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# Creating value with IT - the case of RFID

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# CREATING VALUE WITH IT – THE CASE OF RFID[1]

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## Summary

*This research investigates the use of IT for value creation. Significant advances in IT combined with pervasive digitalisation have fundamentally changed how firms organise their activities, develop new products, and create value. Underlying these changes are the use of IT resources that firms rely on the create value. Drawing from Demil and Lecocq (2010) business model framework, this study develops a framework to examine IT and value creation. Using RFID as an exemplar technology, and relying on multi case study research design, we examine (1) how firms use IT to create value and (2) the evolution of IT use for value creation over time. We find that firms use IT to create value both through changing their activities, and through altering their value proposition embodied in products and services. Over time, IT use as an activity enabler dominates, with no noticeable trend towards transformative and/or value directed usages.*

*Keywords: IT value, business model, RFID.*

Track: e-business and e-government

Word count: 6816

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## Introduction

Creating value through IT has been a major research topic in information systems research for over three decades (Schryen, 2013). Value is generally conceptualised as the efficiency and strategic impacts of IT use on organisational performance (Melville et al., 2004). Two complementary perspectives have driven most of research on IT and value creation (Oh and Pinsonneault, 2007): the resource centred approach which argues that IT is a strategic resource which creates value either by itself (Brynjolfsson and Hitt, 1996) or through combination with other complementary resources (Mata et al., 1995), and the contingency perspective which argues that value is created as a result of a good fit between IT strategy and business strategy (Henderson and Venkatraman, 1993). Underlying both perspectives are two assumptions. First, both perspectives argue that firms create value with IT by applying "*the right IT*" to "*the right processes*" (Melville et al., 2004, see also Henderson and Venkatraman, 1993). Although it is acknowledged that IT deployments can lead to the development of new products and services, the contribution of IT to value creation is by and large considered solely through the perspective of its impact on the firm's business processes and activities, rather than through the changes it can bring to the firm's value proposition itself (Kim et al., 2011; Schyner, 2013). Second, both approaches consider that IT use contributes to value creation primarily through improving and enabling existing firm processes and activities, rather than through enacting radical transformation in the firm's activities. For example, the resource approach emphasises the role of IT resources in leveraging and enhancing existing complementary resources and skills (Bharadwaj, 2000; Wade and Hulland, 2004), while the contingency view focuses on the deployment of IT to align with and support an existing business strategy (Henderson and Venkatraman, 1993). There are few exceptions when researchers envisaged a more transformative role of IT use (Venkatraman, 1994). Nevertheless, the activity enabling focus still pervades current research on IT and value creation. For example, Kim et al. (2011) considered the role of IT capabilities to enhance existing processes by achieving better integration, cost reduction and business intelligence, while Mithas et al. (2011) examines the contribution of a particular type of IT resource to enhance the flexibility, speed and cost economy of existing processes.

During the last decade, significant advancements in IT combined with the pervasive digitalisation of the material world around us have triggered fundamental changes to how firms organise and manage their activities and construct their business strategies to create value (Bharadwaj et al., 2013), and to the nature of products and services embodied in the value propositions delivered by firms (Nambisan, 2011; Yoo et al., 2012). Consequently, recent calls have been made more broadly in IS field for exploring the changing role of IT in firms and the shifting nature of its contribution to value creation (Bharadwaj et al., 2013; Kohli and Gorver, 2008; Yoo et al., 2012). In parallel, research on the business value of IT has also called for further investigation into the role of IT for value creation, especially in terms of moving from a focus on measuring what value is created through IT to investigating the process through which value is created (Kohli and Gorver, 2008; Schryen, 2013) which is still underdeveloped in existing research (Lee et al., 2014).

Addressing these calls for further research on IT and value creation, the goal of this paper is to examine two research questions: (1) how do firms use IT to create value? and (2) how do the patterns of IT use change over time? The next section details the theoretical framework informing our study. The research method is explained in section 3, followed by the analysis of our case studies in the next sections. A summary of findings, implications and limitations concludes the paper.

## Theoretical background

By and large, research on IT and value creation is dominated by attempts to quantify the contribution of IT to economic value, rather than to examine how firms actually use IT to create such value (Schryen, 2013). When the process of value creation is investigated, existing research focuses on identifying the interviewing variables, such as process or organisational change, IT usage, or process performance (e.g. Kohli and Grover, 2008) that explain the relation between IT use, generally expressed in line with the resource based view as IT resources, capabilities, or more broadly, IT investments, and the outcome on value creation, generally linked to firm or market performance

(Melville et al., 2004). However, as early as 2001, Amit and Zott (2001) have argued that the digitally enabled changes in the value creation potential of businesses cannot be explained by existing strategic management theories such as resource based view, and have proposed the concept of business model as a unifying framework to capture the phenomenon of value creation. Similarly, Hedman and Kalling (2003) have argued the business model construct is critical to understand the role that IT plays in firms through enabling researchers to examine the contribution that IT brings to the economic value of the firm.

