MATERIALITY AND ORGANIZING: ACTOR-NETWORK THEORY REVISITED

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Introduction

Information technologies (IT) continue to enjoy a ubiquitous presence in organizations of all kinds, and researchers have become increasingly interested in their economic and social consequences. For many, IT is accepted as the key enabler of transforming business and government enterprises from hierarchical, industrial-age designs to contemporary, information-age designs (Davidow and Malone, 1992; Hammer, 1996; Kalakota and Whinston, 1997). For others, IT's relationship to organizational transformation is more complex and therefore deserving more careful scholarly investigation (Sauer and Yetton, 1997; Arumugam Malar et al., 2019).

Two recent developments have ensured the continued relevance of research on IT's organizational consequences. First, IT applications have become more complex and more tightly integrated, so their organizational consequences are potentially more pervasive. IT's pervasiveness is often manifest in large, integrated databases that can serve the same data anywhere in an increasingly expansive network (Lyytinen et al., 2000; Jonsson et al., 2018). For example, enterprise systems use centralized, on-line data to integrate business functions across organizational and geographic boundaries. Similarly, data-analytic tools exploit "big data" resources and artificial inference algorithms to

produce metrics capable of driving organizational decisions at both high and low levels. Precursors such as on-line analytic processing (OLAP) allowed users to access data at varying levels of specificity by "drilling down" into complex data and create dashboards and other support tools. Such capabilities have expanded given the abundance of data from sources like social media and data mining tools to exploit them.

Second, IT has moved far beyond the realm of private enterprise to become pervasive in public organizations, as services under governmental control are pressured by competition from private enterprises to become more efficient and "businesslike". Understanding IT's consequences for public organizations is significant because public organizations are large employers in most societies. Perhaps more importantly, the quality and efficiency of public services affect virtually all community citizens, suggesting opportunities to leverage IT to enhance education, healthcare, public safety, and overall quality of life.

Given these developments, our purpose was to investigate the organizational consequences of an OLAP tool in the municipal government of Umeå, a city in northern Sweden. We used Actor-Network Theory (ANT) (Callon, 1986a; Latour, 1987; Latour, 1992) because it regards organizational change as an emergent process and focuses explicitly on the properties of technical artifacts. These are important criteria for contemporary theory in IS, as described in the following section. Recent efforts to investigate human-material interactions have suggested that we should account for material affordances – ways to enact objects which are constrained or afforded by material characteristics (e.g. Cecez-Kecmanovic et al 2014). This highlights the agentic role of materiality, or the ability to "make things happen" (Leonardi et al., 2012). However, despite attempts to open the black-box of digital artifacts scholarship has paid little attention to the role of these material practices. Given this lack of materiality

considerations – and the lack of consideration of its agency, most importantly – we suggest that an ANT lens might shed light on how organizational knowledge is created in an IT implementation context. Adopting this view involves a consideration of material agency (artifacts that "make things happen"). The vocabulary provided by ANT introduces possibilities for examining the interplay between social and technical elements over time. Our analysis draws attention to the successive enrollment of actors within the municipal organization and to the modifications of the OLAP tool over the course of the project. Although the modifications made the tool more attractive to different actor groups, the data base underlying the application remained unchanged and shaped a more economic, cost-based approach to public decisions.

IT, organizational change and actor-network theory

Although research on IT and organizational transformation has been pursued actively since the 1950s, results have not supported a simple connection between IT and organizational change. While IT remains firmly associated with the agenda of organizational transformation in professional rhetoric, the research literature suggests a more complicated pattern of findings. Several critical reviews have advocated the study of IT's organizational consequences as an emergent process rather than deterministic outcomes (Kling, 1980; Markus and Robey, 1988; DeSanctis and Poole, 1994; Robey and Boudreau, 1999). In contrast to deterministic causal arguments, emergent causality suggests no necessary causal relationship between IT and organizational change. Rather, IT and organization can be seen as aspects of social structure that are mutually implicated (Orlikowski and Robey, 1991; Orlikowski, 1992). In contrast to variance theory, which conceives of social change as outcome variables caused by antecedent

variables, process theory regards social change as an indeterminate outcome of a temporal sequence of events (Markus and Robey, 1988). Process theory constructs an explanation around the sequence of events that leads to a particular outcome, thereby drawing greater attention to the dynamics of IT-related change.

Research on IT and organizational change has also been challenged to demonstrate the relevance of IT artifacts (Orlikowski and Iacono, 2001), resulting in the subsequent launch of streams of research committed to investigate the materiality of technology (Leonardi and Barley, 2008; Leonardi et al., 2012). Prior research in both IS and organization theory can be criticized for theorizing technology so abstractly that its material aspects are neglected (Robey, Anderson, & Raymond, 2013).

In this study, we used ANT as a coherent frame that helps to focus directly upon emergent social processes involving technology and organizational change. According to ANT, human and non-human actors are linked together in a web of relationships referred to as an actor-network. Within an actor-network, the interests of various actors are translated and inscribed into technical and social arrangements. Through the processes of translation and inscription, actors' heterogeneous interests become aligned and embedded into technologies that stabilize the actor-network, at least temporarily (Callon, 1991; Akrich, 1992). Once stabilized, an actor-network may become seemingly irreversible and thus resistant to further translation (Callon, 1991).

