much focused on sustainable business models in a way that the latter is not. Open innovation is a new corporate mindset that looks outside the traditional opacity of corporate walls, assuming that "useful knowledge is widely distributed, and that even the most capable R&D organizations must identify, connect to, and leverage external knowledge sources as a core process in innovation" (Chesbrough 2006:2). This, as van der Meer points out with regard to the Dutch experience (2007), is no mean feat, and for many "open innovation practice … is lagging behind its promises" (van der Meer 2007:192). However, for the likes of technology giants such as Google, Yahoo and others it has proven a crucial strategy for corporate advancement, albeit that Google in particular seems gradually to be morphing into the kind of company Microsoft became (http://www.guardian.co.uk/technology/2010/feb/14/google-gmail-buzz-john-naughton)

3.3 Platform Web

The wide availability of APIs enables the world wide web to be presented as an alternative operating system to conventional desktop implementations such as those offered by Microsoft or Apple (Tsai 2009; Weiss 2010). Software development on this new platform – creating new applications known as Mashups (Zang et al 2008) - requires no permission from corporate executives, less programming knowledge than that required to write APIs themselves, minimal budget, and very short development cycles, releasing high levels of creativity, and the potential for 'real-time' software applications developed with intentionally very short shelf-lives. A mashup takes benefit from the best aspects of each API in order to achieve maximum effect without being bound to a single source of data. Most interesting, perhaps, of these new Mashups, are those which, as applications, make use of, or present in a new and useful way, data not sourced from a standard database, but which is provided, in real-time, by individuals actively engaged in the micro-blogging phenomenon (Milstein et al 2008). This is part of a broader phenomenon described as crowd-sourcing (Howe 2006; Huberman et al 2009) and reflects the realization that the platform web offers the potential for forms of social empowerment that disentangle applications and their users from 'official' sources such as, in the context of this paper, the UK meteorological office (Howe 2006).

3.4 Mobile Internet

Parallel with these developments, access to the internet on mobile devices significantly increased in popularity through the late noughties (Nutley 2006). This popularity has been publicly led largely by the advent of the iPhone (Marsden 2007), but quickly bolstered by the appearance of a range of different mobile internet devices, which, like Apple's own entry into this market, almost coincidentally included the ability to make phone-calls. It is indeed arguable that the phenomenon of micro-blogging, and rising levels of mobile internet access, are very closely interlinked (Milstein et el 2008), and that the success of Twitter, with its arbitrary 140 character limit, rests on the success of the Short Messaging Service (SMS) which originally surprised everyone in the mobile phone industry with its unexpected and unintended mainstream popularity (Wareham 2009:140). The popularizing of the mobile internet shaped it as an "always on" multimedia communication platform that was simultaneously ubiquitous and a manifestly disruptive social technology. The mobile internet provided the mechanism to directly engage with large organizations *in situ* and to express immediate critique (Liu et al 2005). The mobile internet also presented the potential for a genuinely participatory social media enabling immediate vocal, textual and visual reporting (e.g. qik.com) without the overlay of editorial or corporate agendas or the sensationalism inherent in most mainstream journalism (Langer 1998:1).

3.5 Socio-cultural circumstances

The significance of blogging as a cultural activity has been well recognized (Youngs 2009). By the advent of the #uksnow event there was already a well established blogosphere which – perhaps necessarily – had settled into a pattern in which certain bloggers were continuously watched, commented upon and linked to by a much wider range of blogs including those with a commercial or media orientation as well as more individual efforts. These bloggers (and their blogs) had, in effect, become leaders of the blogosphere (Song et al 2007). Their appearance at the top of rankings in blog-watch websites such as Technorati[1] also reinforced and ensured a continued place within this role. The authority brought by this ascription of leadership can often produce unexpected and contrary points of view from that of mainstream media. The new phenomenon of micro-blogging, led by Twitter, adds an additional layer to the blogosphere, and a new class of authoritative and leading twitterers identified through Twithority[2], whose tweets are followed by tens and even hundreds of thousands. The expanded blogosphere now produces vast quantities of written and visual material that is made denser by constant recycling through retweeting and reposting. The identification and ascription of authority becomes a necessary process to filter and manage the quantity of lower quality information that fills the blogoshere.