Business model research has progressed significantly from its origins in the 1990s in e-business research as a construct useful to map the emerging forms of different business activities orchestrations to generate revenue online to a core concept in strategic management research to describe the architecture of value creation and capture, and thus explain performance and competitive advantage (Zott et al., 2011). There are many different facets to the business model concept that are covered in existing research (Al-Debei and Avison, 2010). We focus here on the value proposition dimension as employed in most strategic management research to explain how firms create and capture value (cf. Zott et al., 2011). We employ the concept of business model here as it depicts value creation in firms and it encapsulates the firm's value proposition for the customers (Osterwalder et al., 2005), as well as the activity system that creates and delivers this value proposition (Seddon et al., 2004).

The business model construct has been widely used in IS research to identify different types of organisational architectures that create and deliver value online (e.g. Clemons, 2009; Timmers, 1998). In contrast, the ways in which firms use IT to create value by changing their existing business models have not been articulated clearly in existing research. For example Hedman and Kalling (2003) use ERP to illustrate how IT can influence the various components of the business model, while Amid and Zott (2001) use the example of e-business to explain how the various characteristics of the business model elements can support value creation. Such research focuses on how IT should be used (Amid and Zott, 2001), or on the impact of IT on the various component of the business model (Hedman and Kalling, 2003), rather than on examining the different ways in which firms deploy IT to create value.

To explore how firms use IT to create value we draw from Demil and Lecocq (2010) business model framework which conceptualise the business model construct as a dynamic relationship between firms' resources, firm's value creating activities and firm's value proposition. The resources and competencies of the firm are exploited through internal and external value creating activities and processes (see also Osterwalder et al., 2005) leading to the development of product and services which are delivered to customers and other stakeholders and which form the value proposition of the firm (see also Al-Debei and Avison, 2010). Revenues emerge from the value proposition that the firm offers to its customers, while the organisational structure composing the internal and external value creating activities and processes determines the costs of the firm. The difference between revenues and costs reflects the margin which can be re-invested in augmenting the resources and capabilities of the firm over time thus explaining changes in the business model over time (see figure 3).
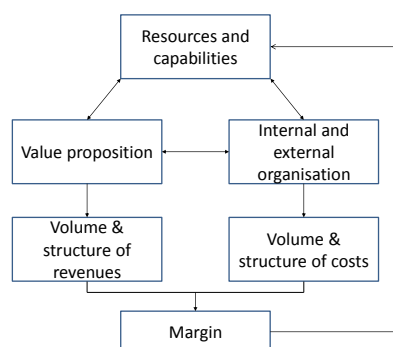


*Figure 1: Demil and Lecocq transformative framework to business model (pg 234)*

This dynamic relationship between the components of the business model allows the framework to examine the transformative effects of innovations, such as the emergence of new forms of digitally

enabled innovations, on value creation over time (Demil and Lecocq, 2010). Although we do not focus here on examining one particular firm over time, the model is useful to answer our research questions as it is based on the assumption that to understand value creation in firms, the value proposition has to be considered jointly with the resources and the processes through which it is created (activity system) (Demil and Lecocq, 2010). Conceptualising IT as a resource and using Demil and Lecocq's model we can thus examine the different ways in which firms use IT to create value through its dual effect on the value proposition and the system of activities through which this proposition is created.

IT has been conceptualised as a resource encompassing the technology, human and complementary IT resources (Melville et al., 2004). We focus here on IT technology resources as embodied by the technology infrastructure and business applications (Melville et al., 2004), similar to the IT asset concept employed by Schryen (2013).These IT resources can create value either directly, through being encapsulated in the products and services that the firm delivers to its customers, or indirectly, by being exploited through value creating processes and activities to influence the value proposition. For example, a retailer can use electronic commerce applications to provide a more convenient service to its customers by allowing them to order products online thus improving its value proposition, or it can deploy supply chain management systems to improve the visibility in its supply chain thus increasing the speed and reducing the costs of its activities. In examining our question of how IT is used for value creation in firms, we can thus differentiate between the locus of impact that IT resources have on value creation: on the value proposition embodied in the firm's products and activities delivered to customers, and on the activities and processes through which this value proposition is created. In contrast, existing IT value research examines the contribution of IT to value creation by focusing exclusively on the latter (cf. Kim et al., 2011; Schryen, 2013). Moreover, within each of these loci, the impact of IT resources can range from incremental where the firm uses IT to do the same as before but better, to radical, where IT use triggers changes that are significantly different. For example, the introduction of virtual simulations of car crashes has originally improved the process of new product development by reducing the costs and increasing the speed of development (Bailey et al., 2012). In contrast, the availability of digital tools for drug discovery has triggered fundamental changes in the process of new product development by radically altering the nature of activities conducted by different types of scientists involved in drug discovery (Dougherty and Dune, 2012). The nature of change thus relates to the role that IT plays in firms: enabling role where IT improves and supports existing processes, activities or products, and transforming where IT triggers the development of new kinds of products, or drives new kinds of organisational arrangements and processes. With few exceptions (Vekatraman, 1994), existing research on IT and value emphasises the former. By mapping these dimensions onto a 2x2 matrix we can distinguish four different types of IT use for value creation in firms (see figure 2).

