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Impacts of RFID on Business Models

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1. Introduction

Business model describes the business logic a company or network of companies use to generate revenue and create customer and network value. It enables to identify how inputs of a company or network of companies are transformed to value-adding outputs (Kamoun, 2008). RFID affects business models through guiding new business models (e.g. RFID-enabled pay-per-use business model) or reshaping existing ones and thereby enables value creation. The number of studies that deals with the mentioned impact of RFID on business models is limited. Understanding the impact of RFID on business models is essential for companies to create a business value by using RFID in order to gain competitive advantage. This study aims to illustrate and clarify the mentioned impact. Thereby it provides an important contribution to the limited studies in the relevant literature.

In this study initially the term “business model” is defined. Subsequently the business model framework adopted in the study is presented and the major components of RFID systems are reviewed briefly. This is followed by brief explanations about RFID business models. Furthermore it is discussed how RFID systems influence the components of the adopted business model framework and how they contribute to reshape existing business models or create new ones. The study concludes with the main findings and implications.

2. Methodology

This conceptual study is a basic research, which is executed based on the previous studies about business models, business model frameworks, benefits of RFID systems as well as the limited studies about the impact of RFID systems on the components of business model frameworks. Its aim is to reorganize the existent ideas in order to give an insight how companies can create business value from RFID technology.

3. Business models

3.1 Definition of business models

Different definitions for the term business model and its building blocks exist in the relevant literature. Table 1 below includes the definitions of some authors.

Based on the definitions in Table 1 business model can be defined as a model that describes how a company or network of companies creates value from new products, innovations, activities for business partners and customers.

Author(s)	Definition
Timmers (1998), (as cited in Schweizer, 2005)	Timmers defines business model as <i>“an architecture for the product, service and information flows including a description of the various business actors and their roles, a description of the potential benefits for the various business actors and a description of the sources of revenues.”</i>
Hamel (2000), (as cited in Schweizer, 2005)	Hamel defines four elements that form a business model: customer interface, core strategy, strategic resources and value network. The customer interface and the value network represent the relation between buyer and supplier side. The core strategy represents the mission of the company and the scope of production. Strategic resources explain competitive advantage gained through competencies and assets deployed. Competencies and assets support the underlying strategy through customer benefits resulting from the core strategy and through company boundaries intermediating between the strategic resources and the value network where a company is positioned.
Hoppe and Kollmer (2001), (as cited in Schweizer, 2005)	Hoppe and Kollmer define business model as an integrated and consistent picture of a company that illustrates the way it aims to generate revenues.
Magretta (2002), (as cited in Schweizer, 2005)	Magretta defines business model as a story that explains how companies work and that contains motivation and a plan that describes how value is delivered.
Betz (2002)	<i>“A business model is an abstraction of a business identifying how that business profitably makes money. Business models are abstracts about how inputs to an organization are transformed to value-adding outputs.”</i>
Osterwalder, Pigneur and Tucci (2005)	<i>“A business model is a conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific firm. It is a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing and delivering this value and relationship capital to generate profitable and sustainable revenue streams.”</i>
Kamoun (2008)	Kamoun defines business model as <i>“the logic a company or network of companies use to generate revenue and create customer and network value.”</i> According to Kamoun business model can be defined as a blueprint that defines the way a business creates and captures value from new services, products or innovations.
Shi and Manning (2009)	Shi and Manning define business model as <i>“the outcome of management actions – planned, emergent or realized – in defining a firms’s offerings and activities.”</i>

Table 1. Business Model Definitions

3.2 Business model framework

Basic building blocks of a business model and the external forces that have an affect on these blocks are described in a business model framework. In the relevant literature various business model frameworks are proposed (e.g. framework of Kamoun (Kamoun, 2008), framework of Shi and Manning (Shi & Manning, 2009), framework of Osterwalder, Pigneur and Tucci (Osterwalder et al., 2005)). Among these frameworks the value-driven framework of Kamoun (see Figure 1), which is constructed considering the inherent use of business model in conceptualizing the value creation and money earning logic of a company or network of companies, is adopted in this study.