Applied to field studies of IT, ANT guides the investigation of networks of people, organizations, software, and hardware (Latour, 1996a, b; Walsham, 1997). For example, Walsham and Sahay (1999) analyzed the development and use geographical information systems (GIS) in district-level administration in India. Their analysis showed that none of the districts studied had created stable sets of key actors with aligned interests related to GIS. Consequently, the tension between the Western developers who initiated

the technology and the local Indian setting remained, and the GIS was not adapted to the local settings. Walsham and Sahay's study was a good example of ANT's principle that social and technical stability resides in the mutual dependency between technological properties and social context. This is also evident in studies of how technology designers negotiate between heterogeneous interests in creating new technologies (Mähring et al, 2004; Norén and Ranerup, this volume). It has become increasingly apparent how new technologies, rather than formal or informal organization, plays a key organizing role in today's organization (Lanzara and Morner, this volume). To this end, ANT provides us with a vocabulary with which to better understand technological agency.

With its focus on actions within an actor-network, ANT stands in sharp contrast to theories of technology diffusion (Holmström and Stalder, 2001). Diffusion theory describes innovation as a process in which definable factors affect the decision to adopt or not to adopt a particular technological artifact. Diffusion models assume that the technologies themselves are immutable and that the adopters retain their basic identity following adoption. By contrast, ANT regards the technological artifact as being moved and changed by social actors who are engaged with it. Actors not only reshape technologies but actors themselves change as the changing artifact spreads through a social network. Thus, one of ANT's central principles is that nonhuman technologies also become actors in actor-networks.

In addition to ANT's principle of nonhuman actors, two concepts most relevant to the present study, *translation* and *inscription*, are discussed in detail below.

Translation is the process of negotiation whereby actors attempt to influence others to accept renditions of problem definitions and potential solutions as valid and legitimate (Callon and Latour, 1981). Translation includes four distinct subprocesses: *problematization*, *interessement*, *enrollment*, and *mobilization* (Callon, 1986a).

Problematization is an initial stage in building a network in which certain actors position themselves as indispensable resources in the solution of problems that they have defined. In problematization, initiators attempt to impose their definition of a problem and their suggested solution on other actors. Initiators not only define the problems and solutions but also establish roles and identities for other actors in the network. Through problematization, initiators establish themselves as an "obligatory passage point" (Callon, 1986a) for problem solution.

Interessement encompasses a variety of strategies and mechanisms by which initiators attempt to enroll other entities. At a general level, interessement involves "actions by which an entity attempts to impose and stabilize the identity of other actors it defines through its problematization" (Callon, 1986a: 207-8). Interessement includes locking new allies into place and cornering entities not yet enrolled. Callon noted that successful interessement "confirms (more or less completely) the validity of the problematization and the alliances it implies" (1986a: 209-210).

Enrollment is a set of strategies in which initiators seek to convince other actors to join them in a multilateral political process. According to Callon, enrollment:

> …designates the device by which a set of interrelated roles is defined and attributed to actors who accept them… To describe enrolment is thus to describe the group of multilateral negotiations, trials of strength and tricks that accompany the interessements and enable them to succeed (1986a: 211).

Motivation is central to enrollment and is emphasized in what is termed "ideological control", which occurs by influencing actors' current evaluations of reality and instilling notions of more desirable states and how to reach them (Brunsson, 1985; Czarniawska-Joerges, 1988).

Mobilization is a set of methods that initiators use to encourage the allied actors to act, and the spokespersons to represent their constituents properly. With allies

mobilized, an actor-network attempts stability. A successful stabilization of a network implies that its contents are "black-boxed", that is, no longer questioned, and in time even institutionalized and taken for granted.

Through *inscription*, actors embed their social agendas into technical artifacts such as information systems. As inscriptions become stable and routine, they are less likely to be challenged or questioned at a later date. Social meaning can be inscribed into virtually any material or medium including formal discussions, public declarations, texts, and technical objects (Callon, 1991).

Information systems are especially interesting material for enrolling in an actor-network. As non-humans, they can be used as delegates for particular interests, authorized to "stand in" or "speak for" human actors (Bloomfield et al., 1997). In contrast to inscribed material that is available for public inspection, information systems are usually complex enough to hide decision processes from view, thereby concealing the way that social interests are represented. In effect, the software routines in IT applications can become "frozen organizational discourse" (Bowker and Star, 1994: 187). As frozen discourse, inscriptions that are embedded in computer software may resist change and display properties of irreversibility (Walsham, 1997).

In sum, ANT views social change as a gradual process that is initiated and guided by actors with specific interests. Their agendas for social change are enacted in translation and inscription, processes that allow to enrol other actors, even those who might originally stand in opposition to the new agenda. Through inscription, the promoters of social change hope to achieve stability and control over the actor-network. As the premises for decisions become inscribed in material artifacts, particularly information technologies, those artifacts assume the role of actors in the network.