The proliferation of low quality information delivered online by semi-anonymous individuals has also influenced the perspective and focus of mainstream broadcast media reporting. The increasing competition of the blogosphere as a reporting and

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[1] http://www.technorati.com/
[2] http://www.twithority.com/

news medium and more generally from the web itself has produced a celebrity and disaster orientated mainstream media that permeates all of its formats including the nightly news bulletins. This approach continues the trajectory of sensationalism that began prior to the popularization of the internet but has become accentuated with the increasing authority of celebrities within the blogsphere and equally by offering increasing transparency onto their activities. Similarly, the need to compete with the vast bulk of materials within the blogosphere has necessitated focus on the most dramatic events (to divert attention from the mundane of the blogosphere) and to constitute these events as disastrous and life(style) threatening. The most recent #uksnow event – in January 2010 - has seen the focus of the media shift rapidly through the spectrum of numerous deaths from falls, failing infrastructure and workplace chaos onto confusion over national student examination arrangements and remote communities being further isolated.

Shifts in mainstream UK politics also contributed to the way in which the #uksnow event was received and interpreted publically. The influence of celebrity orientated media has forced political leaders of major parties to be judged on criteria of personality and charisma (Spinrad 1991). This has increasingly driven political attention upwards towards the reporting of national level politics and at the same time fragmented local government representation with an increasing number of councilors representing small and single interest parties or choosing to stand as independents. In the UK, government privatization agendas have meant that the provision of salt is undertaken by a commercial organization that sells this product to the Highways Agency - the body with overall responsibility for road safety - and local councils for subsequent spreading onto roads and footpaths. Salt is therefore a budget line for these public bodies and one that can be given more or less priority based on political priorities. Relatively mild winters in the UK over the last decade coupled with the diverse set of interests that now frame local council decision-making with a vested interest towards re-election has seen this service provision become a lower priority. However, as Atkinson (1997:409) observes Winter maintenance is, "the service where the travelling public show the least tolerance and perhaps the only service that can achieve star media rating by mid-morning." The impact of the #uksnow event was consequently doubled as adverse weather conditions combined with a low level of civil preparedness to maintain infrastructural services – which became the most noticeable and widespread effect of the event. The situation further combined with mainstream media's proclivity for reporting disaster.

4 Analysis and Discussion

At issue here is what Shadbolt and Berners-Lee (2008) describe, in their introduction to Web Science, as "vast emergent properties [that] have arisen that are transforming society," and the related requirement to examine all aspects of its multimodal and complex interactions. Whilst much of the Web Science literature to date (Shadbolt and Berners-Lee 2008; Passant et al 2009; Halpin & Thompson 2009) seems rooted primarily in the techno-centric computer science paradigm, we are keen to push the boundaries – and not simply over into a correspondingly human centric paradigm, either. Wanda Orlikowski's work on the materiality of knowledge (2006) is of

particular interest in this respect, and specifically in understanding the phenomenon of #uksnow, especially her conceptual tool of the 'scaffold.' Beyond the dichotomies between 'techno-centric' and 'human-centred' approaches to understanding technology, whereby either technology "leverages human action" or "'vanishes' from view in the preoccupation with the social," (2006:461), Orlikowski proposes a third approach, citing Latour (1992; 2004), and Law (1992) among others as having provided a theoretical framework that eschews this binarism. This alternative approach outlines a socio-materiality capable of encompassing both perspectives, and thereby not overlooking or devaluing the essential contributory elements of either. This socio-material approach characterizes knowing as emergent, i.e. continually unfolding; embodied, i.e. experiential, tacit; embedded, i.e. "grounded in the situated sociohistoric contexts of our lives and work,"; and, significantly, material (Orlikowski 2006:460).

To this background Orlikowski brings the concept of the scaffold, outlining a number of characteristics of scaffolding which she then applies to two vignettes, or short case studies, of technologies in organizational settings. For the purposes of this paper we concentrate on just three of these characteristics: that scaffolds are *temporary*: typically existing for the duration of a project; *flexible*: "constructed in situ, adapted to fit the particular local conditions"; and *emergent*: "erected over time, changing in form and function, as needed to continue supporting the changing scale and scope of the element(s) being built over time." (Orlikowski 2006:461-2).

Orlikowski's approach focuses on what she terms the "scaffolding of knowledgeability" (2006:462). This characterizes knowing as being scaffolded "culturally (e.g., through codes, language, norms) and materially (e.g., through physical objects, biological structures, spatial contexts, and technological artifacts)," (Orlikowski 2006:462) with special emphasis upon the last. .

