

ANT-Maps: Visualising Perspectives of Business and Information Systems

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Abstract

In the IS-literature, graphical representations often accompany ActorNetwork Theory (ANT) analyses of IS-initiatives, serving as tools for improving visibility of the case and interest and power of actors. Building on a comprehensive literature survey, we identify a gap in existing visualisation approaches, as these mainly focus on offering visual support of the case. We present a visualisation approach and a generic, precise and well defined notation that is directly mapped to key concepts of ANT, highlighting the process of translating actors to commit to the implementation initiative. The approach is illustrated by an actor-network analysis of a particular IS-initiative in a Swedish media house.

Keywords: Actor-network theory, Information system research, Visualization

Introduction

During the last decade, several contributions to the field of IS have used Actor-Network Theory (ANT) to gain a deeper understanding of the shaping of socio-technical systems and the change of contexts relevant to IS research (Bengtsson and Ågerfalk 2011; Elbanna 2006; Gao 2007; Hanseth et al. 2006; Yoo et al. 2005). In this pursuit, graphical representations often accompany the ANT analyses to improve visibility of the case and actors' interest and powers (cf. e.g. Cho et al. 2008; Cuganesan and Lee 2006; Yoo et al. 2005). Considering the above while surveying the literature on ANT and IS, we identified a gap in existing visualisation approaches, as these, although useful for their respective purposes, mainly focus on offering visual support of the case. Among the various visualisation approaches a generic vocabulary grounded in research seems to be lacking. As Hanseth (2004) observes: It may be discussed to which degree the deeper ontological tenets have been understood and taken seriously." (Hanseth 2004 p. 119).

For increased understanding of development of socio-technical systems and ANT-visualisations in IS-research as discussed in this paper, nothing but a clear and concise ontological foundation of description will suffice (cf. Cordella and Shaikh 2003; 2006). Even though there is a limit to which the concepts in the real world of flux allow themselves for such treatment, such rigour and precision may be warranted for comparative and comprehensive IS-research. As innovative strategic change happens in the intersection of different competencies (Hrastinski et. al 2010), processes of importance to any sociotechnical arena are also disrupted by communication gaps and the lack of a common vocabulary of change among stakeholders. For this purpose, when serving as a tool for studying or enacting IS-implementation, we argue that in any ANT-visualisation, the relationship between ANT-concepts and its graphical representations needs to be clear, precise and concrete. Furthermore, the specified concepts needs to be well defined, and a visualisation should include the relations between the symbols used. In addition, it is important that the visualisation highlights the process of translating actors to commit to the particular initiative.

In this paper we present ANT-maps as a visualisation approach and a generic, precise and well-defined notation directly mapped to key concepts of ANT. Researchers, managers and other stakeholders can now be equipped with a visual and ontologically sound vocabulary for discussing processes of development and change of sociotechnical systems. So that the underpinning to the resilience of IS-initiatives may be understood and subsequently handled..

Our approach is illustrated by a case study of individuals related to a particular IS-initiative in a Swedish media house and their strategy concerning the social media/Open Innovation phenomenon. The data obtained during 2011-2012 concerns a three-year period in total, ranging from 2009 to 2011. The data sources included interviews, meetings, observation, the webpage, e-mails, annual reports, newspaper articles, twitter flows, and media campaigns.

In the following section, we present the theoretical background: ANT and IS and the results of a literature review on visualisation approaches of ANT in the IS field. We provide a description of our research method and we present the empirical setting of the case study that we employ for illustration of our approach. We present the key contribution of this paper, the Actor-Network Maps (ANT-Maps) and their graphical notation language. The results of our findings are subsequently analysed. The results show how actor-network maps could be used to visualise the underpinnings of resilience (or lack thereof) of a particular IS-initiative. In the final section, we conclude.

Actor-Network Theory and IS

Prompted by the complexity of socio-technical systems and the need to acknowledge translation processes occurring to and from non-human entities, Actor-Network Theory (ANT) has been used to gain a deeper understanding of the shaping and change of socio-technical systems relevant to IS research (Bengtsson and Ågerfalk 2011; Elbanna 2006; Gao 2007; Hanseth et al. 2006; Yoo et al. 2005). ANT was developed by Michael Callon and Bruno Latour (e.g. Callon 1986; Callon 1986a; Latour 1985; Latour 1988; Latour 1999) in the sociology of science and technology. This network theory puts emphasis on the concept of non-human actors and the interplay between entities with agency, human- and non-human actors, as well as relations formed by negotiations and interactions. In ANT, the formation and stabilisation of networks are the result of translations and inscriptions (Callon 1986). An important remark raised by Latour (1999) is that the word “network” should not be interpreted in the World Wide Web sense of a collection of related nodes; in fact at the time ANT was conceived, there was hardly any wide spread notion of what a network was or should be interpreted as, quoting Latour (1999), “At the time, the word network, like Deleuze’s and Guattari’s term rhizome, clearly meant a series of *transformations* - translations, transductions - which could not be captured by any of the traditional terms of social theory.” A summary of key concepts of ANT is presented in Sarker et al. (2006) (see Table 1). The interpretation of Sarker et al. 2006, stemming from J Law, is chosen as the basis of our conceptual graphs. The main reason is that the concepts as presented in Sarker et al. (2006) hold an interpretation common to their use in the field of IS. In this way, the homogeneous mapping between the chosen interpretation of the concepts and its visual notation in the conceptual graphs simplifies the practical use of the ANT-maps.