Study site and the studied object

The site of our study was the municipal government of a city in northern Sweden with about 120,000 inhabitants. The accounting department in City office promoted the "Powerplay" project with an aim to make accounting procedures more “professional”. Powerplay is an OLAP tool from Cognos Corporation that provides multi-dimensional views of data. The customized data models in Powerplay are called cubes. Users employ a graphical interface and Powerplay’s transformation server to build cubes incorporating dimensions like time, services and location, and measures like revenue and costs. The transformation server, running on UNIX or Windows NT, populates the cubes with data drawn from a central database. Powerplay’s functions allow users to “drill down” to identify the causes of indicator values, to “twist and turn” information by bringing new dimensions of interest into a report, and to filter by restricting views to particular information in a report. All information in the system was financial, and the system was expected to impact the organization by making organizational members pay closer attention to economic issues in their decisions.

Powerplay was introduced early in Year Two, and by the end of Year Four three versions of the application existed: the client/server version, the Intranet reports, and the light version. For each of these versions, the information core remained the same. The client/server version was deployed so that users in different departments could adapt it to their specific needs. The Intranet reports were promoted to allow politicians and municipal man- agers to access financial data more conveniently. The light version was released in September of Year Four and became popular among municipal managers and staff at the operational level. The light version was designed to serve as an early warning system, for example, by showing budget deficits in red.

The first author met the initiators of the Powerplay project in December of Year One. He subsequently met three other groups of actors who eventually became enrolled in the actor network. These groups included department controllers, technicians, and politicians. Engagement in the field lasted 36 months, ending when Powerplay was implemented in December of Year Four.

Interviews and direct observation were the techniques used in the fieldwork. Interviews were conducted in two phases. The first phase occurred after respondents had been informed about Powerplay but before they had used it. This phase focused upon organizational members' expectations for the Powerplay application. The second phase was concerned with organizational members' actual experiences with Powerplay. Because different actor groups came into contact with the application at different times, interviews were scheduled as soon as the people had used the application. Interviews were conducted, transcribed and coded in Swedish. The translation to English took place after the coding and analysis as part of the preparation of the initial research report.

Seventeen interviews were conducted in the first phase and eighteen in the second phase. The same people were interviewed in each phase with the exception of one additional interview with a controller who began extensive work with Powerplay in phase two. Moreover, three people left the organization after the first interview phase, so their replacements were interviewed in the second phase. All interviews were taped and transcribed prior to analysis.

Direct observations were a crucial element in this study, as observing actors' behavior enabled us to engage in more effective discourse with organizational members. People from every actor group expressed interest in continuing discourse on issues concerning IT and organizational change, which allowed us to learn more about actors'

concerns. Field notes were written immediately following such discussions. The first author also observed meetings and training sessions that involved multiple actor groups.

Transcribed interviews and field notes were coded initially to identify three broad themes: nature of technology, technology strategy, and technology in use. These themes served as a useful starting point because they represent views on technology perceived by different organizational actors, such as technology promoters, managers and users. As initial coding categories became filled with coded text, sub-codes were created that reflected more detailed themes within the basic categories. Because data were collected at different points in time, it was also possible to trace the processes of translation and inscription emerging as negotiations among actor groups.

Tracing the actor-network

Introducing Powerplay

In the contemporary global economy, many public organizations have felt pressure from market competition and its demands for organizational efficiency. The policies of Sweden's social democratic welfare state have been challenged by the spread of capitalism throughout the world, and Swedish municipalities have decentralized and initiated administrative reforms with partial success (Brunsson and Olsen, 2018). Most municipal organizations have also formulated an explicit IT strategy and invested heavily in IT. In the City, the municipal organization had problems maintaining its services as costs escalated during the previous decade. Like other cities in Sweden, the City looked to IT applications such as Powerplay to make municipal administration more efficient. Figure 1 traces major events describing the introduction of Powerplay into municipal administration in the City.

December Year One	A member of the accounting department assumes the role of manager of a new project to establish a new IT application for presenting and analyzing financial data.
Spring Year Two	Department controllers learn about the Powerplay project in one of the accounting meetings.
Summer Year Two	Initiators contact a local consultant to demonstrate Powerplay and to help build the first cube.
April Year Three	IT manager proposes to the city political leaders that the Powerplay project be pursued. The politicians formally decide to support the project.
September Year Four	The light version was released and became popular among municipal managers and staff at the operational level.
November Year Four	Powerplay used as the basis of economic discussions in the municipality. Groups who had not been involved with the development of Powerplay explored the application.

Figure 1. Major events in the development of Powerplay

Translation

Problematization

The Powerplay project was initiated in December of Year One, when a member of the accounting department assumed the role of manager of a new project. At an accounting meeting with department controllers, he briefly described a project to establish a new IT application for presenting and analyzing financial data. The project manager represented a group of five people from the accounting and personnel departments. They had identified two problems in the municipal organization that they characterized as pervasive: untimely information for decision-making purposes and information

overload. New IT, in the form of the Powerplay application, was proposed as the key to solving both problems.

