What do artifacts mean to us in work?

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Abstract

This paper illustrates how artifacts are active elements in the relationships of people and between people and their environments. This does not only mean that they are active in the sense that they are necessary, but also, active in a way that coordinate, and even trigger or initiate, work. The use of artifacts may over time become manifold and not necessarily just serving their initial purpose. Based on the artifacts' property various conventions grow around them and become resources that a community of practice relies on. To improve the understanding of work, these conventions or resources needs to be better understood – even if only to explain what work will be like without them. Concepts from 'Actor Network Theory' and 'Borderline Issues' are applied for analytical purposes.

Keywords: Artifacts, Documents, Work Practice, Actor Network Theory, Borderline Issues

Introduction

«If we took away my computer, my colleagues, my office, my books, my desk and my telephone, I would not be a sociologist writing papers, delivering lectures, and producing «knowledge». I'd be something quite other - and the same is true for all of us» (Law, 1992). No doubt artifacts play an important role in our lives and in our work practice. They are initially brought into our organizations for a specific purpose, however, their use may over time become manifold and not necessarily just serving the initial purpose. The artifacts in use are resources that the communities of practices rely on, however, some of these resources may be 'invisible' for designers or other outsiders. In work rules and conventions develop around the use of artifact over time, this gives them their local meaning within a community of practice (Brown & Duguid, 1994). In the process of design, these resources and conventions are easily overlooked due to their highly local establishment. Since, the design and development of artifacts go hand in hand with the development of work practices (Suchman & Trigg, 1991). By focusing on artifacts and our interactions with them resources are made visible, seen and talked about in order to inform design.

Two case studies are presented. The first case is from a news agency in Norway and the second from a health care institution in Sweden. Our research approach is built upon in-depth case studies as well as ethnographic studies. Interviews and observations have been applied in both studies. Both cases illustrate how artifacts, for instance fax machines, fax sheets, coordination forms, examination requests, different types of shelves and tables, as well as computers - interrelate and interact with people and how this

establishes recourses over time that the communities of practice rely on in the production of the desired results, i.e. TV schedules and radiological diagnoses.

We have observed that artifacts, such as documents have similar meanings and roles in spite of organizational differences. The news agency being concerned with TV information, faxes and schedules, whereas the health care institution deals with patients, medical records, images and image production technology. This contributes to the significance of our joint findings as well as to the richness of our stories to be told in this paper.

The aim of this paper is to analyze and illustrate *how* artifacts' unnoticed properties become important resources within communities of practices. This is done by focusing on how artifacts, depending upon their properties, are embedded into work. We try to reveal the meaning and importance of these resources from the point of view of those who use them. And, as Suchman (1995) pointed out the goal of making work visible for systems design is to develop more appropriate technologies from the point of view of those who will be using them.

Related Research

In systems design, it is common to consider artifacts as tools or media for human activity. When artifacts in general are viewed from the perspective of their use, they can both support communicative and instrumental activities, and they can mediate our activity towards other humans or towards 'objects' (Ehn, 1988). An artifact can augment and even replace individual or cooperative human activities (ibid.). Ehn (1988) has an Heideggerian perspective on artifacts, which means that an artifact, e.g. a hammer, belongs to the 'background', it is ready-at-hand without reflection in the carpenter's world. It must primarily be understood as a practical artifact that she uses in her everyday life, not as a thing or an object external to her. This perspective of artifacts is applied in research projects within the system design field where the issues are cooperative design of computer artifacts (see e.g. (Bødker et al., 1991)). The users are included into the design process based on the motivation that artifacts as such have no meaning; they are given meaning only through their incorporation into social practice (Ehn, 1988).

Investigations into work practices in operations and control rooms have uncovered the meanings of artifacts in some respects. For instance, in their study of an airport operation room Suchman and Trigg (1991) point out the important role of the paper sheets they use, and stress the difficulties involved in replacing this paper sheet with a computer based representation. Electronic representation has some benefits. However, computerized forms have their own problems; for example, they don't allow the same ease of document transfer (Ibid.).

In control rooms such as air traffic control rooms (Hughes et al., 1994), the London Underground (Heath & Luff, 1992) or the Paris Metro (Fillipi & Theureau, 1993), the co-location of workers allows them to observe each other and to monitor the work in progress. By looking at each other's radar screens as well as listening to colleagues' conversations, they improve their understanding of what is going on, and this is necessary for the workers to carry out their own work. These studies have shown that artifacts are important in the «understanding of the activity of the others, which provides a context for your own activity», defined as awareness by Dourish and Bellotti (1992). We stress this point by focusing on how different artifacts are introduced, arranged and co-developed over time within the work itself.