## IT use and value creation

| | ENABLER | TRANSFORMER |
|---|---|---|
| **VALUE PROPOSITION** | **Value enabler** e.g.IT applications as part of service innovations to improve existing value proposition (e.g. ATMs to electronic commerce to on demand services; online banking to improve banking services) | **Value transformer** e.g. IT technologies embedded in products => changes the design of digital products & components (e.g. embedding software into cars, e.g. OnStar @ GM; digital camera onto smartphones e.g. Nokia as the largest digital camera manufacturer) |
| **VALUE CREATING ACTIVITIES & PROCESSES** | **Activity enabler** e.g. deploying specific tools and applications to improve existing processes (e.g. data mining tool decision support systems, virtual simulations for product development, Internet supply chain management systems) | **Activity transformer** e.g. IT tools drive innovative organisational arrangements and processes (e.g. digital tools for drug discovery => radical changes in NPD; crowdsourcing => changes in raising finance; apps => platform) |

(Locus of change / impact of IT — vertical axis; Nature of change / role of IT — horizontal axis)

*Figure 2: IT and value creation*

To consider the use of IT over time, we draw from existing research which suggests that IT uses gradually evolve from supporting automation of existing processes and services (i.e. IT as an enabler)

to redefining the scope of the business (i.e. IT as a transformer) (Venkatraman, 1994). Similarly, the pervasiveness of digital technologies embedded in physical products represents a relatively recent phenomenon, being made possible by gradual advances in IT (Bharadwaj et al., 2013; Yoo et al., 2012), thus allowing IT to be increasingly embedded in new kinds of digitally enabled products and services that change the core of the value proposition itself. We would therefore expect that over time, IT use would move from the bottom quadrants to the top quadrants, and from the left to the right.

## Methodology

We employ a qualitative research methodology relying on multi case study research design. Instead of considering the entire set of IT that firms can use to support their value proposition, we focus on one technology: RFID. RFID has been widely associated both with process improvements, in particular increased efficiencies through process automation and optimisation (Bunduchi et al., 2011), and with enhancing the value proposition either through deployments to improve customer service (Lee at al., 2008) or through its interconnection with the internet of things as a way to develop and design new digitally embedded products (Yoo, 2010). Thus RFID technology offers a suitable exemplar technology to examine IT use both as it influences the activities and processes involved in the generation of value and the products and services that encompass the value proposition for customers.

In order to examine the pattern of IT use, as well as the variation in use over time, we rely on the database of RFID cases that have been published by the RFID Journal, a key publication in the area of RFID, from 2002 when RFID emerge as a promising technology for supply chain management up to the present time. Data was collected and coded in July – September 2014, with the last case included published in 10th of August 2014. The database contains 205 cases, with generally about 15 cases published per year, varying between 7 (2002) and 25 (2005). With few exceptions, most of the cases describe implementations of RFID at single companies, and vary between 3 – 5 pages long. The emphasis is placed on introducing the company and the application, and describing the adoption process starting with generation, acceptance and implementation up to covering future deployment plans. The emphasis in the description of the adoption process is on expected and realised benefits associated with the adoption of RFID, the key challenges encountered during adoption, and the approach to overcoming these challenges. The spread of the cases is wide both in terms of industry (e.g. service and manufacturing) and the type of application (e.g. good versus person track and tracing, sensing, data use including monitoring usage, security and control applications, and other applications). Cases of US companies dominate, although in recent years more cases from outside US are included.

To conduct our analysis we have first read the description of all 205 cases. The aim of this first stage was to familiarise with the cases and with the approach to describe the use of IT. We have then selected 7 cases (Prada, 2002; Silicon Tech Museum of Innovation, 2005; Metro, 2007; Dolphin Stadium, 2007; Grand Rapids City, 2013; City of Dayton, 2014; Marks and Spencer, 2014) where we could clearly identify different approaches to use IT based on our theoretical framework. The number of cases was based on Eisenhardt (1989) recommendation for selecting between 4-10 cases for building theory using multi case study research. The cases were not meant to be representative of the database at this point, but instead the aim was to selected cases where the presence of the phenomenon is intense so that the data present in these cases is rich (Miles and Huberman, 1995). Rich data from intense cases improved the ability to examine the phenomenon, in our case to identify different patterns of IT use across the four variants of use from the framework. The initial list of codes was developed based on the literature review prior to beginning data collection and included the four types of IT use: activity enabler, activity transformer, value enabler and value transformer. We have also coded each case according to the industry, country of deployment, year of publication, year of deployment, and type of RFID application. As the analysis of the seven case studies progressed, different patterns of use were identified and the list of codes was refined to include two further sub-categories regarding pattern of use: dedicated use where the deployment of IT infrastructure and business application technological resources was dedicated to only one purpose, versus combined use where multiple types of IT use were associated with the same IT resources, and conforming versus framing denoting the difference between the espoused use of IT and the use of IT in practice. The aim of this second stage was thus to identify different approaches to IT use in firms. To answer our second

