Technological Artifacts Shaping the POS

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Introduction

According to a rich body of literature (e.g., Callon, Latour 1992; Akrich 1992; Czarniawska-Joerges 1992; Law 1994, Joerges, Czarniawska 1998) technological tools and artifacts play an important role in organizations and in shaping advanced organizations. In this view, technological tools and artifacts and their influence on human relations are often neglected in sociological or organizational analyses. However, when trying to explain organizational issues, technological artifacts cannot be neglected. They are no longer simply means to ends nor to be treated as separate from the social or the organizational body.

Terminological Understandings and Paper Scope

Following Norman (1991) and Norman (1993), we consider technological artifacts as negotiated, embedded, and sedimented sets of rules for goal-oriented action. In this sense, artifacts are a "visible translation of the knowledge developed within and outside organizations" (Masimo, Zamarian 2003, p. 695) and part of a shared organizational language and a tangible expression of the organizational values. They represent receptacles of common experience shared among developers and users (Hutchins 1991, Hutchins 1995).

Thus, artifacts contribute to improving individual, collective or organizational rationality. As sets of rules, artifacts modify the representation of problems and stipulate the transmission of knowledge and information, and they can make explicit a set of shared symbolic values. Technological artifacts support the use of scarce cognitive resources in various ways and guide the representation of relevant knowledge in order to better define and shape the problem to be solved (Orlikowski, Iacono 2001; Benbasat, Zmud 2003).

Considering especially dynamic structuration processes (Barley 1986, Barley 1990; DeSanctis and Poole 1994, technological artifacts are a direct or indirect means of regulation and structuration of distributed (Engestroem 1991) and situated (Suchman 1987) organizational action (providing rules and resources) with varying results. Literature (e.g., Orlikowski, Baroudi 1991; Orlikowski 1992; Sahay 1997; Griffith 1999) has paid increasing attention to the 'impact' of technological artifacts on organizations. Therefore, a way of appreciating the organizing qualities of technological artifacts is to view their regulating effects on action. Technological artifacts offer organizational opportunities and, at the same time, limit the set of possible actions for users.

In the following, this paper extends existing literature by taking technological artifacts and their regulating effects beyond the boundaries of the organization to selected organization-driven, technology-controlled end-consumer actions. The study is based on the case study of METRO Group's *Future Store* (Loebbecke 2004), a 'bricks-and-mortar' supermarket where a set of technological mediations operates under real-life conditions for the first time ever. The technological artifacts, the organization, and the consumers constitute complex relationships to be treated and analyzed together.

Innovative Artifacts in METRO Group's *Future Store*

In its *Future Store*, METRO Group introduced various technological artifacts: New, integrated content devices, a technical content integration platform - the content bus, and Radio Frequency Identification (RFID) technology on palettes, cases, and items - all together with accompanying process changes. These innovations have turned the 'bricks-and-mortar' supermarket into a real-life test-bed for the future of retailing. Content sources along the retailing value chain and content devices in the store have been connected. Processes have been adapted accordingly, seamlessly, in real-time, and without bothering users with technological constraints.

New Content Devices and Platforms as Technological Artifacts

New content devices making shopping faster and easier include 'Personal Shopping Assistants' (PSAs), 'Intelligent Scales', and 'Self-Checkout Systems'. Besides, 'Information Terminals', 'Electronic Advertising Displays', and 'Electronic Price Labels' offer newly oriented customer communication (for details on the different devices see for example Loebbecke 2004). All these devices are fed from a variety of internal and external content sources along the value chain such as METRO Group's Merchandizing Systems (MMS), their pricing and check-out system, manufacturers' basic and enhanced product information, or advertisements.

Each of these technological artifacts needs to be provided with up-to-date data, such as prices and stocking information raising the issue of integrating content sources and output sources. The issue of content integration has been solved in the *Future Store* by relying on the content bus as content integration platform. The content bus ultimately is a technological artifact containing software running in an Application Server. It is positioned between data sources and output formats in the form of a metadata repository. It extracts content from individual applications and their respective data sources (content suppliers) and makes the data available to various output formats (content consumers) in real time.

A de-coupling of output formats from individual data sources takes place. The content bus works with a 'virtual repository', in which all content metadata is contained. It thus constitutes a technological artifact consisting of a central information source for applications and output media in the store. The platform is designed to restrict itself to actual content independent of specific applications or data sources. Based on an open architecture with standard technologies, the content bus provides organizational opportunities by allowing for a massive reduction of cost-intensive, point-to-point connections, which are difficult to administer.

RFID Technology on Palettes, Cases, and Items as Technological Artifacts

In the *Future Store*, METRO Group together with external partners in the Future Store Initiative has tested the first world-wide application of RFID technology under real-life conditions, including tests on item level (see below)[1]. To increase feasibility and to split the cost along the value chain, RFID tags are prepared by brand manufacturers (e.g., Kraft, P&G, or Gillette) and then attached to the items by METRO Group in the *Future Store*.