Brown and Duguid (1994) stress the artifacts' social and material aspects in the framework of their 'Borderline Issues', and Latour (1987), Callon (1986), Akrich (1992) and Law (1992) point to the artifacts' properties and features in socio-technical networks. These issues are elaborated further in the following section.

Conceptual Framework

In order to improve our understanding of artifacts in work practice, we apply some concepts from Actor Network Theory (ANT) (see e.g., Latour (1987), Callon (1986), Akrich (1992) and Law (1992)) and 'Borderline Issues' Brown and Duguid (1994). It has been important for us to find concepts that take artifacts seriously into account and make them explicit in social arrangements.

ANT recognizes that establishing and changing a social order relies on a tight interplay between social and technical means. ANT argues that society would not exist if it were simply social. Humans and things are regarded as 'equal', and are treated in the same way. ANT says that there is no reason to assume, a priori, that either artifacts or people in general determine the character of social change or stability (Law, 1992).

According to ANT, social settings or work practices are nothing but patterned networks of heterogeneous materials (Law, 1992). This heterogeneity emphasizes the significance of artifacts in work practices. The concept of network focuses on interconnections and relationships between humans and artifacts. The ANT's notion of inscription refers to the way artifacts embody patterns of use Akrich (1992). Inscriptions can be properties, i.e., features, characteristics, and possibilities inscribed in artifacts as well as meetings, institutional arrangements, skills, etc. How these properties are perceived depends upon the interpreter and her context. And, they shape the connections between different actors and therefore influence the actors' performance.

According to Brown and Duguid (1994) artifacts have both central and more peripheral properties. What is recognized as a central or peripheral property varies within different communities of practice. What Brown and Duguid (1994) define as 'Borderline issues' are shared resources that constitute a social meaning for a group of people. They are based on continuously presence of the artifacts in a community of practice. Continuity is needed in order to recognize the artifacts' properties, and community of practice is necessary for members to share, recognize and reformulate conventions (Ibid.). These resources are developed over time as artifacts are integrated into current practice and social conventions are developed. Communities of practices maintain the resources, and workers often rely on them (Ibid.). The importance of the peripheral properties often is unnoticed for outsiders.

We find the combination of these concepts fruitful. 'Borderline Issues' focuses on both central and peripheral properties of artifacts, while ANT support us in identifying these properties in work. Understanding and identifying properties in this sense is important because it illustrates how the artifact's properties are significant for its application, and how they are linked to humans and other artifacts in socio-technical networks. Over time, conventions will grow around the artifacts' peripheral properties and become resources in the socio-technical work practice.

Research Approach and Work Settings

The studies were conducted at a news agency in Norway, a company providing news services to the media - such as newspapers, magazines, radio and television; and in the radiology department of a hospital in Sweden. The radiology department is a diagnostic center at the hospital, giving service to all other departments within the hospital.

Our research approach is built upon in-depth case studies at the news agency and on ethnographic studies at the radiology department. Both studies included interviews and observations of work practices. The interviews can primarily be characterized as open-ended qualitative interviews. Totally, 23 interviews and 70 hours of observations were conducted at the news agency, while approximately 30 interviews and 40 hours of observations were conducted at the radiology department. Each of the interviews lasted from 30 minutes to 2 hours.

At the news agency, the production of TV schedules was studied. A TV schedule consists of information about TV programs and when they start. The production of TV schedules starts with the production of TV program information from each TV channel. The information is sent from the channels to the news agency on faxes. At the news agency the process continues with quality control, merging and coordination of the information, as well as typesetting of eight different types of schedules. It ends in a variety of weekly products to be delivered to various newspapers and magazines.

At the news agency there are 6-9 people working with the production of TV schedules the entire week. The information on the fax-sheets is entered into a mainframe system that keeps track of the program information for each channel every day of a particular week. The schedules are formatted in a desktop program on Apple computers and delivered to magazines and newspapers by use of ftp. All of the employees perform the entering of information into the system as well as the formatting of schedules.

Once a week newspapers and magazines have TV supplements for the following week. However, which days this week covers vary from newspaper to newspaper and from magazine to magazine. Some offer a week lasting from Sunday to Saturday, while others present it from Monday to Sunday, according to the day the supplement is published. The huge amount of faxes, the different time frames for different publications, as well as the various types of schedules, make the coordination of work quite complex within the agency. A coordination form is applied in order to deal with this complexity.