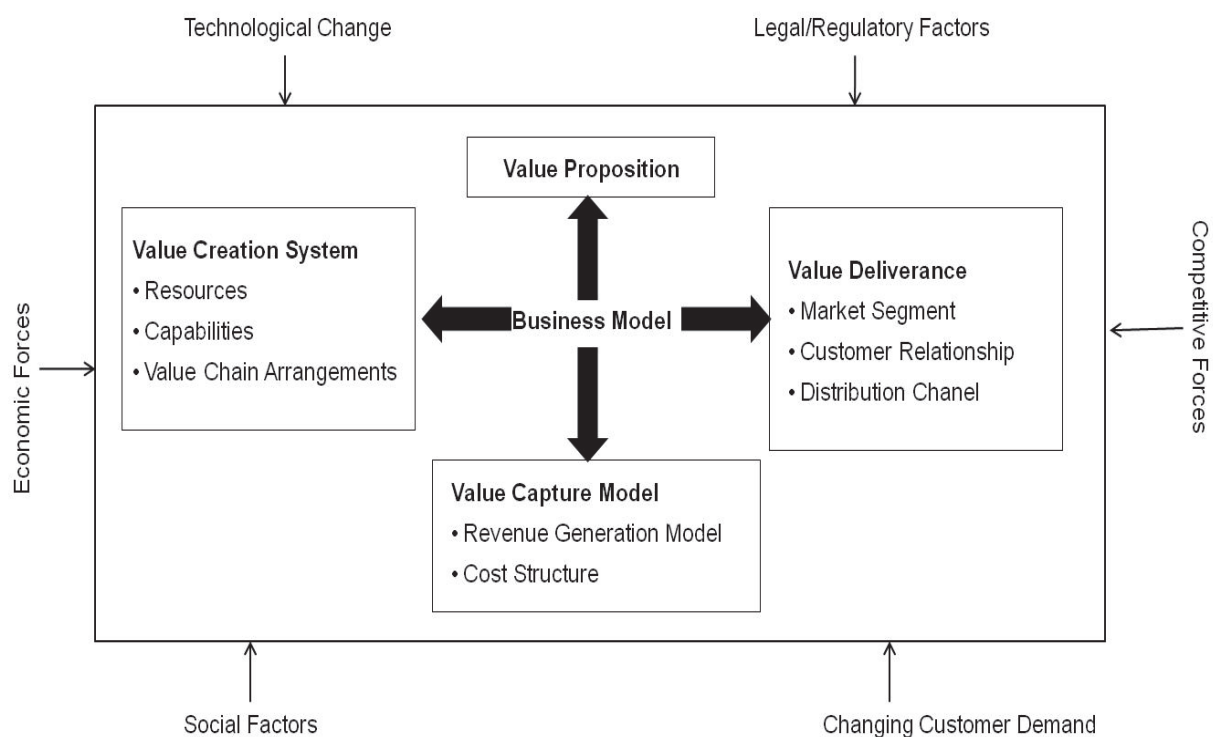


Fig. 1. Business Model Framework of Kamoun (Kamoun, 2008)

The business model framework of Kamoun encompasses four main components: value proposition, value creation system, value deliverance and value capture model. Each of these four components is further divided into subcomponents (see Table 2).

As shown in Figure 1 the components of the defined framework are influenced by external environmental forces "economy", "technological change", "legal/regulatory factors", "social factors", "competitive forces" and "customer demand".

Component	Description
Value Proposition	This component defines the added value that is offered by a company or network of companies to its customers via a bundle of new products, services or innovations.
Value Creation System	This component consists of subcomponents that are necessary to create the above mentioned added value.
Resources	Financial, physical, human, technological and organizational resources that are necessary to execute the business model and deliver the proposed added value.
Capabilities	Skills that are necessary to coordinate the resources.
Value Chain Arrangement	With this component the structure of the value chain is intended. Under the structure the inter-linked activities and alliances of the company with suppliers, partners and distributors have to be understood. These activities and alliances are necessary to execute the business model and deliver the proposed value.
Value Deliverance	This component consists of subcomponents that are relevant to deliver the proposed value.
Market Segment	This component represents the group of customers and geographic markets a company wants to deliver the proposed value. Different segments might have different needs. As a result of this, different products, services and value proposition might be required.
Customer Relationship	This component represents the link the company establishes with its customer to deliver the proposed value.
Distribution Channel	This component represents the way a company transmits its customers its products, services that have an added value for customers.
Value Capture Model	This component consists of subcomponents that are relevant to revenue and costs that arise from the proposed value.
Revenue Generation Model	This component defines how the income is generated. It defines the impact of the proposed value on revenue.
Cost Structure	This component defines the costs that arise to execute the business model and deliver the proposed value.