Just as new technology was defined as the solution to a problem, so was old technology implicated as the problem's cause. The existing financial accounting system, named Macs, had been used for a decade and was judged by users to work well as a database. However, the initiators felt that Macs lacked the ability to generate reports and to aid analysis. Macs produced only ordinary data lists, which were hard to interpret by people without financial training. In order to extract information from Macs in a form that could be presented to a decision maker, one had to import it to another software application, such as Microsoft Excel, which could then produce a useable report. In Powerplay, the initiators sought a technology that would aid the work of financial analysis and presentation.

One key to problematization was the insistence that the need for Powerplay was widely shared in the organization, even before it was formally introduced by the project manager. A member of the initiator group explained it as follows:

> I think that there are many persons that have discovered this at the same time, and after discussions have stuck with the idea. People have been to exhibitions and presentations and have discovered this and found it to be OK, checked it with experts and maybe been able to confirm that this will be suitable and have had some description that suggested that this is something that really will give some flexibility. (I2a[1])

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[1] The people interviewed are identified as follows: I for initiator; PDC for positive department controller; SDC for skeptical department controller; T for technician; P for politician. Each person is also given a specific number. The distinction between the first and second interview for each numbered person is noted with ""a"" and ""b"" respectively. Thus, a quotation from P2b is a quotation from politician number 2 in the second interview phase. The first author conducted a total of four interviews with the project manager. These interviews are labeled I1a, I1b, I1c and I1d. The people who were replaced before the second interview are T1, P3 and SDC3.

This wide interest was related to the increasing demands to review depart- mental activities and to explain and control budget variances. Moreover, a political directive in April of Year Two to begin "personnel accounting" meant that each department needed to produce status reports on its personnel, including the numbers on overtime, on leave, and other categories of employment. This information was not easily produced with the old system.

Although promoting the idea of widespread acceptance of Powerplay, initiators preserved their strategic position in the actor network. In the summer of Year Two, the initiators contacted a local consultant to demonstrate Powerplay and to help build the first cube. The consultant was used only to start up the project, and the initiators managed application development after the consultant left. Initiators wanted to learn necessary details rather than relying on an external consultant. The initiators also wished to avoid defining Powerplay as an IT project, which would have placed it under the control of the IT group. To separate Powerplay from the IT office, the initiators portrayed Powerplay as a new kind of technology, needed by every department in the organization.

> It was we, really, who said that we need this tool and we don't want to call it management information. We see it rather as a tool for analysis and thus we started looking at it. (…) The IT office (…) maybe thinks about this as some kind of management information tool (…) but this has come from us. (I1a)

Thus, the initiators portrayed Powerplay as an indispensable technology and established themselves as the obligatory passage point in the actor-network for obtaining that technology (Callon, 1986a).

Intressement

The initiators next defined roles for other actors in the network such that they would also align themselves with the problem's definition and solution. The project manager articulated a vision in which various actors would play specific roles, allowing the initiators to shape the application to meet specific needs.

> The vision I have right now, and this will depend a little on how we will continue with this, but nevertheless, what we will do as soon as things get more clear with what approach will be chosen and a structure is clear and that there is a "go" from the politicians, is to have an external consultant who knows Powerplay well to educate all critical department controllers — there's about 20-30 of them — during a day where information and training on Powerplay will be provided. We might be forced to divide them into smaller groups, but it is important that everyone gets the same information and then when you have had your training you will get access to the application and can work with it.
> You need to have made the deal and have purchased the application so that it is all installed and ready. Then we need to have a group where we meet and discuss this application (...) what we have understood and not understood concerning use but also future development. (I1a)

From the outset, initiators identified the actors (consultants, controllers and politicians) to be aligned, the specific mechanisms for enrolling them, and the chronological order in which the actors should be aligned. The consultants were needed to educate the department controllers, who would become the primary users of Powerplay. Politicians were needed to provide resources to develop the IT infrastructure. The initiators' vision also identified specific mechanisms (training, IT infrastructure, meetings) to enroll each group of participants in the actor-network. The department controllers were identified as the first actors to enroll, and it was decided that their interests could best be satisfied with a client/server version of Powerplay. The interests of other actors, such as politicians and municipal managers, could be met with reports made accessible over the Internet.

Enrollment

The department controllers' official assignment was to serve politicians, department managers and civil servants with statistical and financial information to support decisions. The accountants produced the overall budget and conveyed it to the controllers who worked on the budgets of their particular departments. The work was similar in most departments, but three sub-municipal departments were different. While a municipality was normally organized vertically within different sectors, those working in smaller municipal sub-units worked across specialties. We identify the controllers of the municipal sub-units as "skeptical" department controllers to differentiate them from the "positive" controllers in the larger departments.

The initiators took advantage of the existing dialogue between the accounting department and the department controllers. The project manager described this relationship:

> When it comes to the budget, we have always had a pretty good contact between the department controllers, who mainly work with closing of the books, accounting, also budget work in parts, and us at the accounting department. (…) And it has come to the point where we preach and they listen and, hopefully, do as we say. (I1b)

During the spring of Year Two, the department controllers first learned about the Powerplay project in one of the accounting meetings, which were held on a regular basis between the accounting department and department controllers. The controllers from the larger departments were positive about Powerplay because they shared a feeling that the project had a strategic vision behind it, something that had been lacking in the past.