The radiology department is a service unit, carrying out radiological examinations for clinical departments inside the hospital, other hospitals and primary care units (general practitioners). The radiology department supplies radiological opinions on, and interpretations of, radiological images ”delivered” to clinicians by means of reports and meetings. The radiological examinations and reports make a significant contribution to the correct diagnosis and treatment of patients within health care.

The examinations offered to clinicians by the radiology departments are defined as skeleton, chest, mammography’s, ultrasound, odontological, gastrointestinal, examinations performed at primary care units, urinary tract, vascular examinations, CT (computer tomography) and MR (magnetic resonance). The services defined by the name of a part of the body (chest, skeleton) implicitly means X-ray imaging.

The radiology department involves the administrative staff, which is the link between the radiology department and the outside world; radiographers, who are the specialist in image production; radiologists, who are the interventional and diagnostic specialists; and computer technicians, who support all the other actors with regard to computer systems. Radiological work involves distributed actors that carry out activities

occasioned by a high degree of unexpected events.

In the radiology department various computer systems are used, such as PACS (picture archiving and communication system), RIS (radiology information system), and HIS (hospital information system). PACS supports the electronic storage, retrieval, distribution, communication, display, and processing of image data. In combination with HIS and RIS it provides a means for managing work associated with radiological examinations.

The medical staff at the clinical wards writes examination requests on paper. Each request includes data such as the patient's name, the date requesting the examination, the name of the clinician, the type of examination required (e.g. computer tomography, magnetic resonance, angiography, chest examination, ultrasound, mammography, etc.) and the patients symptoms and signs as well as the clinician's preliminary diagnosis.

Cases: News Agency and Health Care Institution

The news agency

It is a very busy day in the Media Department of the news agency. A lot of faxes keep arriving from the TV channels in Scandinavia, as well as from various other European countries. The department's largest customer, a weekly magazine, is supposed to get its TV schedules later this day. In addition, the newspapers must have their daily delivery. However, TV information for more than half of the channels is still missing.

The fax machine is ticking. An employee is already busy entering TV information from faxes into a mainframe system. She looks around, and sees that all of her colleagues are quite busy as well. She knows that it is her turn to pick up the faxes now since the others have already done this several times today.

She walks over to the fax machine, takes the two faxes and puts them in shelves. Both faxes are from Channel 8. One of them contains information that is supposed to be included in the schedules that are to be delivered today. She puts this fax directly into the specific space, labeled «to write» in the week-shelf. The other fax contains information concerning future TV programs. She puts that fax in the in-shelf. It will later be moved to the week-shelf when it is time to process it. She goes back to her desk and continues entering TV information from the Sports Channel that she was working on before the last faxes arrived.

One of her colleagues sees that there is a new fax in the week-shelf. One less missing channel, he thinks. He has just finished entering data from Channel Z into the system, and he is looking for more work to do. He takes the Channel Z fax with him and places it in the out-shelf. He marks the coordination form to show that the information for this particular channel is registered in the mainframe system. Then he picks up the fax from Channel 8 in the week-shelf, and returns to his desk and starts entering that information into the system as well. The last faxes he has processed all contained errors in one way or another. He has called three different channels earlier today, and he hopes that this time the faxes are error-free. All these telephone calls take time, and they bore him.

A third colleague is working with a desktop program to make the TV schedule pages ready for printing. She realizes that there is a new fax in the out-shelf, which indicates that some new information is electronically available in the system. She checks

the coordination form and confirms that Channel Z has been finalized. If any information from a channel is missing, this is registered on the form as well. The customer's style sheet is open on her computer. She goes into the mainframe system and copies the information into the right place on the style sheet. She does some proofreading during the formatting, and she deletes some words, rewrites some sentences, etc., in order to fit the text into the space available for that particular channel. When she is through, she marks the coordination form.

One of the writers got tired of all the errors he had handled during the day, and went out to get something to drink. While he is gone, his boss comes by and places a piece of paper on his desk. The paper contains some corrections from the Sports Channel. A representative from this channel had called the boss to ask for some last minute changes in their program. When the writer returns after his short break, he sees the paper and starts working on the new changes at once, before he continues the work he was doing before the break. He knows that when corrections come directly to his desk, it is important. He has to make sure that the corrections are implemented.

When all the TV information has arrived, has been entered into the system, and formatted in the desktop program, the schedules are ready for delivery to the customers.