Table 1 Key Concepts in Actor-Network Theory (Sarker et al. 2006)

| Concept | Definition |
|------------------|--|
| Actor | "Any element which bends space around itself, makes other elements dependent upon itself and translates their will into the language of its own" (Callon and Latour 1981 p. 286). |
| Actor-network | "Heterogeneous network of aligned interests, including people, organisations and standards" (Walsham and Sahay 1999 p. 42). |
| Punctualisation | Treating a heterogeneous network as an individual actor to reduce network complexity (Law 2003). |
| Translation | The process of the alignment of the interests of a diverse set of actors with the interests of the focal actor (Callon 1986; Walsham 1997). |
| Problematization | The first moment of translation, during which a focal actor defines identities and interests of other actors that are consistent with its own interests, and establishes itself as an obligatory passage point (OPP), thus rendering itself indispensable (Callon 1986). |

| | |
|---------------------------------|--|
| Obligatory passage point | A situation that has to occur for all of the actors to be able to achieve their interests, as defined by the focal actor (Callon 1986). |
| Interessement | The second moment of translation, which involves negotiating with actors to accept definition of the focal actor (Callon 1986). |
| Enrollment | The third moment of translation, wherein other actors in the network accept (or get aligned to) interests defined for them by the focal actor (Callon 1986). |
| Inscription | A process of creation of artifacts that would ensure the protection of certain interests (Latour 1992). |
| Speaker/delegate/representative | An actor that speaks on behalf of (or stands in for) other actors (Callon 1986; Walsham and Sahay 1999). |
| Betrayal | A situation where actors do not abide by the agreements arising from the enrollment of their representatives (Callon 1986). |
| Irreversibility | "Degree to which it is subsequently impossible to go back to a point where alternative possibilities exist" (Walsham and Sahay 1999 p. 42). |

Translation in the view of ANT is a four-stage process, by which an actor-network is created. Often, this process is followed from the perspective of one actor, the focal actor. The first moment of translation is problematisation, in which an actor defines a problem/task/opportunity/challenge and tries to persuade other actors to accept the 'programme', i.e. to pursue a solution. This moment establishes the actor, usually the focal actor, as an obligatory passage point. Subsequently it renders the actor indispensable with regards to the proposed programme. The second moment is interessement, in which the focal actor as the initiator of a particular problematisation tries to place other actors into roles proposed in the programme. The third moment is enrollment. In this phase, the focal actor succeeds in convincing other actors to accept the roles proposed as part of the interessement moment. The fourth moment is mobilisation. By ensuring durable and irreversible relations, the actor-network becomes stabilised. It is important to note that translation is a process, never a completed accomplishment (Callon 1986). In the following Table 1, the constructs addressed are the key concepts in Actor-Network Theory as presented by Sarker et al. (2006), hence in this paper, mobilization is not addressed outside of the constructs of irreversibility and inscription.

The process of translation may fail in stabilising the actor-network, which subsequently collapses. *Inscription* is a process in which the translation of actor interests is embodied in artefacts such as texts, technical objects, embodied skills etc (Callon 1991; Latour 1990).

In the IS-field, graphical representations often accompany the ANT-analysis in order to improve visibility of the case and the actors' interests and powers (cf. e.g. Cho et al. 2008; Cuganesan and Lee, 2006; Yoo et al. 2005). According to the intentions of Latour and Callon, in ANT the same vocabulary and theoretical lenses are to be used in the same manner for every actor, regardless of size, attributes or power. However, acknowledged by Simon (1969), the natural and the artificial make us ascribe attributes to the IT-artefact, e.g. barriers of inertia such as resistance to new technology etc that may exist in an organisation.

Related Research

The literature on ANT provides a vocabulary to describe the events in the transformation of networks. It does not however provide any form of guidance on how to accurately depict an actor-network, or, by a more correct vocabulary, provide a snapshot of an actor-network during its transformation (cf Latour 1999). Through the years, however, different forms of diagrams and flow-chart analogs have been used (cf. Callon 1986; Akrich and Latour 1992). In the seminal work of Callon (1986) when he explores the domestication of the scallops and fishermen of St. Brieuc Bay, several visualisation approaches are used as an aid to support the narrative, ranging from relational diagrams to more naturalistic depictions illustrating the interests of different actors. A different approach to visualisation is used by Akrich and Latour (1992), based on Latour (1991), that depicts an association chain of human and non-human actors. From the latter they also used a more narrative visualisation to discuss technological

change as means of promoting change in an actor-network. In this specific case, the goal of a hotel manager was to make the customers return.

In the following, we elaborate on the state of the art in ANT-visualisation within the field of IS via a presentation of existing approaches related to the IS-field (Cuganesan and Lee 2006; Monteiro and Hanseth 1995; Yoo et al. 2005). By reviewing 82 journal articles that could be classified as contributing to Actor-Network Theory in the IS-field, we found 16 articles that contained visualisations directly related to actor-networks. Based on our interpretations of the aim of the visualisations, these contributions were divided into three categories. It should be noted that some papers contain more than one visualisation and thus, visualisations of the same paper may be part of more than one category. However, the categories are mutually exclusive as no single visualisation appears in more than one category. The categories are as follows:

- a) Frameworks that visualise the relations of the actor-network, necessary translations, (obligatory) passage points, etc. that build up the domain (see Table 2).
- b) Models that visualise the actor-network at some stage of the narrative (see Table 3).
- c) Supportive visualisations that act as an aid for the user to better understand certain key concepts or stages in the narrative (see Table 4).

To be noted concerning Table 2, three of the contributions containing analytical frameworks used adoptions or derivations of the relationship diagram in Lyytinen and King (2002). Lyytinen and King (2002) present a visualisation of the relationships between the social and organisational elements of innovation and the components of the introduced technical innovation. Although not explicitly an ANT-framework, they discuss spheres of the introduction of wireless service in terms of actors. Making the actors explicitly mapped into the ANT-vocabulary, Bengtsson and Ågerfalk (2011), Gao (2007), Yoo et al. (2005) all adopt or present approaches inspired by the framework of Lyytinen and King (2002).

The three remaining articles present various depictions of ANT vocabulary. As an example, based on the analytical framework of Law and Callon (1992), Heeks and Stanforth (2007) present a visualisation of the trajectory of an e-government project. In line with Law and Callon (1992), the presented analytical framework is aimed at the macro level and focuses on the project as the focal actor.