> Yes, we are really happy about them working with the same system so that we can work together. We have wanted this for a long time so that they can understand our needs. But, I don't know, it doesn't feel like they have so far. But now we are heading in the same direction and this is really nice, to be able to work together. (PDC1a)

The interests of the positive department controllers were quickly aligned with those of the initiators. They regarded the client/server version of Powerplay as a complex technology that could enable them to explore economic data in greater detail. One controller emphasized the importance of adjusting the application to the specific needs of each department:

> It is a system that can satisfy all levels of the organization. A caretaker at a daycare center should be able to take out the reports she is interested in with her web-reader and maybe be able to drill down and find out why things are the way they are without having to wait for some data sheets to come with the internal mail two weeks after the end of the month. (PDC1a)

Although Powerplay was seen as a faster and more flexible application than those previously used, it was also seen as more difficult to use. Thus, the positive department controllers wanted training to be included in the implementation of the application:

> Well this has to be done in different steps as I see it. Because first of all, we here at city hall, we need to know the system and maybe need to know how to build these cubes and create reports while there maybe is only a query function for those further out in the organization where they cannot create the cube but can go in and look at the figures (...) So there will be different types of education efforts. I'm sure about that. It has to be that way. (PDC2a)

The positive department controllers also emphasized that a basic understanding of accounting and financial issues was needed to interpret financial data. To them, an easy-to-use system could be a dangerous tool in the wrong hands, particularly those of politicians:

> I have always said that there is a risk that the technology develops at such a speed that the craftsmanship behind the figures runs the risk of disappearing. So I have been a bit against politicians being able to sit at home and take out the figures on their screens. Because I know that…it might look like 28 million in the accounting, but with the knowledge that we have we know that we won't end up there in the end of the year. (PDC1a)

The skeptical controllers at the municipal sub-units did not believe initially that Powerplay would be useful, and they criticized the way that it was presented to them.

> I think they do it badly at the accounting office, and I've said that to [the project manager] too. You're supposed to understand everything all at once. We get information overload. I mean, if you have a meeting from 8:30 to 12, for example, and then you're supposed to go through a number of items on the agenda, then you're already tired after two hours. You don't listen. (SDC1a)

Skeptical department controllers also had mixed feelings about the prospect of IT being central to their daily activities, but they accepted the requirement to use the new technology:

> It's with mixed emotions, mixed emotions. …Take the home service assistants, the ones who've been trained to manage the health care assistants, 30-40 assistants, and they get support from a few administrators centrally. You know when you've been through it yourself and been a manager for a group of health care assistants who are difficult. That's how you see it when you're tired of it all. To sit there on your bum and learn about new technologies. It's fun but that isn't what I was hired to do. (SDC1a)

Skeptical department controllers were eventually enrolled in the actor network because they believed that Powerplay had potential and were resigned to using it as the only reasonable alternative. Using a more advanced tool would allow them to analyze their budgets more effectively and to understand better why one department had a shortfall of money while another department had a surplus. Although some confessed a weak knowledge of IT, they accepted its importance to the municipality.

The technicians at the IT office were the designated experts on IT in the municipal organization and were involved in IT planning as well as mainframe and desktop operations. In the Fall of Year Two, the initiators recruited the technicians to influence the politicians to support the Powerplay project financially. The initiators feared that the politicians would not share the vision behind the project because of the costs involved with new technology. Requirements included a web-based solution that would necessitate Internet access for all persons with decision-making responsibility. Consequently, a potentially large outlay of funds might be required. Because the IT manager was well connected with the politicians, the initiators could use the technicians to lay the groundwork for their subsequent enrollment of the politicians.

In the Powerplay project the IT office only worked on issues defined by the initiators. Even though the municipal organization had its own IT office, the unit or department in need could contract any consulting firm to handle its IT problems. The IT manager explained:

> You're allowed to contract consultants. In principal, they can do what they like. (…) We naturally have a certain role, primarily in the base system since we have the machines. We serve as consultants. So obviously it is important how we view things, but the administration has considerable freedom to do what they like. There is no heavy-handed central control from any group. (T1a)

The key to translating the interests of actors in the IT office to be supportive of the project rested with the superiority of the new web-based IT infrastructure adopted for Powerplay. There were, technicians argued, no good alternatives to Internet-based technologies:

> Yes, the classic client-server technology, I see it as on its way out. It's old fashioned. It's too difficult to keep track of what is on all the different clients. So we want to have as thin a client as possible. (T1a)

As they saw it, there was too much work connected to client-server applications compared to the low maintenance costs of Internet-based applications. Easy access also favored the newer technologies. Thus, technicians aligned with the initiators' vision and its business value and technical superiority: "They need a powerful tool to be able to combine information quickly, get new information or combine the information in a new way" (T2a).

In April of Year Three, the IT manager proposed to the city political leaders that the Powerplay project be pursued. The politicians formally decided to support the project on the same day. The estimated cost for the project's implementation was SEK 450,000 (USD 52,100), but it was emphasized that this cost covered only the purchase of the software and that additional costs related to building the infrastructure would be necessary.