research question concerning the evolution of patterns of use over time, we have then randomly selected seven cases each year (as seven was the lowest number of cases in one year) which we then coded using the list of codes refined following stage two. We have coded 91 cases (almost half of the total of 205 cases). This last stage also served to further refine the codes concerning the patterns of use identified at stage two. One further category of pattern was identified referring to types of framing: up or down (from enabling to transforming or vice versa) and activity directed versus value directed (from value to activity).

## Case examples

Six illustrative cases (four of the original seven selected at stage two, and two that were selected during stage three) are discussed below that are indicative of the patterns identified in the data. The influence of IT on value creation is represented in Figure 3, with dashed boxes denoting the location of IT influence, italic representing enabling influences, and underline representing transforming influences.
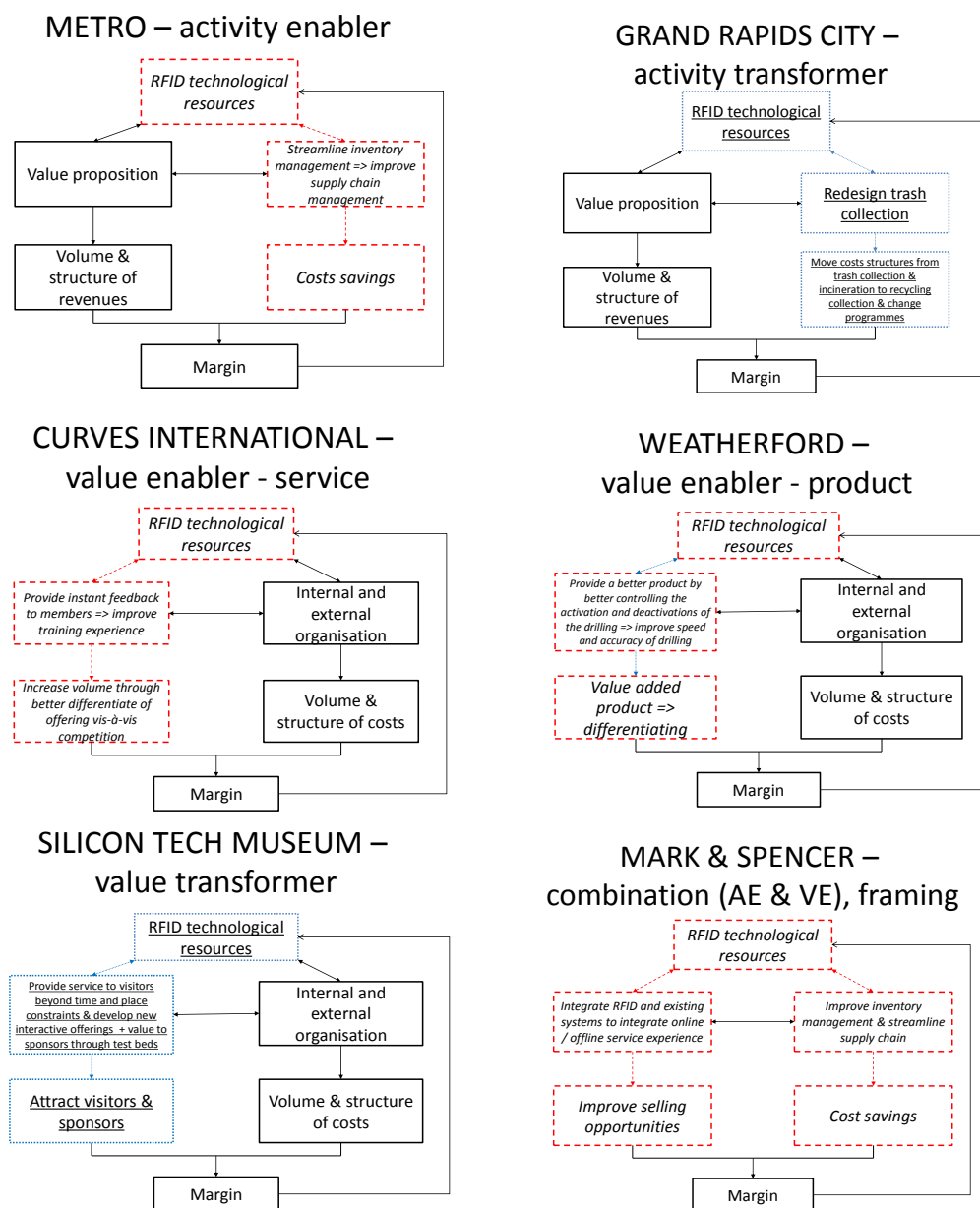