Table 2. Group A. Frameworks that visualise the relations of the actor-network, necessary translations, (obligatory) passage points, etc. that build up the domain.

| Author | Comment |
|-------------------------------|---|
| Gao (2005) | Analytical framework similar to Lyytinen and King (2002). |
| Yoo et al. (2005) | Analytical framework adopted from Lyytinen and King (2002). |
| Gao (2007) | Framework of actor-network analysis, different from Gao (2005). |
| Heeks and Stanforth (2007) | Analytical framework of Law and Callon (1992). |
| Andrade and Urquhart (2010) | Inscription and translation framework depicting the activities, their relation and order used in ANT, derived from the vocabulary of ANT. |
| Bengtsson and Ågerfalk (2011) | Analytic framework adopted from Lyytinen and King (2002). |

As a second category of visualisations we find Cuganesan and Lee (2006), Gasson (2006), Monteiro and Hanseth (1995), Sarker et al. (2006), and Thapa (2011) who all present models that visualise the actor-network at some stage of the narrative (see Table 3).

| Author | Comment |
|-----------------------------|--|
| Monteiro and Hanseth (1995) | Model showing the complexity of a standardised solution. |
| Cuganesan and Lee (2006) | Model showing relations and effects in regards to the involved actors. |
| Gasson (2006) | Model showing different stages and aspects in the development of the actor-network. |
| Sarker et al. (2006) | Model visualising relations and breakdowns. |
| Thapa (2011) | Model showing relations to the obligatory passage point - showing the enrollment/mobilisation phase. |

The final category of visualisations, Supportive visualisations (see Table 4), acts as an aid for the user to better understand certain key concepts or stages in the narrative. Hence, the visualisations are less expressive than the models of category 2 as they often do not depict the entire network and their relations. We find that the supporting visualisations all are connected to Callon (1986).

| Author | Comment |
|-----------------------------|--|
| Gasson (2006) | Supporting figures depicting time and actors. |
| Lee and Oh (2006) | Figure showing relationship amongst protocols. |
| Sarker et al. (2006) | Complementary figures based on Callon (1986). |
| Pentland and Feldman (2007) | Narrative network for analysing the narrative. |
| Cho et al. (2008) | Figures describing relations as complement to the narrative. |
| Rodon et al. (2008) | Complementary figure to depict the formation of networks from problem to solution, Complementary figures based on Callon (1986). |
| Cornford et al. (2010) | Complementary figures based on Callon (1986). |
| Thapa (2011) | Complementary figures based on Callon (1986). |

By our literature study, we have identified a gap in the existing knowledge of ANT visualisations for IS. In summary, the result of the literature study shows that substantial contributions are to be found in the visualisation approaches, and that visualisations are used in conjunction with ANT-analyses in IS. As an example; arguing that "...an ANT-informed understanding can enable practitioners to better anticipate and cope with emergent complexities.", the visualisation approach of Sarker et al. (2006) acknowledges that ANT allows for non-human actors to be represented in the analysis and that ANT holds an inherent flexibility towards the modelling of the actors as either micro (e.g. individuals) or macro representations (e.g. organisations), and to the unstable nature of macro actors. In this vein, they model the disintegration of the macro representations, cf. the punctualisation phenomena of Law et al. (1992). By a blackboxing of the heterogeneous parts of actors into their actions, Sarker et al. (2006) enable a focus of the visualisation to certain aspects of the events.

Unfortunately, important for comparison of different projects as well as for the practical use of ANT, in our literature survey we found that in the comprehensive, precise and well-defined meaning of the ANT concepts are not

mapped into the visualisation. Hence, comprehensive, precise and well-defined relations between the graphical representation and the concepts in ANT are not captured in the vocabularies of the visualisations, making the accumulation of best practice as well as theoretical synthesis difficult.

In addition, the visualisations accounted for are in general used as descriptive snapshots of the relations of the actor-network, necessary translations, and (obligatory) passage points that build up the domain. Some contributions present frameworks that acknowledge translations in the graphical representations. Unfortunately, except for the macro-level trajectory of Heeks and Stanford (2007), all visualisations at most depict the before and after state of the actor-network, lacking a representation of the transformation trajectory between different formations of the network as described in the narratives.

Our aim is to devise an ANT-visualisation, in which the relationship between the concepts of ANT and their graphical representations is generic, precise and well-defined, and to highlight the process of translating actors to commit to the implementation initiative.

Method

The research approach adopted for this qualitative study takes its departure in the canonical action research method (CAR), which suggests cycles of diagnosing, action planning, action taking, evaluating, and specifying learning (Baskerville and Wood-Harper 1998). This study consisted of the following three phases respectively that adhere to the rigor and relevance criteria for CAR (cf. Benbasat and Zmud 1999; Davenport and Markus, 1999; Davison et al. 2004):

Diagnosing and action planning: Understanding the arena and research needs

As this research is part of a larger undertaking in relation to develop a comprehensive OIS-system for Swedish media house, we needed to get a comprehensive understanding of the background of the organisation, its various stakeholders, their activities and their vision that was the driving force to the OIS-initiative. Parallel to forming an understanding of the case, we needed to visualise the case narrative, and this need prompted the current research project. Together with the primary researchers involved in the development, a joint agreement of the research outline was developed. It may be noted that several stakeholders had previous knowledge and experience of research projects, and thus, were positive to the project, and showed great willingness to share their stories. To ground the visualisation approach in theory, we decided to conduct a comprehensive literature study. In addition, to better understand the case we planned to gather external data on the case.

Action taking: Strand one: Literature Survey

We conducted a literature study on visualisation approaches used in conjunction with ANT-analyses in IS. Widening the outlook to adjacent social theories, additional techniques for visualisation are well employed in Stakeholder Theory (Donaldson and Preston 1995; Freeman 1984; Laplume et al. 2008). We found that stakeholder maps (cf. Boonstra and de Vries 2008; Freeman 1984; Newcombe 2003) could be a point of departure. Unfortunately, the components used do not incorporate key concepts in ANT-literature, since neither the process of translation nor non-human entities are acknowledged (Louma-aho and Paloviita 2010; Phillips et al. 2003; Phillips and Reichhart 2000). This is unfortunate because a core component of socio-technical systems is the IT-artefact that, together with the (human) users, forms a socio-technical system for information handling (cf. Alter 2006; Benbasat and Zmud 2003; Orlikowski and Iacono 2001). Similarly, Louma-aho and Paloviita (2010) argue, the current complex corporate environment may be better described, because the origin of corporate crises may be the result of non-human stakeholders that are left unacknowledged. To this point, such extensions of stakeholder theory are generally not accepted. The consequences of such an extension of stakeholder theory, while benefitting from its visualisation techniques, but against its original ontological underpinnings, are not to be taken lightly. It means that to include the IT-artefact or a change strategy as a non-human stakeholder, the philosophical ramifications need to be well understood. Still, in IS-implementation projects, there is a need for prognostic tools for studying and enacting a practitioner perspective that acknowledges the socio-technical nature and its consequences. Begging the ontological questions that arise on the non-human stakeholder and its consequences, we decided to approach the issue from an actor-network perspective. This decision guided the literature study. The existing approaches surveyed in the literature study were divided into three categories according to their aim. As any interpretation is based on partial