The #uksnow phenomenon displays and independently confirms many aspects of this approach. The physical infrastructure is readily identified as the mobile internet, encompassing the internet-enabled mobile devices themselves, the masts which broadcast and receive the signals within each cell, and the server farms which host and route the millions of digital files involved. This technological scaffold is coupled with the meteorological scaffold of snow clouds moving across the British Isles, with varying precipitation according to atmospheric conditions and topographic elevation. Added into this mix are the cultural phenomena of social networking, and the microblogging techniques for using a minimally truncated (140 character) version of the (160 character) short messaging service standard, a political situation in which salt is scarce, a media obsessed with disaster and the age-old British fascination with the weather. The resulting 'mashup' in the narrow sense as a web-based application and in the wider sense as a specific combination of circumstances represents a situation that requires the understanding of a very Orlikowskian socio-materiality. Trying to understand and interpret the phenomenon, from either a techno-centric or purely human-centred perspective, would miss so much of this confluence of interrelated aspects of modern life. The scaffolding that makes #uksnow possible, moreover, displays how *emergent* cultural and social practices can come together in response, not just to the weather, and the British fascination with it, but to the possibilities newly inherent in the technological scaffolding of the mobile internet and the

potential of microblogging. #uksnow is *temporary* – a quick script that presents itself in response to snow, and is simply forgotten and discarded once it has melted. It also represents a supremely *flexible* array of potential implementations for both the technologies involved and the cultural obsessions they directly cater to.

In taking up the theoretical lens of materiality offered by Orlikowski, however, we also suggest, along with other more philosophical work embracing the lessons of post-structuralism for Information Systems research (Kreps 2010), that the advent of the social web in many ways extends and problematises the distinction of the artefact from people's usage. #uksnow reconfirms Scolai's (2008) observation that, "moving away from a network perspective to a performative view in order to grapple with the issue of materiality may be unnecessary." However, our reasons differ from that of Scolai (2008) in that the distinction of artefact from people has not only become indefinite but has moved towards an intimate merger of the human and machine in a manner described by Virilio (1997) and Deleuze and Guattari (1987). This merger or 'machinic phylum' (Deleuze and Guattari 1987) also reflects the cyborg described by Haraway (1991) as the human directly provides the data based upon their own subjective assessment of snowfall levels and without this real time stream of data #uksnow cannot exist.

The information technology of the #uksnow mashup thus becomes merely an appendage for amplifying each element of human communication (masquerading as data) that is received. "The crux of embodiment relations is that we extend perception and the spatiality of our bodies by means of information systems" (Scolai, 2008). Other systems delivered by mobile devices similarly adopt this blending of human and machine in a way that makes distinction difficult and problematic. Examples include location-based applications such as the Grindr and Layar applications offered for iPhones as well as FourSquare and Gowalla. Scolai (2008) advocates that "adopting a more flexible approach to symmetry and intentionality is a practical route to developing materiality."

Leonardi and Barley (2008, 160) observe that "what remains unresolved, however, is the epistemological and ontological nature of the relationship between the material and the social and, hence, how information technologies and organizing are tied." But by - taking up their later challenge that "students of technology and organizing pay little analytical attention to a technology's material constraints and affordances and focus, instead, on showing how people organize around the technologies they employ" – we suggest that the 'voluntaristic' nature of #uksnow reveals how the social web has altered the balance of these relationships – at least in the context of information technology - to one in which constraints or affordances are weighed towards human factors rather than technological ones. Cultural knowledge, in this case of adverse weather conditions, is formed 'conventionally' from collectivity and collective communications. In effect, this returns the interpretation and critique of a system somewhat problematically to the realms of the social and cultural while simultaneously resisting the "reduction of social order to dematerialized social orders and of the material to objects of interpretation" (Reckwitz 2002, 197).

5. Conclusions

The #uksnow Mashup offers insight into a specific paradigm of software development practices that eschews many of the formal software engineering principles found in computer science. The Mashup relies on the free and ready availability of APIs that enable rapid linking of data sources with acceptable contemporary user interfaces. While Ben Marsh, the creator of the #uksnow Mashup, has now updated the website and registered the twitmap.com domain, the original mashup was the result of rapid development that was never meant to represent the first version in an iterative development process. This shifting paradigm also emphasises the way in which software has increasingly become an engaged social process that requires mass-participation with the resultant visual representation being an amplification of human activity and knowledge.

The theoretical lens of Orlikowski, and the importance of materiality more broadly, are confirmed in the discussion of #uksnow as it reveals the complex interplay and mutually dependent references that combined to form the #uksnow Mashup. The inferences to be gained from the multiple technological and social threads whose complex intertwining result in the #uksnow event suggest not only that Orlikowski's socio-materiality is a better approach than either a techno-centric or human-centred bias, but suggest further, with Scolai and others, that this socio-materiality, from a poststructuralist perspective, incorporates constitutive interrelationships between cultural and artefactual realities making the question of materiality versus sociality further complex. This intimate merger of human and machine, or 'machinic phylum', we conclude, is perhaps most poetically evidenced in the core ephemerality of the entire event.