Considering today's technical developments, one has to distinguish between RFID tags on palettes and cases on the one hand, and tags on items on the other hand. RFID on palettes and cases mainly points to process innovations along the inter-company value chain. On the contrary, RFID on items is still in its infancy. Also tested in the *Future Store*, it provides insights into content integration potentials and challenges in a new order of magnitude.

RFID on Palettes and Cases

Although RFID on transport packages such as cases is still limited in the *Future Store* environment, the involvement of numerous manufacturing partners, different classes of products and applications at the factory, warehouse, distribution centre, stockroom, and shelf provide perhaps the most comprehensive look at how the deployment of an RFID infrastructure as new technological artifacts impacts processes and relationships in a retail deployment:

- Concerning product transport, METRO Group Distribution Logistics fits RFID tags to all product palettes and cases before they are shipped to the *Future Store*. The tags are electronically time-stamped and then entered into the central computer of the RFID goods flow tracking system. The tagged products and packages can thus be located and identified along the entire logistics chain, all the way to the *Future Store* sales floor. Outside the *Future Store*, the tags become inoperable.
- Structuring the warehouse dispatch, goods ready to be shipped to the *Future Store* are taken from the central warehouse to the dispatch area. As they pass through the exit gate, an RFID transceiver reads the codes on the palettes and cases and passes this information on to the RFID good flow system. The goods then have the status 'on route to destination'.
- In the context of goods delivery to the store, RFID helps to control whether the arriving goods match the order. When the trucks arrive at the *Future Store*, the palettes are once again identified by an RFID reader handling more than 350 tags per second. Then the goods are registered as 'in the store warehouse'.
- Concerning warehouse management and storage in the backstore, the goods flow system exactly registers the goods in the warehouse. Each storage location in the backstore area has an RFID tag which is stored in the RFID goods flow system, together with the RFID numbers of the palettes and cases stored at the particular location.
- Finally, for the transport of goods into the *Future Store* sales room, RFID readers, located at the warehouse exit doors, identify every palette and case that goes through the store. The readers then send the relevant RFID numbers to the RFID goods flow system, which identifies the products as 'transported into the store.' To avoid duplicate entries, RFID tags on empty cases and palettes are removed or de-activated. Afterwards, empty containers are returned to the store.

1 Additional RFID pilot tests are undertaken for instance in Group pilots in the Kaufhof department stores.

RFID on Items

RFID tagging on item level offers additional opportunities, but also challenges. In the *Future Store*, item level tagging is tested under real-life conditions for selected products: and 'Mach 3 Turbo' razor blades (Gillette), 'Philadelphia' cream cheese (Kraft Food), and 'Pantene' shampoo (Procter & Gamble). Brand manufacturers focus on different functionalities with 'their' item level tags. Gillette experiments with tags for anti-theft protection. Kraft Food aims to gain experience with the management of expiration dates and out-of-stock issues. The respective Smart Shelves are equipped with readers that inform the *Future Store* staff when the shelves have to be replenished. Finally, Procter & Gamble runs tests on innovative marketing concepts. All brand manufacturers would like to deploy the technological artifacts to regain more control along the supply chain via exploiting the set of rules embedded in the artifacts.[2]

However, the accompanying information / data management is still tricky. Information creation reaches a new order of magnitude as each individual RFID tagged product is followed all the way through the store- or even product life-cycle.

Challenges Resulting from Technological Artifacts at the POS

Organizational Challenges

Integrating various new technological artifacts, i.e., content provision devices, content bus, and RFID based infrastructure components, lead to increased organizational complexity.

Towards Improved Work Processes

The fast and convenient data transfer enabled by RFID supports retailers in accelerating their workflows. RFID tags attached to palettes and cases can contribute to tracking can track the transport and whereabouts of the merchandize throughout the supply chain. Thus, the newly introduced technological artifacts together with legacy IT systems have rendered retailing processes faster, more transparent and effective.

Beyond process improvements in the *Future Store*, the employment of RFID has also demonstrated potential to revolutionize retailing and the retailing value chain (for details see for instance Loebbecke 2004; Loebbecke 2005). Certainly, any potential advantages and regulatory opportunities have to be balanced against potential disadvantages such as constrained individual actions and additional expenses.

Centralization of Originally Separate Applications

The technological artifacts provided by different technology partners must be stored and operated centrally if results are to be integrated in and displayed on various outlets. As long as content bus, checkout systems, intelligent scales, information terminals, and the other devices and embedded applications come from different prestigious companies, the technical

2 Additional item level tags on CDs, DVDs, and videos not only allow customers to view trailers of certain films and sample music CDs, they also serve for theft prevention and have a function similar to that of conventional 'Electronic Article Surveillance' devices.

integration requirements lead to major management and organizational issues. Who owns the application, who owns the data, who owns the interfaces? Who is willing to give up control over their contribution? What kind of incentives can be offered? How can players be assured that in the next roll-out wave, they are not just suppliers to other technology providers? These questions underline the potential, but also the task of the technological artifacts to either regulate and structure organizational and inter-organizational actions directly or at least demand such regulation and structuration intertwined with a wider technological artifact roll-out. In addition, when impacting the data management, technological artifacts directly intervene with and permeate the main organizational processes.