The initiators, by this time, could demonstrate that the application indeed was working because it already was being used at the social service department, the technical office, and the school department. They had enrolled the IT office and received support of a formal proposal. Ongoing political support was needed, however, to ensure that financial resources would continue to become available for the project.

Although department controllers were seen as the key users for the application, the politicians were also seen as important users and the key decision-makers in the organization. The initiators' idea was to make financial data available to the politicians by putting it on the Intranet on a regular basis. The plan was to refine their financial routines to perform accrual accounting every month, which meant that there would be a monthly balancing of the books. According to the initiators, that would provide a much better a picture of departmental performance, one that was updated quickly and accurately and available to relevant parties. This financial data would not be based on projections, as

before, but rather on actual data. The politicians had asked for this and a better technological infrastructure prior to the Powerplay project. In addition, the politicians had asked for access from their homes to crucial data.

Although they had originated the idea and enrolled the other actors in the network, the initiators continued to describe the Powerplay project as a joint effort involving many actors and as a part of the IT office's strategy. It was important, the initiators felt, that the politicians did not see the Powerplay project as something that the accountants had initiated. To ensure a favorable perception, the initiators framed the politicians' decision as an economic choice between client/server and web-based technologies. The initiators favored a web-based version because it would provide access for more people in the organization, be easier to maintain, and cost less. However, they advocated the client/server version for the department controllers to ensure faster implementation. The Internet was seen as the appropriate platform for the versions for the politicians and the municipal managers.

Politicians were already disenchanted with the existing reporting system, and they saw value in a system that would produce more timely and accurate information:

> I don't want anything like this [holds up the printouts from the latest financial report]. I want an agenda and then a one-page summary on what it's about. I don't want these thick stacks.
> Sometimes I've seen the same paper sent out several times. Here, this came out today, the municipal executive board's papers. And I've seen many of these as attachments and everything several times. That's why we decided to streamline how we handle things. (P2a)

The politicians also emphasized that information had to be available and comprehensible to the general public. That meant it had to be presented in such a way that non-experts could understand what was written. The municipal organization was required to make information publicly accessible, so the politicians were concerned about ways to present the

information that the public considered useful. In this regard, the politicians saw Powerplay as an important project for improving the quality of the local democracy.

> It's important that the citizens are able to see how tax money is used. Today the budget and the operational plan are public knowledge, but it's a matter of continually working to make this more accessible to people. (…) You shouldn't have to be an accountant to understand when they're talking about financial numbers. (P4a)

> Yes, I think it would be good for democracy if as much information as possible were available to those who are interested. (…) But it still has to be easily understood, maybe even more easily understood, when you see the key ratios and so on. (P3a)

The politicians' primary concern was increasing the ability to explore the ways to accomplish more work of higher quality with less money.

> Yes, I see where it can streamline certain areas and improve the quality in other areas. (…) In our budget with nearly SEK 1.5 billion, if we use one percent of the money badly, that's SEK 15 million. And that's a lot. And instead of having done badly with one percent at the end of the year, we'll see how things are going after four months. (P1a)

Different versions of Powerplay were developed in the Fall of Year Four to provide this reporting capability to groups who had not yet used it. An initiator explained how Powerplay was being used in the social services department, the technical department and the school department:

> And they use this in their normal work, follow-up and so on. So it has actually gained a concrete meaning now. (…) And it is beginning to spread to other areas now that we have some positive examples to point to and people who support this. (I5b)

As this interest spread, Powerplay continued to exist in several different versions. The client/server version continued to be the version used by the department controllers,

and by the Fall of Year Four had become an integral part of departmental routines. The politicians were given access to Intranet reports, where the central economic developments were outlined with no possibilities to explore the data in detail. In a similar vein, the municipal managers were given access to the light version of Powerplay. The Intranet reports and the light version both gave the users an accurate and timely view of economic developments, permitting decisions to be made with better information. Although the various versions differed, their presence uniformly shifted discussions and debates toward economic criteria.

Mobilization

The final process in the translation of actor interests is mobilization, where translation is complete, actor interests are stabilized, and controversy is removed. Mobilized actors are committed to a common course of action. There is considerable evidence that actors were mobilized to fulfill the interests articulated in the initiators' main vision. IT managers were proposing budgetary support for Powerplay to the politicians; politicians were funding the project and becoming active users; department controllers were deploying Powerplay within their units; and municipal managers were active users of the light version. The different Powerplay versions were resources for the initiators because they stood in and spoke for them in a great many contexts. Thus, the actor-network became seemingly stabilized and no controversy surrounded Powerplay within the organization.

Inscription

Powerplay effectively became the medium for inscribing social change in the way the municipality would be operated. Although the impetus for a more market-driven local

economy originated outside the municipal organization, the adopted IT application became the mechanism for embodying the social agenda of greater financial accountability. This was the envisioned impact, and this is the impact that was realized. Although different versions of the application allowed the enrollment of successive actor groups, the inscription was not materially affected by the production of different versions.

Although it appeared to the actors that their particular needs were accommodated with the versions that they favored, the social agenda was deeply inscribed through the dependence on common data and software routines supporting analyses. The accommodations affected the interface and degree of access for various users but did not affect the decision process or the data that informed that process. All different versions of Powerplay addressed the need for better financial analysis, which the initiators had defined as the problem to be solved.