Finally, then, with Nigel Shadbolt and Tim Berners-Lee (2008) we conclude that in the space between technical, social, and philosophical appraisal and critique of such events as #uksnow, a new web science is being – and needs to be - carved out, but one that is beyond both techno-centricity and human-centricity, and prepared to explore the existential and epistemological implications of such human-machine mergers, the better to understand, theorise, respond to, and create such socio-technical mashups.

References

1.   Adams, B., Phung, D., Venkatesh. S.: Social reader: Following social networks in the wilds of the blogosphere. In: 1st ACM SIGMM International Workshop on Social Media, WSM'09, Co-Located with the 2009 ACM International Conference on Multimedia, MM'09 p73-80 (2009)
2.   Atkinson, K.: Highway Maintenance Handbook. Thomas Telford Publcations (2007)

3.   Babcock, W., Whitehouse, V.: Celebrity as a Postmodern Phenomenon, Ethical Crisis for Democracy, and Media Nightmare Journal of Mass Media Ethics. 20(2) 176-191 (2005)

4.   Bakker, J-L. McGoogan, J., Opdyke, W., Panken, P.: Rapid Development and Delivery of Converged Servces Using APIs. Bell Labs Technical Journal 5(3) 12-29 (2000)

5.   Benslimane, D., Dustdar, S., Sheth, A.: Services Mashups: The New Generation of Web Applications. Internet Computing, IEEE 12(5) 13-15 (2008)

6.   Chesbrough, H.: Open Innovation: A New Paradigm for Understanding Industrial Innovation. In: Chesbrough, H., Vanhaverbeke, W., West, J. (eds.) Open Innovation: Researching a New Paradigm Oxford University Press, Oxford (2006)

7.   Clarke, P.: A flurry of #uksnow. Honestly Real. The blog of Paul Clarke. http://honestlyreal.wordpress.com/2009/02/01/a-flurry-of-uksnow/ (2009)

8.   Crawford, K.: Following you: disciplines of listening in social media. Continuum 23(4) 525 -535 (2009)

9.   de Souza, C., Redmiles, D., Cheng, L., Millen, D., Patterson, J.: Sometimes you need to see through the walls. In Proceedings of the 2004 ACM conference on Computer supported cooperative work. 63-71 (2004)

10.   Deleuze, G., Guattari, F.: A thousand plateaus : capitalism and schizophrenia. Minneapolis, University of Minnesota Press (1987).

11.   Fletcher, G.: Cargo Cults in Java. Paper presented to The Eighth Java and the Internet Computing   Curriculum   Conference   (JICC8). http://www.ics.heacademy.ac.uk/events/presentations/408_fletcher.pdf (2004)

12.   Halpin, H., Thompson, H.S.: Social Meaning on the Web: From Wittgenstein to Search Engines. IEEE Intelligent Systems 24(6) 27-31 (2009)

13.   Haraway, D.: Simians, Cyborgs and Women. Free Association Books. (1991)

14.   Henning, M.: API Design Matters Communications of the ACM 52(5) 46-56 (2009)

15.   Howe, J.: The Rise of Crowdsourcing. Wired 14(6) (2006)

16.   Huberman, B., Romero, D., Wu, F.: Crowdsourcing, attention and productivity. Journal of Information Science 35(6) p758-765 (2009)

17.   Jansen, B., Zhang, M., Sobel, K., Chowdury, A.: Twitter power: Tweets as electronic word of mouth Journal of the American Society for Information Science and Technology 60(11) 2169-2188 (2009)

18.   Katz, E., Liebes, T.: No More Peace!: How disaster, terror and war have upstaged media events. International Journal of Communication 1 157-166 (2007)

19.   Kirkpatrick, M.: So You're Launching a Platform: After Ubiquitous APIs - What's the Next Frontier? ReadWriteWeb. www.readwriteweb.com/archives/after_apis.php 23rd Apr (2008)

20.   Kreps, D.: My Social Networking Profile: Copy, Resemblance or Simulacrum. A Poststructuralist Interpretation of Global Information Systems. European Journal of Information Systems 19(1)

21.   Kulathuramaiyer, N.: Mashups: Emerging Application Developmnent Paradigm for a Digital Journal. Journal of Universal Computer Science 13(4) 531-542 (2007)