*Figure 3: RFID use and contribution to value generation in the illustrative cases*

## Metro: RFID as activity enabler

Metro, the largest retailer in Germany, first began experimenting with RFID in 2003 when it started using tagging pallets and cases for delivery from one distribution centre to its Future Store in Dusseldorf. As goods arrived at the store, the data on tags was automatically reconciled with the order and was used to update the inventory management system. Following the pilot, in 2004 Metro deployed RFID across nine distribution centres, eleven stores and twenty suppliers. The espoused benefit of RFID deployment was cost reductions through increased efficiencies in the supply chain.

RFID deployment involved tagging and tracking pallets and cases at suppliers' distribution and manufacturing facilities before there were shipped to Metro. The tags were linked to Metro's enterprise management system which many suppliers also use. Once goods arrived at Metro, the tags were read to check whether deliveries match orders, the inventory management systems were updated automatically, and the suppliers were alerted that the shipment had arrived.

The company exploited RFID technology mainly to improve the visibility of its supply chain processes in order to streamline existing operations both externally with suppliers and internally between their own distribution centres and stores. The benefits of RFID deployment consisted primarily in cost savings through improved efficiencies in existing processes such as cutting the time involved in loading and unloading the trucks, order picking, and checking goods.

## Grand Rapids City: RFID as activity transformer

Grand Rapids, a US city, had been using RFID to transform the collection of recycling and garbage in the city since 2010. The technology was implemented as part of a change programme to reduce air pollution in the city by decreasing the amount of trash incinerated. The case emphasises the benefits associated with improvement in process efficiency, in particular cost savings through streamlining garbage collection operations. However, these improved efficiencies are a by-product of exploiting the technology to completely redesign the way in which trash and recycling is collected and paid for by its citizens.

RFID tags were attached to garbage carts and are linked to individual citizens' account. Garbage collecting trucks were equipped with readers and were linked to the city back-office application. Each garbage cart was identified with a particular customer account as it was picked up allowing the city to charge customers automatically for trash collection depending on how much trash they generated, and to reward customers for recycling when recycling carts were picked up by the truck. This new pay as you trash system made possible by deploying RFID marked a significant departure from the previous approach where citizens were paying a flat fee for having the trash and recycling picked up every week. The new system allowed the city to incentivise its citizens to recycle more and to reduce the amount of trash generated. Data was also collected and used to better target the city's recycling programme activities. Thus RFID allowed the city to redesign the activities involved collecting and payment for garbage to transform citizens' behaviour to generate less trash, and to use the data to design new programme activities. Although not mentioned explicitly, the outcome of this transformation changes the structure of the garbage collection operations costs, which shifts from predominately collecting trash and incinerating trash to collecting and dealing with recycling and also increasingly investing in education activities and incentivising programmes to promote recycling behaviour.

## Curves international: RFID as value enabler - service

RFID had been used by Curves International, a US based fitness centre, since 2007, to provide members with personal and immediate feedback during training. The technology is portrayed as adding significant value to the service delivered to the customer.

RFID tags were embedded into wristbands provided to each member, and linked to the individual member information stored into a central database. RFID readers were attached to each piece of equipment. Before a member uses the system for the first time, they take a fitness test whose results were included in a central database. The test also generated preliminary targets for each piece of equipment in the gym which were stored in the central database. The RFID enabled wristbands can be

used by members to log onto the central database, modify their profile and adapt the targets. Each piece of equipment that members use activated the tag on their wristband, accessed the member's profile from the database and displayed real-time feedback to the members during the workout regarding whether they had met the set targets for that piece of equipment. Personal trainers were also using the system to hold the member more accountable for the workout, thus improving the service they deliver to customer. The use of RFID to improve the value proposition for the members was considered critical in allowing the company to differentiate its offering in the market, thus both attracting more members as well as maintaining a pricing structure that reflects the differentiated offering.

## Weatherford: RFID as value enabler – product

Weatherford, a Swiss oilfield service firm, had incorporated RFID into its new RipTide drilling reamer launched in 2010. The technology is used to activate and deactivate the drilling reamer remotely thus significantly increasing the value of the product for its customers, the oil and gas companies.