Table 2. Components of Business Model Framework of Kamoun (Kamoun, 2008)

4. RFID-systems

RFID is an Auto-ID technology that enables to identify tagged items by means of radio waves. Main components of a RFID system are:

- *Tag (Transponder)*: It consists of an antenna and a microchip. Microchip stores data about the tagged item. Antenna transmits the data about the tagged item to the reader by means of radio waves (Kavas, 2007).
- *Reader (Transceiver)*: It is a device that communicates with tags through radio waves and reads data on them (Karygiannis et al., 2007).
- *RFID Middleware*: It is a software that is used to consolidate, aggregate, process and filter raw RFID data received from multiple readers to generate useful information for end-users. It transmits also the processed data to backend enterprise applications (Kamoun, 2008).

- *RFID System Software*: It is necessary for the communication between tags and readers. This software enables to read tags, write on tags, detect and fix erroneous data as well as to realize authentication for security (Üstündağ, 2008).
- *Backend Enterprise Service*: This service enables to receive filtered RFID data from the middleware and integrate these with existing applications such as ERP, SCM or CRM systems through Application Programming Interfaces (APIs) (Kamoun, 2008).

5. Reshaping existing business models or creating new business models with RFID

RFID can reshape existing business models or create new ones. Instead of manual scanning of the products bought at paying counter, automatic scanning through RFID is an example for reshaping of a business model. Through reshaping, efficiency of business model can be increased. RFID is also used to reduce failure rate, shrinkage, operating stock and to enhance on-time delivery, shipment quality and so forth.

RFID technology can also be used to create a new business model that enables to generate new value creation opportunities and therewith to gain competitive advantage as well as to develop new ways to make money. Table 3 includes some examples for this type of RFID business models.

RFID Business Model	Description
RFID Infrastructure & Management Services Provider	Provider of RFID infrastructure-related products and solutions (e.g. tags, readers, data integration services, middleware)
RFID-enabled pay-per-use Business Model	According to this model a firm that has a huge number of assets in a given industry lets its trading partners to use these assets and to pay for the assets per use. The firm tracks its assets through RFID devices located throughout the supply chain.
RFID-based Security Provider	A firm that provides RFID-based tracking solutions for authentication, brand protection as well as to combat tampering, theft, counterfeiting.
Information and Business Intelligence Agent	A firm that uses RFID to offer new information-based services. It analyzes, for example with the use of data mining techniques, the extensive data collected from RFID systems and provides business intelligence solutions.

Table 3. Examples for RFID Business Models (Kamoun, 2008)

6. Impact of RFID on the components of the adopted business model framework

6.1 RFID and value proposition

RFID can provide a new or an added value for customers of companies that use this technology. As this value is a motive for customers to prefer the mentioned companies, it has a positive impact on the revenues of the companies. A new or an added value can be proposed by RFID:

- *Through creating a new way of conducting economic transactions among trading partners:* RFID enables to form new strategic networks such as buyer-supplier partnerships, pay-per-use business models. As RFID used in these networks provides various advantages (e.g. cost reduction, superior customer service level) for companies, they want to be a partner in such a network. For example, the tracking capability of RFID enables a company to realize pay-per-use business model that means invoicing the trading partner for the hired asset each time he uses the asset. Pay-per-use business models help trading partners, who participate in these models, to reduce purchasing, storage and maintenance costs as well as to eliminate losses due to stock thefts (Kamoun, 2008). For example, a furniture manufacturer can hire RFID-tagged sofas produced by him to a hotel according to pay-per-use model. He can monitor the usage of sofas with the help of RFID (e.g. a sofa can count the number of persons that sit on it, the person's weight and seating time) and create a monthly itemized billing statement to the hotel (Bohn et al., 2004). This model enables the hotel to exempt from purchasing and maintenance costs.
- *Through providing a superior customer service level:* Superior customer service level produced by using RFID increases customer satisfaction, which has a positive impact on the revenue stream of a company. For example, Metro aims to enrich the value of its product offerings through RFID-enabled smart shelves, smart dressing rooms that allow its customers to find the correct size, color and additional information about a displayed garment by touching a screen (Weber, 2003). Such a service can be a good motive for a consumer to go Metro for shopping.
- *Through reducing transaction costs by achieving transaction efficiencies:* RFID can increase the efficiency of executed transactions (Lin et al., 2006)). This causes reduction at transaction costs. Transaction efficiency and cost reduction can lead to lower prices that are an important motive for customers to prefer a company (Kamoun, 2008). For example, instead of scanning each product bought manually at the paying counter, a retailer can use RFID and scan automatically as well as instantaneously all bought products at the counter as the customer passes through a reader and exits the store. Thereby scanning and paying processes can be executed more quickly. This means time saving for customers and labor saving for companies that use RFID (Erickson & Kelly, 2007).

6.2 RFID and value deliverance

Among subcomponents of value deliverance RFID has an impact on customer relationship component. RFID can increase customer satisfaction that has a positive impact on revenue stream. For example in a store, which uses RFID, a customer can get information about the existence of a garment matching his style, size and color requirements and if the desired garment exist, the store's clerk can precisely locate the garment for him. If the garment is out of stock, customer can get information with the help of RFID-enabled system about the nearest store where the garment is available. Contactless checkouts are other examples that increase customer satisfaction by using RFID. This type of checkouts enables automatic scanning of RFID-tagged items in shopping carts by RFID readers at checkout counters. Readers enable also the automatic billing of customers using their RFID-tagged credit cards (Kamoun, 2008). Gaining insights about consumer behaviours is essential to execute marketing activities successfully. Marketing activities aim to increase customer satisfaction and thereby to affect revenue stream positively. Data mining technologies enable to gain the necessary insights. It is possible to combine RFID with data mining technologies. Based on RFID-captured consumer behaviour valuable insights about consumer behaviour can be created with the help of data

mining technologies. These insights are used to enhance responsiveness of companies to their customer preferences (Kamoun, 2008; Hoffmann et al., 2005). Clothing retailer, for example, can make promotional offers based on collected and analyzed information of buying habit (size, favorite colours etc.) of a consumer who has a loyalty card (Erickson & Kelly, 2007).

6.3 RFID and value capture

6.3.1 RFID and revenue model

As illustrated above RFID can increase customer satisfaction, strengthen customer loyalty and thereby has a positive impact on revenue (Kamoun, 2008).

RFID can also be used to protect manufacturers against counterfeits, which are a real threat to the revenues of manufacturers (Kamoun, 2008). Product authentication plays an important role to combat counterfeiting and to detect counterfeit products. It enables to determine whether a given product is genuine or counterfeit. RFID-based product authentication is an important technological measure for checking the originality of a product that moves in a network of companies. Up to consumer each actor in a network can be the entry point of the counterfeit product. To realize a secure network each actor in a network has to verify the authenticity of the products on hand. To understand whether a given product is genuine or counterfeit, the insertion of a security feature into the product and the authentication of this feature are essential. RFID tags can be used for the authentication of security features (Filimon, 2008).

RFID increases network visibility, which affects revenues positively (Kamoun, 2008; Erickson & Kelly, 2007; Lin et al., 2006). Out-of-stock situations, which means loss of revenues, can be prevented through a better visibility. Better network visibility prevents also to retain great amount of stock that can be sold at discounted prices, if it is not sold by the end of the season (Kamoun, 2008).