The radiology department

An employee from the medical department's administrative staff is entering the hallway in the radiology department. There are shelves on the wall to the right, and he places a document in one of the shelves. When an employee from the radiology department's administrative staff passes the shelves 10 minutes later, she glances at the shelf where the document - an examination request form - is visible. She brings the request to the administrative area, and paper in hand she enters an appointment for the patient into the RIS. She places the examination request form in another predefined special shelf visible to the radiographer out in the hallway between the administrative and image-production areas. After a glance at the shelf, the radiographer is triggered to initiate the preparation of the patient, the equipment, and the room for the examination. She carries out the X-ray examination written in the medical request. She adds information into the medical request, to inform other medical staff of her actions. Then she places the light medical request on a table visible to the administrative staff. When an administrative staff sees it, she distributes it to a shelf the diagnostic area.

A radiologist in the diagnostic area has just finished diagnosing a chest examination, he looks at the shelves where the new examination requests are placed and realizes there are more patients to diagnose. He walks over to the shelves, takes the new examination requests and brings them over to the diagnostic work stations. This patient has old X-ray films from an earlier examination; these need to be compared with the images in the PACS. The radiologist stands up and walks over to the lightboard and positions the X-ray films in a row. When diagnosis is accomplished the radiologist dictates the report on a tape. He walks over to the predefined shelves for secretaries, takes the examination request and the tape and puts them in a shelf. A secretary sees that there is a new report to transcribe. She brings the tape and medical request to the administrative area and adds an examination report to the medical request. Thereafter, she returns to the diagnostic area and places the examination request in the shelf predefined for the radiologist who diagnosed the images. The radiologist sees that there is a transcribed report in his shelf. He takes the document and checks it thoroughly and signs off. Then he places it in a predefined shelf for the next day's multidisciplinary

conferences, and goes back to the diagnostic workplace by the computer screens. After the images have been diagnosed a second time at the conference, they are put in an 'out-shelf', finally, the administrative staff distributes the report including the diagnosis to the medical department.

Artifacts in Work Practices

We have observed that humans and artifacts are interrelated in work in order to fulfill some aims or intentions. Artifacts are developed and brought into our world to support us in our work. And, we are more or less dependent on them in that respect. If we look around in our work places we see documents, binders, computers, telephones, fax machines, printers, shelves, pens, cups, etc that we use and interact with every day. At other work places hammers, nails and screwdriver or shots, stethoscope and tweezers are present. However, these artifacts are, in some respect, 'parts of us' (Ehn, 1988), and we cannot do our job without them.

All these artifacts have intentions, properties and features that are more or less generally accepted. For instance, the aim of shelves is to support the organization of work by sorting documents, or other artifacts, in them. The hammer is used to nail. And, documents are produced and used for the need of sharing information. However, artifacts may have more peripheral properties as well, and these peripheral properties may become important common resources that the communities of practice rely on.

In the news agency and radiology department artifacts are introduced in order to organize work in such a way that the employees produce the schedules and patient treatment in time. Fax machines were introduced in order to make it easier and faster for TV channels to deliver their TV information to the Media department. Shelves were introduced because fax sheets needs to be separated according to channels and weeks. Shelves have predefined places with names on them, and it is a simple technology to use. Just as medical requests were introduced in order to support the communication of medical data between medical staff. The coordination and request form was introduced to help coordinating complex processes. Carstensen and Sørensen (1996) report that introducing some kind of formalism is a way of dealing with complex work situations.

Artifacts do not only have roles as organizers. Computers, shelves, fax-sheets and medical request forms are visible and present in the rooms where people are working, they are also essential in the individual's understanding of the activities of the others, which provides a context for their own activities. For instance, the process of moving faxes and medical request forms between shelves makes the personnel aware of the status of their work as well as who is working on what. Previous research has illustrated that this awareness keeps the articulation of work on a relatively low level (Braa & Sandahl, 1998). The similar phenomenon is observed in the radiology department.

We have seen that arrangements of artifacts, as documents in shelves, are important for the awareness of human activity. And, when documents become electronic, there is no need for shelves, tables or fax machines. The visible paper documents are gone, the process of carrying them, sorting them or using them becomes invisible as well. Implicit information necessary for peoples' awareness is gone. The implicit information may preferably be represented in some other technology in order to keep the work practice together.

Dourish and Bellotti (1992) emphasized the importance of awareness in work, and we illustrate how this awareness may depend on the arrangement of artifacts in work

practices. Latour (1987) and Akrich (1992) state that artifacts have politics, in the sense that «they constitute active elements in the organization of the relationships of people to each other and with their environment» (ibid. pp.1). This does not only mean that they are active in the sense that they are necessary, but also, as we have seen, active in a way that they coordinate, and even trigger or initiate, work.