The product has been developed in conjunction with one of Weatherford main customers: Marathon Oil which was experimenting with RFID to enhance drilling operation and approached Weatherford to help develop the technology. The RFID enabled drilling reamer involved a RFID reader which was incorporated into the drill controller to control the cutting tool. To activate the tool, RFID tags are sent via a dedicated dart to the downhole to reach the cutting tool. The tag transmits the instructions to the RFID reader located on the tool's controller and activates or deactivates the controller. A graphical user interface allows operators at the surface to program the drill. RFID tags and reader also collect data during the drilling from other devices located in the drilling apparatus such as accelerometers and pressure transducers. Once the controller is brought to the surface, the data can be downloaded and analysed thus allowing customers to determine how effectively the tool is functioning. The RFID enabled drilling reamer is creating significant value for Weatherford customers as it increases the speed and accuracy of drilling. Faster and more accurate drilling means that the RFID enabled drilling reamer can drill holes that are bigger than those drilled with comparable hydraulic based reamers. Bigger holes mean higher extraction volumes. The RFID enabled product is thus allowing the firm to differentiate its product in the marketspace vis-à-vis the existing hydraulic based drilling reamers.

## Silicon Valley Tech Museum of Innovation: RFID as value transformer

Silicon Valley's Tech Museum of Innovation had been using RFID since 2004. Wristband embedded with RFID tags have been used to identify exhibits that customers visit, to select the language of content that needs to be displayed for each of these exhibits, and to gather information about these exhibits and build a personalised web page that customers can log on with the RFID tag ID and access later on. The espoused driver for deploying the technology was to enhance and extend visitors' experience. For example, the case study dwells on how RFID improves convenience by allowing customers to visit the museum without having to carry leaflets with additional information.

In reality however, the museum exploits RFID to develop new value propositions for its customers. RFID allows the museum to provide an entirely new kind of service: a personalised web page with additional information about the customer selected exhibits, with personalised pictures (as some RFID reader stations can also take pictures of the visitors in front of an exhibit and upload them online) that extends the service beyond time and space confines of the visit to the museum. Moreover, the technology allows the development of new forms of interactive products. For example, using RFID tags and the associated web page, visitors can engage in new ways with the exhibits through participating in experiments whose development can be observed online during the next days, such as inserting jellyfish DNA into bacteria to change colour. Visitors initiate the experiment while at the museum, read their tag to associate the experiment with their personalised web page, and during the following days staff take pictures of the progress of the experiment and upload them on the web. Visitors can access these pictures through their personalised web page. Similarly, RFID tags can be used to store information about the interactive games that visitors play whilst at the museum and display in game pictures, updated contest information and ranking on the webpage. The ability to

track and trace the exhibits that visitors interact with, combined with the development of other applications (web, interactive games) had allowed the museum to develop new value proposition for the customers. The development of such new types of interactive services is seen as a way of attracting and engaging new generation of visitors with the museum. Moreover, the development of RFID also allows the museum to provide value to sponsors and Tech's board of directors, many of which are from Silicon Valley companies, as a test bed for their new technologies.

### Marks and Spencer: RFID as activity enabler and value enabler

M&S had been using RFID to track and manage apparel items since 2003. In 2012 it decided to extent RFID tagging to all general merchandise across all 750 UK stores, and across 200 factors in 20 countries. By 2013, the technology had been rolled out to the homeware department. The deployment is largely portrayed in the case study as marking a fundamental change in the business both in terms of transforming how the company organises its operations, and how the service is delivered to customers.

RFID tags are attached to each piece of merchandise within stores. Sales associates use RFID readers to take the inventory twice a month by scanning the sales floor and the stockroom. The reader automatically removes duplicate reads and transmits the information to the company's central RFID database. Once data has been verified, the system updates the store's stock database. The system also updates automatically the daily delivery list, thus highlighting the merchandise that needs to be replenished. The system streamlines inventory management by speeding up inventory tracking and stock replenishment resulting in lower costs. RFID is also used to support omnichannel experience, by integrating RFID with existing systems. For example RFID system is integrated with the M&S touch-screen kiosks that allow a customer to place an item in front of the kiosk and access information about and order related products. RFID is thus deployed to improve customer service, enhancing the value proposition. The technology is thus currently deployed by the firm to improve the efficiency of existing inventory management activities and to enhance the service provided to its customers.

## Patterns of IT use for value creation

The first four cases presented illustrate the four categories identified in our framework. We have found evidence for all four types of IT use. These findings demonstrate that contrary to the prevalent view in IT value research, IT contribution to value creation manifests not only through improvements in existing processes and activities (cf. Kim et al., 2011), but also through changes in the value proposition delivered to customers and embodied in the firm's products and services. Moreover, we also find that such changes can range from enhancements in existing processes and products to more radical transformations that lead to significant changes in the business model of the firm, for example re-designing the scope of activities (e.g. Grand Rapids) or the nature of value delivered to customers (e.g. Silicon Tech Museum). Nevertheless, we find that by and large the use of IT as activity enabler dominates appearing in 81% of the cases (75 out of 91), with the other types of IT use trailing way behind with the next most popular use, value enabler appearing in only 24% of the cases. Our findings thus indicate that radical and non-process directed types of use are still relatively rare for RFID technology.