In this capacity, Powerplay actively participated in the enrollment of new actors into the actor-network. As adaptations that were interpreted to serve new actors' interests, each successive version reached out to a new constituency to extend the network. In effect, the initiators authored a strong narrative (Latour, 1992b) associating their efforts to adapt the OLAP tool to the needs of multiple interest groups in the organization. In the present case, the narratives functioned as persuasive accounts, accepted by the enrolled actors, to explain how Powerplay was co-constituted. Such "modes of ordering" (Law, 1994) often portray technology as a persuasive actor in the network. The premises for decisions were inscribed in all Powerplay versions, which assumed the roles of actors to help the initiators stabilize and control the actor-network. Evidence of inscription was apparent for each of the groups in the actor network. Powerplay helped most of them to deal with financial pressures by providing the means

to analyze expenditures and to recommend cost reductions. From the initiators' perspective, using Powerplay addressed the problems of more timely information and information overload. The project manager stated:

> I believe I see that my own work and material that I produce is very different from what was done before. In the past I felt it was very difficult to work with those reports. Terribly difficult. I'm sure that others experience that too, but now I can customize reports and access information much more quickly. And I get exactly the information I'm looking for, as compact as I like it. I don't have to print 50 pages just to get the last line of information. (I1d)

Department controllers described Powerplay as a tool that provided more opportunities to reflect on financial issues and that yielded faster answers to their questions. The department controllers gained a better understanding of the consumption and generation of resources, and they were better able to identify discrepancies between budgeted and actual expenditures. Overall, the department controllers felt more actively involved when using Powerplay.

> Now, for example when the books are being done, I had great use of Powerplay when I was going to analyze things, to examine and rearrange the data. It would have taken forever to do this in the Macs database, to ask questions and summarize. (…) So I think we'll have more control of the accounting in this respect. (PDC3b)

The politicians also recognized the value of the new financial awareness:

> Yes, it's much better. And I think that's because we have a more structured discussion about what we want out of the different control systems. (P4b)

The inscription of financial analysis into the organization had stabilized by the end of Year Four. Its presence shifted discussions and debates toward economic criteria. For example, at the time of Powerplay's introduction a heated discussion surfaced concerning the relationship between the amount of resources consumed and the actual

accomplishments of the municipal organization. Although this debate involved issues that Powerplay could not address, Powerplay was accepted as the tool for producing analyses that informed the municipal departments as well as the politicians on economic issues. The project manager summarized:

> I mean, we've been fairly well off financially in the past, and this clearly led to not prioritizing the financial aspects. Now that Swedish municipal finances aren't doing so well, every decision is challenged. There is a risk that when everyone is upset about the finances and are trying to cut costs everywhere that decisions will be made that actually cause costs to rise in other areas. This enthusiasm for cutting costs quickly often results in badly thought out proposals. I think the better the information that is used to make decisions through tools such as this one and other management information tools, the better the decisions. That's the actual goal. (I1c)

Thus, Powerplay had helped to place municipal governance on a more rational basis and addressed the need to operate with fewer funds allocated from the central government.

Actor-networks and non-human agency

We have used ANT to analyze the organizational consequences of a particular application of information technology for financial administration in the municipality of Umeå, Sweden. There are still important gaps in our understanding of the particular role of IT's materiality in organizational practices (Leonardi et al., 2012; Mutch, 2013). This chapter generates new insights into how IT-enabled organizational change is an ongoing issue, which involves material artifacts, such as the Powerplay application in our case, which are also able to *d*o things. This approach implies a shift of focus from how organizational actors "use" material artifacts as tools, to how the human and the non-human are interlocked within everyday practices (Leonardi et al., 2012). Because

Powerplay afforded more detailed examinations of financial performance, it promised to increase the accountability of department managers to base decisions about social programs on economic criteria. Via inscription, discourse about financial matters in the municipality became "frozen" in the Powerplay technology, effectively shifting focus toward a cost-based rationale for decision making, in contrast to the previous emphasis on service (regardless of cost).

This shift in focus can be understood in light of ANT's treatment of technologies as non-human actors in an actor-network. Although technologies are created within the social realm, technologies also act back upon the social realm by regulating simple actions such as entering data into a computer. Latour (1988: 301) refers to "the behavior imposed back onto the human by nonhuman delegates" as prescription. Thus, Powerplay can be interpreted as prescribing the particular type of analysis in policy matters undertaken by the municipality. In this way, Powerplay became an active delegate, which spoke for the initiating accountants (Latour, 1996b).

Figure 2 represents the episodic character of actor translation by introducing the concept of "negotiation loop". The loop commences when an actor group formulates an *issue* as a specific *problem*. In our case, the initiators converted the issue of resource shortage into two problems: untimely information for decision-making and information overload. As the negotiation loop continues, actors propose a *solution* to the problem that they have identified. In the case, initiators proposed Powerplay, thus completing the problematization phase in Callon's (1986a) translation model. Following the proposed solution, the negotiation loop continues with *validation*, in which an actor group either validates the claim that the solution will solve the problem or invalidates the claim. The solution is either *excluded* or *stabilized* as a result of the validation exercise. In the case of Powerplay, actor groups did validate the initiators' claims and stabilization occurred.