22.   Langer, J.: Tabloid television: popular journalism and the 'other' news. Routledge (1998)

23.   Latour, B.: Where are the missing masses? Sociology of a few mundane artefacts. In: Bijker, W., Law, J. (eds.) Shaping Technology, Building Society: Studies in Sociotechnical Change. pp 225–258, MIT Press, Cambridge, MA. (1992)

24.   Latour, B.: Nonhumans. In: Harrison, S., Pile, S., Thrift, N. (eds.) Patterned Ground: Entanglements of Nature and Culture. pp 224–227, London: Reaktion Books. (2004)

25.   Law, J.: Notes on the theory of the actor-network: ordering, strategy, and heterogeneity. Systems Practice 5(4), 379–393. (1992)

26.   Leonardi, P., Barley, S.: Materiality and change: Challenges to building better theory about technology and organizing. Information and Organization, 18, 159-176. (2008)

27.   Liu, B., Hu,M., Cheng, J.: Opinion Observer: analyzing and comparing opinions on the Web. Proceedings of the 14th international conference on World Wide Web. Chiba, Japan, 342-351 (2005)

28.   Marsden, G,: What is the mobile internet? Interactions 14(6) 24-25 (2007)

29.   Marsh, B.: The blog of Ben Marsh http://www.benmarsh.co.uk/ (2009)

30.   Milstein, S., Chowdhury, A., Hochmuth, G., Lorica, B., Magoulas, R.: Twitter and the micro-messaging revolution: Communication, connections and immediacy – 140 characters at a time. Sebastopol, CA: O'Reilly Media. (2008)

31.   Nutley, M.: Users will dictate the development of mobile content New Media Age 09.02.06 16 (2006)

32.   Orlikowski, W.: Material knowing: the scaffolding of human knowledgeability. European Journal of Information Systems 15, 460–466 (2006)

33.   Passant, A., Samwald, M., Breslin, J.G., Decker, S.: Federating Distributed Social Data to Build an Interlinked Online Information Society. IEEE Intelligent Systems 24(6) 44-48 (2009)

34.   Reckwitz, A.: The status of the 'material' in theories of culture. From 'social structure' to 'artefacts'. Journal for the Theory of Social Behaviour, 32(2), 195- 217. (2002)

35.   Sawyer, S., Allen, J., Lee, H.: Broadband and mobile opportunities: a socio-technical perspective Journal of Information Technology 18 121-136 (2003)

36.   Scolai, P.: Materialising Materiality. In: Proceedings of the 29th International Conference on Information Systems (ICIS), Paris. (2008)

37.   Shadbolt, N,. Berners-Lee, T.: Web Science Emerges. Scientific American. October 2008, 32-37.

38.   Shamma, D., Kennedy, L., Churchill, E.: Tweet the debates: Understanding community annotation of uncollected sources. In: 1st ACM SIGMM International Workshop on Social Media, WSM'09, Co-Located with the 2009 ACM International Conference on Multimedia, MM'09 pp3-10 (2009)

39.   Silva, L., Lakshmi, G., Mousavidin, E.: Exploring the dynamics of blog communities: the case of MetaFilter Information Systems Journal 19(1) 55-81 (2009)

40.   Song, X., Chi, Y., Hino, K., Tseng, B.: Identifying Opinion Leaders in the Blogosphere. In: CIKM'07 Proceedings of the 16th ACM conference on information and knowledge management pp971-974 (2007)

41.   Spinrad, W.: Charisma: A blighted concept and an alternative formula. Political Science Quarterley 106(2) 295-308

42.   Tsai, C., Lee, C., Tang, S.: The web 2.0 movement: Mashups driven and web services. WSEAS Transactions on Computers 8(8) 1235-1244 (2009)

43.   Van der Meer, H.: Open Innovation – The Dutch Treat: Challenges in Thinking in Business Models. Creativity and Innovation Management 16(2) 192-202 (2007)

44.   Virilio, P.: Pure War. Semiotexte, NY. (1997)

45.   Wareham, J., Busquets, X., Austin, R.: Creative, convergent, and social: Prospects for mobile computing. Journal of Information Technology 24 139-143 (2009)

46.   Weiss, M., Gangadharan, G.: Modeling the mashup ecosystem: Structure and growth. R and D Management 40(1) 40-49 (2010)

47.   Youngs, G.: Blogging and globalization: the blurring of the public/private spheres. In: Aslib Proceedings: New Information Perspectives 61(2) 127-138 (2009)

48.   Zang, N., Rosson, M., Nasser, V.: Mashups: who? what? why? In: Conference on Human Factors in Computing Systems CHI'08 pp3171-3176 (2008)