Our data revealed two different categories of IT use patterns. First, we can differentiate two patterns of use depending on whether the IT resource is dedicated to one type of IT use, e.g. as activity enabler (e.g. Metro), versus combinations of at least two types of IT use where the technology is used to achieve multiple objectives, e.g. Marks and Spencer where RFID infrastructure and applications are used both to improve the inventory management process and to seamlessly link the offline and online channels thus improving the service for customers. Second, we can differentiate between patterns of use depending on the discourse surrounding the deployment of the technology: conforming where the espoused use conforms to the real use, and framing where the firm portrays the use of IT differently from the real deployment. For example, in case of Metro RFID the espoused focus of RFID deployment was on streamlining inventory management (conforming), while in the case of Marks and Spencer the technology was framed as playing a transformative role both in terms of redesigning existing processes and in radically altering the value proposition for the consumers. In reality

however, and at least for the time being, the deployment with Marks and Spencer had the more mundane effect of enhancing existing activities and value proposition. In the case of framing patterns, two types of framing emerge: framing horizontally from activity to value (value directed) or from value to activity (activity directed), and framing vertically, either from enabler to transformer (up) or from transformer use to enabler use (down). For example, in the case of Marks and Spencer framing is up from the real use as an enabler, to an espoused use as a transformer. In the case of the Silicon Tech Museum the framing is down, with the espoused focus of the use of RFID on improving the existing service delivered to visitors, while in reality the deployment of RFID allows the museum to transform the value proposition by developing new, interactive forms of services. While we find evidence in our data for all types of patterns of IT use (see table 1), we find that dedicated use and conforming patterns predominate, representing 71% and respectively 68% of the cases.

| Patterns / Types | Total cases | AE | % | AT | % | VE | % | VT | % | Conforming | % | Framing | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dedicated use | 65 | 52 | 80% | 4 | 6% | 7 | 11% | 2 | 3% | 52 | 80% | 13 | 20% |
| Combined use | 26² | 22 | 85% | 11 | 42% | 15 | 58% | 7 | 27% | 10 | 38% | 16 | 62% |
| TOTAL | 91 | 74 | 81% | 15 | 16% | 22 | 24% | 9 | 10% | 62 | 68% | 29 | 32% |

Table 1.        Patterns versus types of IT use.

As expected, activity enabler is also the most popular type of co-use appearing in 85% of combined uses, with value transformer being the least popular appearing only in 27% of combinations. Although other types of IT use appear only rarely as dedicated uses, we find that activity transformers and value enabler appear in about half of the combined usage cases (42% and respectively 58%). This finding might indicate that firms experiment with other types of IT use following the deployment of IT first as an activity enabler. We also find that while dedicated use cases tend to be conforming (80% of the dedicated cases are conforming), firms engaging in combined uses tend to involve at least some element of framing as framing appears in 62% of the combined cases.

## Evolution of patterns of IT use over time

The table below presents the distribution of the patterns over time

| Year | No | Type o IT use | | | | Patterns: number | | Patterns: espoused | | Type of framing | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | AE | AT | VE | VT | Dedicated | Combined | Conforming | Framing | up | down | Activity directed | Value directed |
| 2002 | 7 | 6 | 0 | 1 | 2 | 5 | 2 | 5 | 2 | 1 | 1 | 1 | 0 |
| 2003 | 7 | 5 | 2 | 3 | 1 | 4 | 3 | 4 | 3 | 0 | 3 | 0 | 0 |
| 2004 | 7 | 5 | 2 | 2 | 0 | 5 | 2 | 3 | 4 | 1 | 1 | 1 | 2 |
| 2005 | 7 | 5 | 0 | 2 | 2 | 5 | 2 | 3 | 4 | 2 | 1 | 1 | 1 |
| 2006 | 7 | 7 | 0 | 2 | 0 | 5 | 2 | 7 | 0 | 0 | 0 | 0 | 0 |
| 2007 | 7 | 6 | 1 | 1 | 0 | 6 | 1 | 6 | 1 | 1 | 0 | 0 | 0 |
| 2008 | 7 | 6 | 0 | 2 | 0 | 6 | 1 | 5 | 2 | 1 | 0 | 1 | 0 |
| 2009 | 7 | 7 | 1 | 0 | 2 | 5 | 2 | 6 | 1 | 0 | 1 | 0 | 0 |
| 2010 | 7 | 6 | 2 | 1 | 1 | 5 | 2 | 4 | 3 | 0 | 2 | 1 | 0 |
| 2011 | 7 | 7 | 1 | 1 | 0 | 5 | 2 | 6 | 1 | 0 | 0 | 0 | 1 |
| 2012 | 7 | 4 | 2 | 2 | 0 | 6 | 1 | 4 | 3 | 0 | 2 | 1 | 1 |

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² Combined use include combinations of two, three or four types of IT use, hence the sum of types of IT use which are used in combination can be greater than the total cases of combined use (i.e. AE+AT+VE; AE + AT => 2 cases of combined use, but AE involved in 2, AT involved in 2 and VE involved in 1).