and temporary views of the interpreter, the classification of the existing ANT-visualisations for IS and the outlook on stakeholder maps reflect the views of the authors of this paper. The literature survey consisted of 82 papers from 29 journals in IS and adjacent fields in the time interval 1992-2011. The material was categorized and analysed. Thus, even by a more nuanced classification scheme, ANT-visualisations in the realm of IS-projects are likely to show a similar gap. In addition, to enable a more rigorous classification, the pre-categorization was conducted by one of the researchers and subsequently it was analysed in collaboration with a second researcher.

Action Taking: Strand two: Case study

Data was obtained over a three-year period in total, ranging from 2009 to 2011. The data sources included interviews, meetings, observation, webpages, e-mails, annual reports, newspaper articles, twitter flows, and media campaigns. Our study emphasises the importance of a micro-level understanding of the actors and their power and interests in relation to the OIS-Vision. As the dominant actors changed, including non-human actors such as the vision and the business logic, the implementation strategy changed too, leading to the cancellation of key positions and changes in OIS-investments earlier pursued.

The empirical research setting is a particular IS-initiative in a Swedish media house and their strategy concerning the social media/OIS- phenomenon. Thanks to its role as means for supporting such business objectives, ICT for intra- as well as inter-organisational use is rapidly becoming ubiquitous (cf e.g. Barua et al. 1995; Sethi and King 1994; Tallon et al. 2000; Watts and Henderson 2006). The exploitation of IT in and for corporate strategy implementation, however, is no panacea for which a straightforward road to success could be found (cf e.g. Mintzberg et al. 1998; Mintzberg and Quinn 1991). Clearly, the organisations of today are all sociotechnical systems and their actors and processes are inherently complex. As globally distributed knowledge and experience through ICT now is available to organisations for the purpose of maintaining and advancing business innovation, organisations increasingly find reasons to become engaged in the open innovation paradigm (cf. Chesbrough 2003; Chesbrough et al. 2006). Open innovation software (OIS), i.e. systems or software for the purpose of supporting open innovation initiatives, may be defined as web 2.0 applications for open innovation (Hrastinski et al. 2010). The basic criteria for classification as an OIS are the ability to allow broad user participation (crowdsourcing), web-based communication and the possibility of collaboration. Hence, inter-organisational systems with the purpose of tapping into the global knowledge may be viewed as a type of OIS. Boonstra and de Vries (2008) argue for both tangible and intangible benefits of inter-organisational systems. These include closer links between the value chains of organisations, lower transaction costs, flexibility (Golden and Powell 2004), improved services and closer partnerships (Bhyteway and Dhillon 1996). The OIS-initiative under investigation can be viewed as an attempt to realise the vision of the media house to establish itself as a strong actor in the online-era.

Evaluation and Learning Outcomes

The topic emanates from the need to visualise an actor-network during an IS-project. Our rationale for this endeavour has been to address a knowledge gap affecting visualisations of ANT. To us this knowledge gap provides a barrier for the understanding and theoretically grounded use of ANT in an IS-development context. Qualitative investigations are subject to questioning as to their generalizability and validity, thus we have evaluated the research strategy, method and outcome to eg. the relevance criteria of (Benbasat and Zmud, 1999). As an example, our approach develops cumulative, theory-based, context-rich bodies of research, to enable prescriptive and proactive activities when using ANT to describe a particular change project or state of affairs. The learning outcomes were iteratively introduced into the subsequent and parallel research cycles. In this way the new understanding of the empirical arena, the research setting as well as the process has been used in an accumulative way, resulting in the suggested common vocabulary, its properties, and relevance for the IS-field. The empirical material has been collected, analysed and put to use in accordance to the three phases as described above. In order to take departure from the current state in research, we resorted to a comprehensive literature study as well as reviewing the ontological underpinnings of ANT and its relation to IS-research. In summary we turn to CAR for introducing rigor to our research process and subsequently strengthen the validity of the results (Davenport and Markus, 1999). Our approach acknowledges the dynamic nature of IS-development projects, which allows us to visualise actor interactions and fluctuations in the actor's interests and power in relation to the IT-artefact and other non-human actors. In this way ANT-maps aid in visualising challenges in the realisation of an IS-project, which could be useful for highlighting resilience of the initiative. The usefulness of ANT-maps in non-academic settings needs to be further investigated. Our original intent was to devise a means of visualisation of ANT-analysis. However, we posit

that if it gain acceptance for wider use, ANT-maps could also be employed for accumulation or comparison of IS-research, thanks to its adherence to ANT and generic and non-case specific notation.

An Illustrative Case: An OIS-Initiative in a Swedish Media House

To accommodate the reader for the comparison of the narrative to the visualisation, the interpretation of ANT-concepts are made explicit in the below narrative.

Prelude to the OIS-Initiative

In early 2009, a Swedish media house introduced a new vision statement: the media house was to connect people and ideas, and strengthen its geographical region via collaboration. A new chief editor was hired, with the intent to gain a strong leader that was committed to the cause of leading the media house into the new era of web presence. As the focal actor, the vision is a broad concept including business strategies, engagement, transparency, innovation and value creation including social, economic and ecological values. It is inscribed in physical artefacts including digital representations as well as being advocated by enrolled human actors. As the traditional distribution form of media is threatened by “new digital media”, a further strengthening of the web-based presence is an important part of the vision, as well as playing a more active part in the community by using social-media techniques to achieve reader engagement. The commitment to the web-based format and a more interactive homepage was expressed by the chief editor on the first day as chief editor in a chat session with the readers. During the same interview the chief editor expressed a strong positive attitude towards social-media. It shows that the chief editor was enrolled to the vision, and publicly acknowledged this. As the realisation of the process develops, new technical aspects of the vision are inscribed, such as new venues of distribution to e-book readers, including the possibility of providing subscribers with e-book readers as part of their subscription. By inscribing strategic use of technology as a part of the vision, the vision became the center of the translations that would lead to the formation of the OIS-initiative.