For instance, documents may be coordinating artifacts. The aim of the examination request and the fax sheets are to share vital information between different communities of practices and being a carrier of information. We have seen that the documents may coordinate activities in two senses. First, documents' material and visible presence, in a shelf or on a table according to their structured trajectory in the radiology department and news agency afford the linking of actions and events over different sites and times without personal interaction between staff. When the medical request or fax sheets are distributed to a particular place, the responsibility of work is handed over to a particular community or person. In both places, the coordination of work is indicated by 'who is holding the document'. The paper acts as a token and the shelf in which the documents are placed represents the state of work. Secondly, in the radiology department the examination request is formatted in ways that trace work, which enables various communities of practice to coordinate particular activities between themselves. This is done in a way where one actor adds information to the medical request that is both supervising and required by the next actor in order to take action. For instance the clinician demands a 'particular' examination to be carried out at the radiology department according to his/her findings of the patient. Medical records integrates distributed and isolated entries into an assembly which itself carries meaning (Berg, 1997).

According to Schmidt and Simone (1996) particular artifacts are introduced in order to manage the coordination in work. This does not only mean that particular coordination artifacts support coordination, but also, as we have seen it, some artifacts support coordination in itself. The coordinated role of the document is what keeps up the progress of work in the news agency and at the radiology departments, it is essential by means of 'keeping the work practice together'.

In a way, artifacts may be active actors as well. For instance, the administrative staff at the radiology department receives an examination request from a clinician, the administrative staff places the examination request in a special shelf visible to the radiographer. After a glance at the shelf, the radiographer fetches the request and reads the information. She then carries out the X-ray examination requested in the document, etc. The similar observations have been made at the news agency. We have observed that, in these situations, artifacts, such as documents on shelves, trigger human action. The fact that these documents are tangible, ecological flexible and light have implications for the ease of which they can be physically transported within the communities and laid out in particular spaces (Luff et al. (1992); Harper & Sellen (1995). When and if documents are placed in specific locations, they represent signals. The same is observed at the news agency. What happens on the fax machine, the number of faxes received, and the shelves in which they are placed, are of vital importance to how the working day will develop.

The perspective of saying that artifacts as well as humans can be actors, in the sense that they put other humans or artifacts into actions is an analytical stance, and not an ethical position (Law, 1992). We, as well as Law (1992), do not mean that we have to, or should, treat people as machines. We do not want machines to have rights, duties or responsibilities that we usually accord to people. An artifact cannot take control over humans literary speaking. The point we want to make, however, is that artifacts may have peripheral properties that enable various use within a community of practice, and that

conventions in work ‘allow’ artifacts to have the role as actors.

In systems design, it is common to consider artifacts as tools or media for human activity. When artifacts in general are viewed from the perspective of their use, they can both support communicative and instrumental activities, and they can mediate our activity towards other humans or towards ‘objects’ (Ehn, 1988). In addition, we have seen that within particular communities of practices, both fax-sheets and examination request forms are actors that trigger work; they make things happen and are in a way ‘subjects’ that people rely on. Therefore, in order to understand work practices, we must see artifacts as actors as well as tools and media.

We found the combination of concepts from ANT and Borderline issues useful. ‘Borderline Issues’ focuses on both central and peripheral properties of artifacts, while ANT support us in identifying these properties in work. Understanding and identifying properties in this sense is important because it illustrates how the artifact’s properties are significant for its application, and how they are linked to humans and other artifacts in socio-technical networks. Artifacts have properties that is central and peripheral, where the importance of the peripheral properties often is unnoticed for outsiders. Over time, conventions will grow around the artifacts’ peripheral properties and become resources in the socio-technical work practice.

Conclusions

We have in this paper described *how* artifacts’ peripheral properties become common resources that over time the communities of practices rely on. These resources, lying as they do ‘beyond the object’, seem to us important to understand in the process of understanding work.

In work, artifacts and their resources have over time established a relatively stable and pragmatic work process. However, when new computer technology is introduced the old technology as well as its accompanying resources may disappear, hence the stability in work may be challenged.

We have in our cases illustrated examples of *how* particular artifacts’ have translated into unnoticed common resources within a community of practice. For instance, fax sheets and examination request forms do not only transfer information but also simultaneously indicate the status and progress in work, this is enabled through its peripheral properties of being tangible, ecological flexible, tailorable, light etc. The visibility of artifacts, as well as their arrangements, is important for people’s awareness and coordination in work. We have seen that artifacts have been actors that triggered human activity. This implies that to consider artifacts exclusively as tools and mediums is too restricted if we wish to understand work practices. To address problems of design and use of artifacts in these changing conditions, the common resources and its role in work practice needs to be better understood – even if only to explain what life will be like without them.

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