Stabilization refers both to social stabilization (i.e. the acceptance of new values and norms) and technical stabilization, which was represented by the various Powerplay versions. Socio-technical stabilization, therefore, results from a successful negotiation loop. However, stabilization is temporary because the application may be renegotiated when subsequent actor groups are approached. Thus, the negotiation loop includes an arrow designating *new issues*, which leads into a subsequent negotiation loop involving another set of actors.

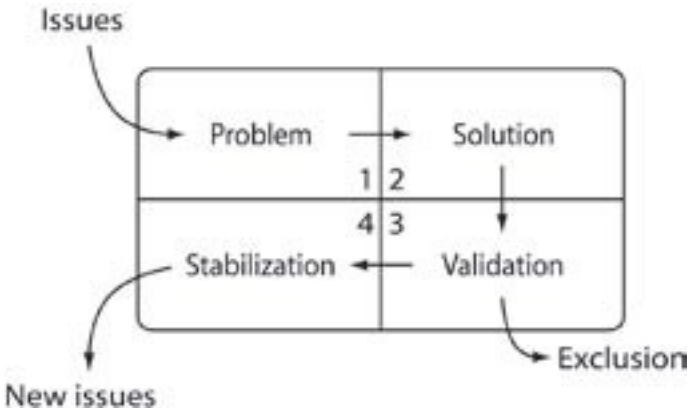

Figure 2. A negotiation loop

The concept of negotiation loops provides an understanding the way that technologies are shaped by actors, and how in turn actors are shaped by technologies. It reflects ANT's declaration that the world is full of hybrid entities containing both human and nonhuman elements, whose analytic separation is difficult (Latour, 1993). The stabilization phase of the negotiation loop is fundamentally both social and technical in character, and ANT deals with these relations simultaneously. Rather than "black boxing" the technological artifact, negotiation loops help to expose a network of social and technical relations to critical scrutiny. As Latour stated: "The fate of what we say and make is in later users' hands" (Latour, 1987: 19).

Although ANT often considers technologies to become immutable, subsequent actors may treat past solutions as new issues and formulate problems that are solved with modifications to or replacements of existing technologies. Given the greater "interpretive flexibility" of information technologies, such future modifications are relatively open to negotiation (Orlikowski, 1992). A seemingly endless progression of upgrades, new versions, and replacements characterize IT applications. Few systems seem built to last, so ongoing negotiations characterize software applications better than the black box metaphor.

Although our field study ended following the enrollment of politicians with the Internet version of Powerplay, the model invites speculation on possible future actors and modifications of the technology. In Umeå, we can anticipate a sequence of negotiations involving new actors not analyzed in this paper. For example, as department managers experience the daily consequences of using Powerplay, they may object to having their social programs evaluated on a more economic basis. As citizens discover that services are cut because they cannot be cost-justified, they too may exert their influence on future applications. These possibilities did materialize to some degree following the completion of our data collection. The manager of the social services department resigned, and some of the City's citizens protested in front of the City Hall in protest over the budget cuts. These and other issues could be analyzed using an extended series of negotiation loops.

Although conceiving of IT-related change as a series of negotiation loops accommodates the prospect of ongoing changes to both technology and organization, IT applications are not unlimited in their flexibility. Tothe contrary, earlier decisions on technical issues such as data structures, hardware platforms, and communication protocols can establish constraints that are not easy to change. Indeed, Powerplay was an

application whose core properties remained closed to negotiation. Regardless of the version deployed, discourse on financial issues invoked the new standardized vocabulary promoted by the initiators and inscribed in the technology. Policy disputes were subsequently mediated with the language of standardized key ratios and other analyses that Powerplay supported. The interests of the initiators, as reflected in their definition of the problem and its solution, were therefore preserved.

We have demonstrated the suitability of ANT for analyzing information technologies, which are ostensibly more mutable than the more tangible artifacts (e.g., automatic door openers and speed humps on streets) often studied by actor network researchers. Although the original vision was changed via translation, the underlying idea of cutting costs using Powerplay was never contested. Such mutations served the instrumental purpose of enrolling successive actor groups even though the basic functionality of the application permeated all versions. Thus, actors' interests were successfully translated into acceptance of the new agenda for managing the city's affairs. The success of a translation refers to the completeness with which actor interests are aligned, not to some objective criterion of value. If other actors deem their agendas inappropriate, translation and inscription may not be successful. Powerplay became an actor by amplifying the initiators' original vision and disseminating it throughout the organization. Rather than conceiving of social change as the result of implementing IT, therefore, ANT regards change as a social process in which IT can become one of the actors.

In conclusion, our study shows the value of understanding the network of actors implicated in the organizational consequences associated with advanced applications of IT. We regard IT's social impacts as indeterminate yet subject to strong social influences, as revealed in the processes of translation and inscription within an actor-network. We

conclude that ANT provides a valuable analytical lens through which to observe IT-related organizational change, and we await future studies that provide even sharper images of the role of IT in actor networks.

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