Deploying the initiative

During the end of 2010, a position as chief for digital business development was created. The recruitment phase ended in early 2011 and the media house had strengthened its competencies to realise the vision. The recruitment of the digital business developer shows that the vision had not only enrolled the organisation, but also translated other actors to further develop the vision and allocate more resources to its realisation. As part of the refined vision, a further development of the web-based activities of the media house and reader engagement and interactions are proposed. Well aligned to the vision, an open innovation system was suggested as a more transparent and interactive relation with the readers. It strongly translates the other actors the executive board, including the chief editor, into beliefs resulting in the actions that initiate the OIS-initiative. At this point the chief for digital business development was not appointed, and thus not enrolled into the actor-network for the OIS-initiative.

Break down of the initiative

After a period the OIS-initiative breaks down. Although in line with the ideas of a greater web-presence, the executive board no longer wanted to invest in the OIS-initiative as part of realising the vision. Opposed to this, the chief for digital business development, and to almost a similar extent the chief editor, were both highly invested in the planned and partly executed OIS-initiative. The chief for digital business development left the OIS-implementation team, thereby no longer being an actor in the OIS- initiative.

After

In the after situation, the chief editor is enrolled by the executive board to its low interest in the OIS-initiative. As the minutes of the meetings concerning the OIS-initiative show, the chief of digital business development and the expert team envisioned that the OIS was aligned with the vision. Still, this was not the perception of the executive board. Although the OIS-initiative did not reach a final testing stage, its focal actor, the vision, was still firmly inscribed. The abandonment of the OIS-initiative resulted in lost resources, reduced trust and the loss of valuable competences as the chief of digital business development refrained from further interest in the realisation of the

vision. This example shows that the enrollment of other actors, such as the chief for digital business development, does not necessarily mean the introduction of an agent that will have a lasting effect on the actor-network.

Moving Forward

Moving forward from the breakdown, a subsequent initiative of the media house resulted in development of a collaborative web, compared to the original OIS-initiative, a modest OIS-system, comprising of an interactive platform aimed at co-creation. This points to the effective enrollment to the vision, albeit suggests a reinterpretation of how the vision could be approached. More true to the original approach to realise the vision, an alternative way of moving forward after the breakdown would be through a series of translations by a new actor. In such a scenario, as initially envisioned, an OIS-system could be deployed. Such an actor may be human, e.g. the owners of the media house that consider the OIS-initiative to be of utmost importance, but also non-human, e.g. disruptive technology demands or organisational mergers. In the following section, we develop a vocabulary for mapping this narrative into a visualisation.

A Graphical Representation for the Visualisation of an Actor-Network

We present an ANT-map as a graphical representation for the visualisation of an actor-network. It comes about as a series of two-dimensional matrices that plot the actors and their relations, as well as the processes of translation that is ongoing at the particular time interval of its representation. In this way, the dimensions allow for highlighting various perspectives of an organisation, e.g. technology acceptance, sustainability matureness, or simply interest in the initiative and power to realise one's own interests (cf. Newcombe 2003). Each instantiated matrix is a descriptive interpretation, which means that it is always dependent on the context of the case under analysis and the interpreters, and thus, any interpretation merely depicts a partial view of the narrative. Due to the functional organisation models, the fragmentation and difference in perspective, to enable better and more coherent decision making, a common vocabulary for describing and discussing their processes and knowledge is needed. Examples from other areas include the global movements of standardisation and protocols in web technology and internet-based communication. Consequently, for use in the planning and management of an IS-initiative, we stress the importance that the vocabulary used in the visualisations is directly mapped to ANT-concepts (see Table 5). However, by means of visual representation of "non-physically based data" cognition may be amplified (Card et al. 1999), as visualisations are to make use of human visual/spatial abilities to solve the abstract problems (Keim 2002).

| Concept | Definition | Legend |
|------------------|--|---------------------|
| Actor | "Any element which bends space around itself, makes other elements dependent upon itself and translates their will into the language of its own" (Callon and Latour 1981, p. 286). | ● |
| Actor-network | "Heterogeneous network of aligned interests, including people, organisations and standards" (Walsham and Sahay 1999, p. 42). | ●-● |
| Punctualisation | Treating a heterogeneous network as an individual actor to reduce network complexity (Law 2003). | ● |
| Translation | The process of the alignment of the interests of a diverse set of actors with the interests of the focal actor (Callon 1986; Walsham 1997). | N/A |
| Problematisation | The first moment of translation, during which a focal actor defines identities and interests of other actors that are consistent with its own interests, and establishes itself as an obligatory passage point (OPP), thus rendering itself indispensable (Callon 1986). | Introduction of a ● |

| | | |
|---------------------------------|--|---------------------|
| Obligatory passage point | A situation that has to occur for all of the actors to be able to achieve their interests, as defined by the focal actor (Callon 1986). | ~ |
| Interessement | The second moment of translation, which involves negotiating with actors to accept definition of the focal actor (Callon 1986). | ---> |
| Enrollment | The third moment of translation, wherein other actors in the network accept (or get aligned to) interests defined for them by the focal actor (Callon 1986). | → |
| Inscription | A process of creation of artifacts that would ensure the protection of certain interests (Latour 1992). | Introduction of a ● |
| Speaker/delegate/representative | An actor that speaks on behalf of (or stands in for) other actors (Callon, 1986; Walsham and Sahay 1999). | ● |
| Betrayal | A situation where actors do not abide by the agreements arising from the enrollment of their representatives (Callon 1986). | N/A |
| Irreversibility | "Degree to which it is subsequently impossible to go back to a point where alternative possibilities exist" (Walsham and Sahay 1999, p. 42). | |

In Table 5, the symbols ~ and || represent an obligatory passage point and the concept of irreversibility respectively. Thus, in our visualisation these key concepts of transformation are not represented by symbols inside the power and interest matrix but placed in the accompanying time axis that represent the trajectory of the narrative.