| 2013 | 7 | 4 | 2 | 3 | 1 | 4 | 3 | 5 | 2 | 0 | 2 | 0 | 0 |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2014 | 7 | 6 | 2 | 2 | 0 | 4 | 3 | 4 | 3 | 2 | 0 | 0 | 1 |

*Table 1.        Distribution of patterns of use over time.*

Contrary to our expectations, we can identify no noticeable trend towards an increase in either in transformative use (from enabler towards transformative) or in value use (away from changing activities towards influencing the value proposition component of the business model). The use of RFID as an activity enabler dominates in equal measure across the 12 years, while evidence of transformative and/or value use is evident from the beginning without any discernible upwards trend. Similarly, the pattern of dedicated versus combined use, and framing versus conforming also remains largely constant over the year.

When examining the distribution of types of framing over time, we can notice an absence of framing up in the second part of our period (from 2009) from enabling to transformative, although such framing up was noticeable in the first period. This framing tendency, rather than necessarily the underlying patterns of actual use, could reflect the adaptation of firms to changes in the prevalent expectations for the transformative use of IT, which from being largely expected in the early years of RFID adoption have been tempered in the recent years as RFID has become more widely spread and the case for adoption has been clarified.

## Conclusions

This paper set out to explore how IT is used in firms to create value. To guide our exploration, we draw from Demil and Lecocq's (2010) transformative business model approach to develop a framework to identify four types of IT use to create value in firms depending on the locus and nature of IT impact. We then apply this framework to the case of RFID and examine the evolution of different patterns of IT use over time. We find that firms predominantly use RFID to create value through improving the efficiency of existing processes and activities. However, in contrast to existing research (Kim et al., 2011; Schryen, 2013) we also find evidence that firms use RFID to change the product and services that embody the firm's value proposition, and to radically transform both their value creation activities and their value propositions. Such transformative uses of IT for value creation explain how established firm use IT to change their existing business models either through transforming their value proposition (e.g. Tech Museum), or through re-designing their activity system (e.g. Grand Rapids).

Where our main contribution lies is the identification of different patterns of IT use which explain how firms deploy IT resources to generate value within the confine of existing business models: dedicated versus combined uses, and conforming versus framing. We find that dedicated use dominates, where IT resources are deployed to achieve one particular objective (e.g. activity enhancer or value transformer), and that such use generally conforms to its espoused purpose. We also find evidence of combined use where firms use the same IT resources to achieve multiple types of impacts and/or across different loci. Combined use is akin to Schryen's (2013) approach to disaggregate IT resources and link them to different business objectives in order to identify synergies between different assets. In our case, we find that firm link particular IT resources (i.e. a particular RFID application) to multiple purposes so that synergies are exploited between different types of IT use. For example in the case of Marks and Spencer, the deployment of RFID improve inventory management system also allowed the company to link the online and offline channels thus improving the quality of the service delivered to customers who demanded seamless interaction across multiple channels. These synergies between multiple types of IT use translated into better exploitation of RFID resources to create enhanced value for the firm. We also find that firms that rely on combined use generally tend to frame their deployment either as more conservative or as more transformative (e.g. the case of Marks and Spencer) than it really is. Framing is often associated with seeking legitimation, with firms framing organisational activities and processes in ways that match the expectations of their relevant audiences (Dougherty and Heller, 1994). It is thus possible that framing patterns are indicative of firms' efforts to adapt to different expectations of their relevant audiences, either customers (for example in framing activity use as value use to emphasise change in value proposition), or

shareholders (for example in framing enabling as transformative to portray the image of an innovative firm).

Contrary to our expectations, we did not find any evidence of change in patterns of usage over time, with the exception of a decrease in framing up uses. This finding suggests that, at least for the case of RFID, transformative and value focused uses of technology have existed since the early stages of technology adoption. There is also no noticeable change in the patterns of use over time. The constant and predominant use as activity enabler could be linked with the organising vision (cf. Swanson and Ramiller, 1997) that emerged during the evolution of the technology. In the case of RFID, the discourse concerning the organisational application focused on process improvements starting with automotive applications in early 2000, to the mandates of retailers in early 2000s and up to more recent exploitations for supply chain efficiency improvements in other sectors (Bunduchi et al., 2011). As consensus emerged around an organising vision linked to activity and process improvement, implementation efforts continue to concentrate mainly within this domain. One of the limitation of this research is however our focus solely on the scope of technology deployment (value or activity, enabler or transformative) rather than the scale of deployment (e.g. pilot to full implementation). It is likely that in many of the early cases the scale of implementation was significantly smaller while with the more recent cases, as the business case for RFID developed, costs went down and technology advanced the scale of deployment increased. Evidence of this exists in some of our cases (e.g. Marks and Spencer which mentions early, smaller scale deployment). It is thus likely to find that over time the major tendency is a change in scale from small to large rather than the scope of use, from activity to value and/or from enabler to transformer.

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