Internal Information Availability for Customers

For the first time, in the *Future Store* internal information, so far only used in the METRO Group Merchandizing System, has been made available to customers. Additional information (obvious and well-known in the databases of the MMS) need to be displayed in a way that customers can read. Abbreviations are to be avoided; category names have to be adapted. For instance, METRO Group has renamed categories which have been taken for granted in the past (e.g., a numerical code for 'wine') as something that makes sense has to appear on the front-end displays. From a point of view of artifact design, these changes in communication rules embedded in the technological artifacts have implications on the coding. Electronic Article Numbering (EAN) or Electronic Product Code (EPC) per se are not sufficient, additional manual recoding is necessary of all products and product categories which are to be presented directly to customers.

Only with such adaptations, the technological artifacts allow for a common experience for system developers, institutional users and end-consumers.

External Content Availability for Electronic Advertising Displays

The electronic advertising displays in the *Future Store* can display static pictures or video spots which are triggered by a specific customer with his / her customer card approaching the display.

In several cases, static electronic displays are fed from the METRO Group internal promotions database; data that also serve weekly flyers in newspapers. Often, not even any picture exists for particular items which, so far, have only been promoted with text and price. But as black screens would be negative and as 'just words' on a screen do not attract attention, redesigned processes are required that provide a picture for (almost) every product. Such pictures are to be made available in different sizes and formats for additional outlets such as advertising displays in different sizes, but also Personal Shopping Assistants, intelligent scale, electronic shelf labels, and the like. As product pictures are not created by METRO Group itself, but come from brand manufacturers and their advertising agencies, the provision of digital pictures requires considerable changes in the process management within *Future Store* and METRO Group, but also regarding their cooperation with various external partners.

The same holds true for video displays placed in the *Future Store*. Spots to be shown on these displays have to meet certain technical requirements. They ought to be shorter and more concise than the common 30-second TV spots. These spots have to be delivered to *Future Store* by the brand agencies (so far a retailer does not hold a pool of advertising spots); in most cases they even have to be redone in order to be truly suitable for in-store display. For

instance, P&G has offered additional 30 spots developed specifically for the *Future Store*. Obviously, the necessary inter-organizational process adjustments are numerous. Further, one can easily imagine things becoming even more complex if one expects product promotion videos on in-store advertising displays to also show store-specific prices / discounts.

Handling of Privacy Concerns

RFID on items has stipulated the transmission of information to users (employees and end-consumers). This has raised privacy complaints which have gained public attention and increasingly have put pressure on what was meant to enhance customer convenience. Privacy issues on a legal level (varying among countries) as well as on consumer perception level could significantly inhibit the roll-out of the new technological artifacts, especially on item level. To react, METRO Group has introduced a *De-Activator* which permits customers to overwrite the information on the chip, and thus to de-activate the RFID tag after having paid for their goods.

Summary and Further Research

Humans, here end-consumers, do not ask for technological artifacts such as barcode scanners, touch-screen kiosks, liquid-crystal displays, RFID or any other specific technology. Instead, they demand more accurate price information, more complete and up-to-date product information, assistance in finding specific items, less out-of-stocks and a faster checkout. Hence, increasingly governed by technological artifacts, today's retail industry faces a new reality where consumers choose how they are governed. Consumers enjoy more choices and have more information upon which to base their buying decisions.

Central and de-centralized software packages provide the option of innovative shopping experiences. Content integration devices offer functional interfaces at the front-end and the back-end for most retailing activities.

For retail organizations such as METRO Group, the challenge resulting from such innovative technological artifacts at the POS remains to un-lock the potential of the technological artifacts in order to provide:

- More individual information and service offerings for shoppers and more effective process and communication functions for manufacturers;
- Different customer experiences based on state-of-the-art technological artifacts for content integration supporting organizations at the POS; and
- New technological standards for retailing to be implemented internationally, thus regulating the modernization process of the industry on a sustainable basis. Experiences already studied for instance under the heading of EDI protocols (e.g., Perales et al. 2001, Nelson and Shaw 2003, Nakayama 2003) have to be transferred to RFID as a new technological infrastructure.

Driven by the newly introduced technological artifacts in METRO Group's *Future Store*, this paper investigated some of the regulating effects on action that state-of-the-art technological artifacts have in that environment. It illustrated how technological artifacts offer organizational opportunities and define users, here consumers, and their actions and underlined the importance of these effects within and beyond the organizational borders in which the technological artifacts are deployed.

In an increasingly automated environment, the implicit governance of technological artifacts has visibly shaped regulation and structuration and the patterns of governance, communication, interaction and coordination at the POS. Along those dimensions, further research into the roll-outs of similar technological artifacts are necessary to provide more in-depth and more generalizable insights into these fascinating facets or organizational processes and design.

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