Drawing on stakeholder maps of Freeman (1984) and Boonstra and de Vries (2005; 2008) as a point of departure for a suggested notation in use, see Figure 1, each actor is represented by a dot (●). In ANT, an actor may very well represent an entire network of actors (●-●), to the point where this is an acknowledged concept, denoted as 'punctualisation'. In our visualisation notation, the punctualised network of actors is represented by the single actor notation; a dot (●). For our case, the EB, executive board (Figure 1), consists of a group of people, although in this narrative, presented as one actor. Sometimes an actor is meant to act as a speaker/delegate/representative of another actor. One example in this case is that the customers of the media house are affected by the OIS-initiative, albeit they lack direct influence on its realisation. Instead, the executive board acts according to their interpretation of the readers' interests. Regardless of whom the speaker speaks for, according to Callon, 1986 the speaker is an actor. Consequently, a speaker is an actor, which is represented by a dot (●).

Problematisation occurs prior to the network being formed (cf. Table 1). This concept is formalised by the introduction of a new actor, which is represented by introduction of a dot (●). The goal of inscription is to create artefacts that ensure the protection of certain interests. If this artefact is of relevance in the actor-network, it is either an actor itself or affects other actors, thus, being an actor (cf. Luoma-aho and Paloviita (2010) on translation and spheres of new stakeholders).

ANT allows for different actors to hold different attributes of e.g. power or influence. By exerting such power they are via enrollment (→) able to translate others into sharing their opinion or supporting their cause. Enrollment could be interpreted as willingness to take part in the translation process.

Inspired by Sarker et al. (2006), vectors (--->) may be understood as a measurement of how well the focal actor has performed with regards to interessement of other actors at a given point of time. Often it means that interessement could be mapped to a process of alignment of the actors towards the focal actor. The direction means the direction of interessement. And the length of the vector is the relative attraction of interessement between actors. In this way the vectors of the ANT determine the alignment of the network.

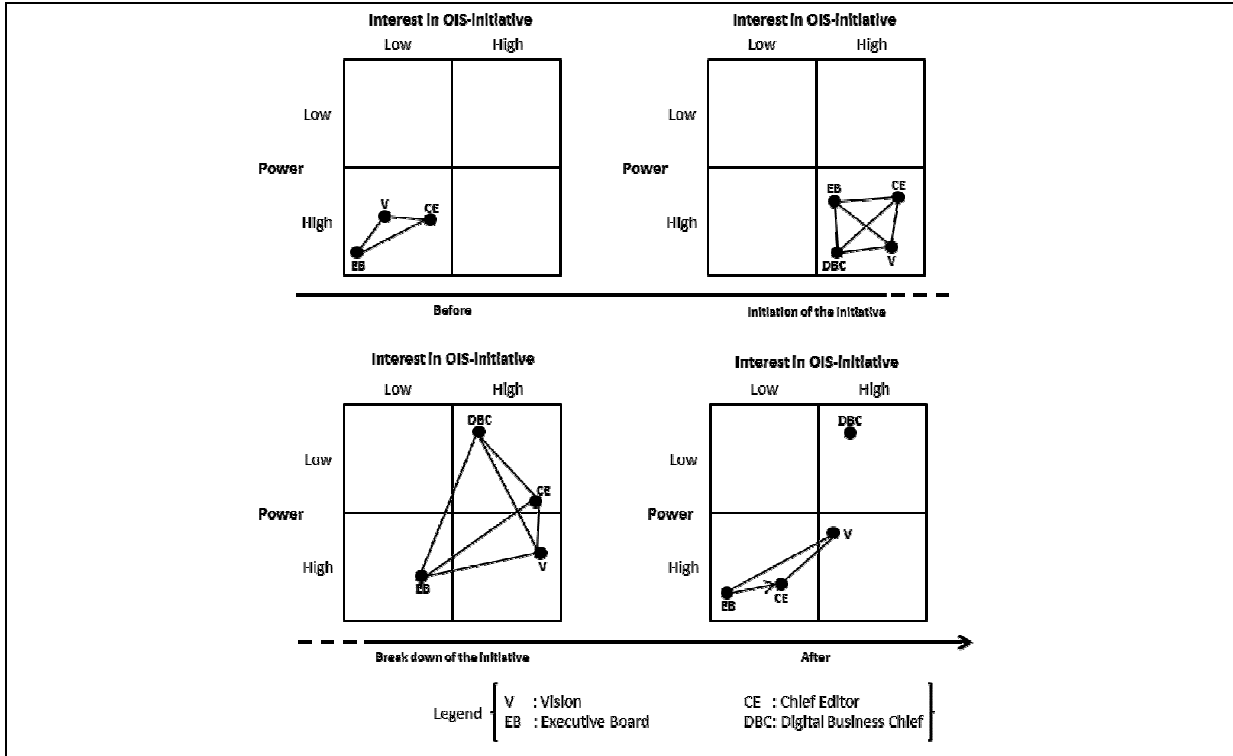


Figure 1. ANT-Maps for the OIS-Initiative of the Media House

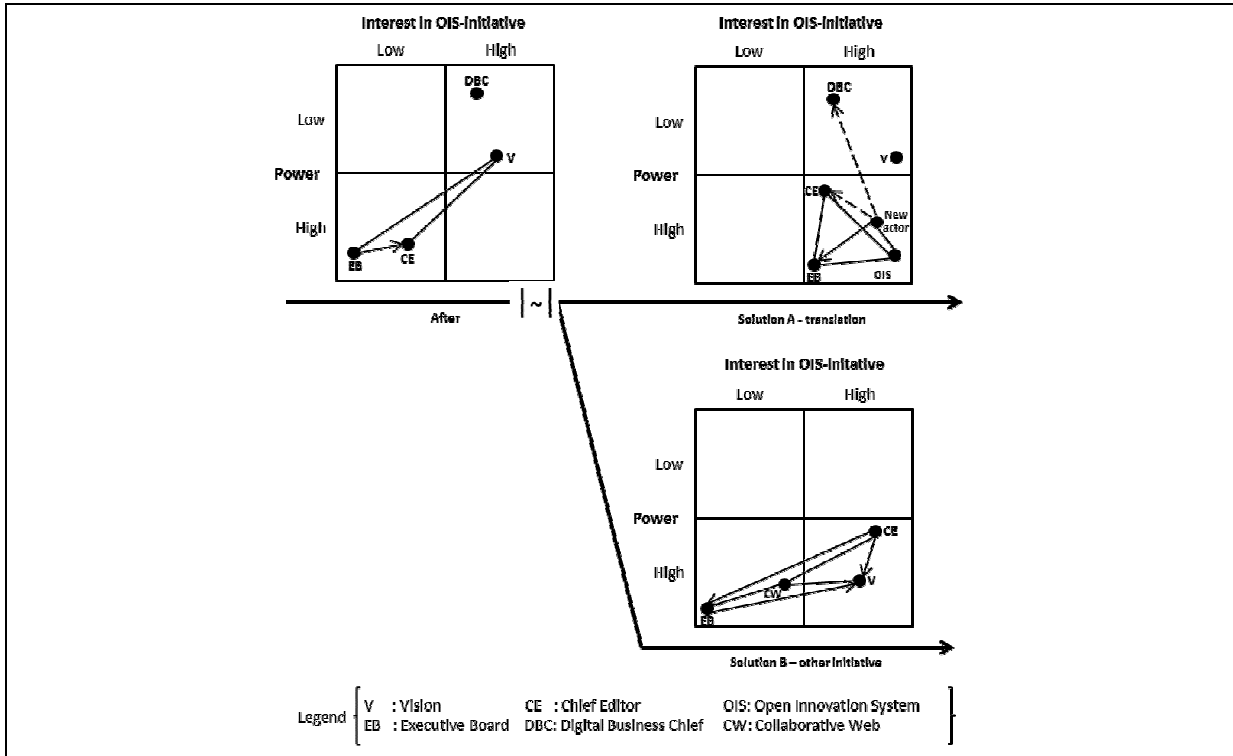


Figure 2. ANT-Maps for alternative future scenarios

The narrative of our case, as visualised in Figure 2, contains a point of irreversibility in the form of the breakdown of the OIS-initiative. We model this irreversibility via the || insertion. Coinciding with this point of irreversibility is an obligatory passage point. The timeline represents the trajectory of the narrative. The obligatory passage points are marked via the ~ insertion at the timeline. This highlights the importance of an analysis that follows the narrative throughout its entirety, as a snapshot is only able to capture a specific time slice of the narrative. Hence, for the modelling of IT-projects, the commitment and subsequent realisation of the IS can in most cases be viewed as irreversible, and thus, it may be interpreted to contain two obligatory passage points. This further stresses the importance of visualising the interactions of the actors and the dynamics of the entire narrative in any analysis. The two obligatory passage points are not irreversible in a strict sense as it may be possible to reach a point in which other alternatives exist and may be taken on. For an IS-project, it means that irreversibility is to be interpreted in this more pragmatical sense, as it usually is impossible to roll-back the status in the actor-network without substantial cost in resources or goodwill.

Analysis

As presented above, the result of the literature study shows that substantial contributions are to be found in the visualisation approaches, and that visualisations are used in conjunction with ANT-analyses in IS. However, the visualisations accounted for, neither focus on a common vocabulary aligned to the ANT-concepts nor conveying the process of translation and its dynamic nature. The literature survey is comprehensive as it consisted of 82 papers from 29 journals in IS and adjacent fields in the time interval 1992-2011 that aimed at contributing to the field of ANT and IS. Thus, even by a more nuanced classification scheme, ANT-visualisations in the realm of IS-projects are likely to show a similar gap.

A Formalisation of ANT-Concepts

Widening the outlook on adjacent fields may present additional techniques and visualisation languages. Drawing on well-established methods of visualisation of social contexts, our approach takes its departure from stakeholder theory (Boonstra and de Vries 2005; 2008; Freeman 1984). However, in our approach, the components of the visualisations are directly mapped to well-established concepts in ANT-literature, i.e. the vocabulary of the ANT-maps is precise and well defined by its grounding in ANT-theory. For the same reason the ANT-maps are generic as the visualisation allows for a visualisation of the ANT-analysis regardless of the case. In our approach, the visualisation is built up from theoretically acknowledged ANT-constructs rather than providing an overview of the narrative. Cf. Gao (2007), Cho et al (2088), Sarker et al. (2006). In fact, in all the surveyed contributions, no legend of the graphical notation can be found. Hence, the interpretation of the notation of our approach rests on the definitions of ANT-concepts, making the visualisation vocabulary generic, precise and well-defined. In this way any actor-network may be visualised by means of the ANT-maps.

Explanatory Depth: Making Explicit the Dynamical Nature

We present the ANT-Maps and their graphic notational language. In contrast to all the approaches except for the macro-level trajectory Heeks and Stanforth (2007) found in the literature survey, but in line with the original intent of Latour (1999), our visualisations consist of a series of transformations as they are to be repeated and form a trajectory in time. Latour (1999) emphasises the key facet of ANT as its dynamical nature. The word “network” is to be interpreted as a series of “transformations - translations, transductions - which could not be captured by any of the traditional terms of social theory.” Key notion of our approach is the acknowledgement of the dynamic nature of actor-networks (cf. Latour 1999) by the instantiated power and interest matrices along a time axis. As the ontological tenets of ANT are intended to capture the actor-network as a series of “transformations”, the processes of ongoing change needs to be made explicit in any visualisation. The purpose of the visualisation of Heeks and Stanforth (2007) is to provide a macro-level trajectory of the efforts to enroll potential local actors to a global project. In contrast to this approach that visualises the full trajectory representing both temporal and spatial movements in one figure, in our approach, we present the dynamic nature via snapshots (or timeslices) of the actor-network in chosen points in time. The transformations of the actor-network become visible via the relative reconfiguration of the snapshots. The choice of and frequency of these snapshots are subject to the user. Major events may be illuminated via matrices modelling the actor-network before, during and after an important event. In this way we may also simulate alternative future scenarios of the narrative (see Figure 2). As a result, only limited

by the medium of presentation (eg. paper, 3D visualisations or animations), to highlight the transformation, a more comprehensive series of snapshots could be presented.

Explanatory Depth: Conveying the Process of Translation

In accordance to the nature of socio-technical systems and this intention of ANT, for IS-research Lee (2001) acknowledges that “Research in the information systems field examines more than just the technological system, or just the social system, or even the two systems side by side; in addition, it investigates the phenomena that emerge when the two interact” (Lee 2001 p. iii).” However, it is not uncommon that redundant information and an inability to reuse, link and connect related processes dilute and obscure organisational phenomena to an extent that the key cross-functional processes cannot be properly modelled. Our visualisation approach opts to provide visual clarity of the affected actors (actor-networks) and their individual relations as well as their interaction. Contrary to earlier approaches found in the literature study, we introduce the ability to visualise intressement, enrollment and the generic relations within the actor-network. It allows us to highlight certain actors and their translations as enacted in relation to the chosen dimensions of the matrices of the ANT-maps. In our case the interest and power in the OIS-initiative. In addition, the snapshots allow us to introduce, put into play and disconnect actors to visualise change in the actor-network over time. Consequently, the effect of a new actor may be simulated and visualised in parallel scenarios (see Figure 2, alternative scenarios). In this way, we stay true to the nature of IS-research by allowing examinations of not only the technological system, or just the social system, or even the two systems side by side, but the investigation of the phenomena that emerge when the two interact (Lee 2001 p. iii).

Discussion: Acknowledging a Multifaceted Context

To successfully implement any strategic change, a thorough understanding of actors and their roles, as well as organisational routines and standards is called for (Hanseth, 2004). He argues that: “The network constituting a technological artefact includes its designers and their social context.” Thus, for any IS-initiative, the different facets of the social context become important. Subsequently, a narrative contains several dimensions that cannot be simultaneously captured by a model. Instead, the model is a visualisation of a certain perspective of the narrative, highlighting aspects and simplifying others. It means that the interpretation of the designers is important for the choice of dimensions presented. As found in the literature survey, most visualisations of ANT analyses, despite their descriptive value, do not deal explicitly with this issue. If contrasted and compared side by side, ANT-maps that depict the analysis of the actor-network while highlighting different perspectives of interest to the implementation initiative may better show asymmetries or imbalances of interests or powers inherent in the actor-network.

For the same reason, the importance of repeating the analysis becomes apparent, as the introduction of a new actor or the reconfiguration of the network may change any previous status of the actor-network. Over time, the vectors show how management needs to focus the efforts to create enrollment, for example the process of translating actors to commit to the implementation initiative may be highlighted and subject to strategic activities. In addition, continuous development and learning in the organisation may be supported. In this way, the translations and transductions occurring in the network may be highlighted. It should be noted, however, that as each ANT-map represents the narrative at a selected point in time, the trajectory is not a continuous model of the case, but a series of snapshots chosen by the interpreter. Still, they may be used for visualising the underpinnings of resilience (or lack thereof) of a particular IS-initiative. Shown by Regester and Larkin (2005), early identification of these issues is vital, as the possibilities for remedying the consequences of the issue diminish with time, while resource spendings increase.

As noted above, a common reason for using ANT in IS is the support for modeling technical artefacts as part of the actor-network. However, as pointed out by Hanseth (2004), in accordance with the intentions of Latour (1999) the focal point of ANT is the transformations of the network, which transcends the use of ANT solely for sociotechnical actors. Hence, ANT also allows for the inclusion of any element within any sphere of interest related to the actor-network. Consequently, as a demonstration of its generic, precise and well-defined properties, the vocabulary of ANT-maps supports such visualisation. As a result, in contrast to the approaches presented in the literature study, as an example (see Figure 2) we can visualise the transformations of a vision into its realization as a separate actor, the Collaborative Web – a sociotechnical artefact, while still representing the original vision as an actor. Furthermore, we are also able to simultaneously visualise both actors influence within the actor-network. In this way, the visualisation of the actors, i.e. both the inscriptions of the vision and how well the system inscribes the vision in the

other actors of the network may be highlighted. This visualisation may be used to support a joint discussion of goals and further joint dialogue on challenges, barriers and priorities among stakeholders of a change project.

Conclusion and Future Work

Our contribution, for the purpose of furthering the dialogue on challenges, barriers and goals in various contexts of IS-implementation initiatives, is the ANT Maps - a visualisation approach for ANT-analyses of socio-technical systems. We opt for a common vocabulary for describing and discussing their processes. Our intent is to suggest a means of visualisation that aligns to the ontological tenets of ANT. Addressing a gap in existing visualisation approaches of ANT, we developed a generic, precise and well-defined vocabulary that directly maps to established ANT-concepts. Managers and IS-researchers could draw upon these for the investigation of potential and current sources of influence of actor-networks and their impact on (other) aspects of particular spheres of interest.

Furthering visualisation approaches in IS in line with the original intent of Latour (1999), by plotting matrices as a series of transformations over a timeline, our approach emphasises the dynamic nature of actor-networks as the ANT-map forms a trajectory in time. In this way we are able to visualise actor interaction, changes in the actor-network and to show such changes in relation to the IT-artefact, a corporate vision and other non-human actors. This highlights the lack of resilience of IS-initiatives, which in turn may be understood and subsequently addressed before resources have been unsuccessfully allotted and spent. These findings need further validation, by extended studies on their usefulness in various IS-implementation settings. As part of ongoing work, ways of utilising the two-dimensional matrices to highlight different perspectives and values are investigated. In addition, usability issues of the visualisation approach and the ability to highlight competing but equally valuable dimensions e.g. sustainability impact and corporate strategy implementation need further scrutiny.

Limitations

Does the fluid reality of a sociotechnical phenomenon lend itself for formalisation? Naturally, the reality is too complex to capture in its entirety. However, as ANT is employed in IS-research, our approach may be seen to hold some merit as the matrices may be employed for visualisation of a commitment expressed to a certain vision, value, goal, specification, process of a system or activity. As a complement of a written narrative, in itself a formalisation and partial model of the state of affairs, thanks to its common vocabulary, the ANT-maps directly maps to established social theory, while adhering to its ontological underpinnings.

The interpretation of the empirical material originates from the views of the authors. Although the symbols of the visualisation language, to a large extent are acknowledged in adjacent fields, the notation presented does not capture the rationale of the actors that underlie the depicted events. As the visualisations are thought to be a complement to the written presentation of the narrative, the ANT-maps depict a state of affairs based on the narrative. Hence, the motivations of the actors are not visible in the visualisation. However, the visualisations may serve as support for discovering differences in the goals and motivations within the actor-network.

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