6.3.2 RFID and cost model

Cost structure is also an important subcomponent of the value capture component. Utilization of RFID in companies or company networks can contribute much to reduce costs. Below this contribution is illustrated based on some examples:

- RFID enables perpetual inventory that is important to get information about current inventory level. Through perpetual inventory time and costs for physical inventory are saved. Stocking more or less items as a result of false inventory information can also be prevented (LakeWest Group & MeadWestvaco Intelligent Systems, 2003).
- As every item from warehouses to distribution centers and from these centers to retail shelves can be tracked through RFID, a reduction in stockouts can be ascertained by using RFID. In companies or company networks items leaving shelves or facilities are automatically recorded via RFID, computers are updated in terms of existing stocks and purchasing is executed if inventory levels drop too low. With less worries about stockouts companies or networks hold less safety stocks. Reduction at stocks means less inventory costs (Erickson and Kelly, 2007; LakeWest Group & MeadWestvaco Intelligent Systems, 2003).
- As demand for stocking decreases it will be possible to use store floor, which is used before for stocking, for new products that enrich the product range of a company or network of companies. In other words additional merchandise will be available for sale without costly requirements of store design and remodel (LakeWest Group & MeadWestvaco Intelligent Systems, 2003).

- As mentioned above RFID enhances transaction efficiency that gives rise also to cost reductions. For example, automation of some processes (e.g. checkouts, incoming goods control) via RFID causes a reduction both at labor costs and costs that incur to rectify errors caused by manual execution (Erickson and Kelly, 2007).

6.4 RFID and value creation

In order to create value with RFID, resources such as IT personnel with proper training, RFID infrastructure (tags, readers, printers, antennas, computers, networking equipment, middleware, application software, integration software etc.) must exist. A budget must also be allocated (Kamoun, 2008).

To operate RFID systems and to create a value some capabilities are also necessary. Following some examples for capabilities are listed (Kamoun, 2008):

- Ability to deal with erroneous tag reads, data redundancy, damaged tags
- Ability to manage reader and tag collision, signal inference and noise
- Ability to overcome great amount data generated by readers to enhance existing knowledge base and enable intelligent decision making.

RFID affects the structure of value chains in three ways (Kamoun, 2008):

- It eliminates inefficiencies in existing value chains. For example, RFID enables to track the movements of goods from the store's back door to the point of purchase in real time. This leads to better inventory visibility.
- It can enhance the collaboration between chain partners. For example, the collaboration between retailers and suppliers can be enhanced through RFID that enables suppliers to optimize production and replenishment scheduling based on real-time demand.
- It can give rise to new strategic networks. RFID enabled pay-per-use business model is an example for such a strategic network.

6.5 RFID and external environmental factors

Among external factors shown in Figure 1 technological change, competitive forces and legal/regulatory factors are relevant for RFID business models.

As at the present day RFID infrastructure is costly the use of this technology is limited. However through technological developments it is expected that infrastructure costs will decrease. For example, it is expected that with the help of nano technology silicone chip demand will disappear and through ink based RFID circuits costs of tags will decrease (Kış, 2006).

Adversaries of RFID declare that RFID threatens data privacy. According to them through RFID consumers can be tracked and thereby not only the consumption behaviours of consumers but also their private lives and other habits can be tracked (LakeWest Group & MeadWestvaco Intelligent Systems, 2003). However through some methods data privacy can be protected. Using lock command, kill command, press-to-activate switch, blocker tags, clipped tags and electromagnetic shielding, active jamming, frequency hopping, encryption of data in transit, encryption of data stored on tags, authentication are some examples for these methods. Furthermore regulative countermeasures can play an important role to eliminate fears about data privacy. Garfinkel's manifesto - named RFID Bill of Rights - is an example for regulative countermeasures. According to this manifesto consumers that consume tagged products have the following rights (Korkmaz et al., 2006):

- To know whether a product is tagged

- To have a choice to accept, discard, disable or remove the tag
- To know which information is saved on tags
- To know when, where and why tags are read
- Not to lose their rights (e.g. right of product return) even if they prefer to buy products without tags or deactivate tags with kill command.

The firm IDTechEx projects a very rapid growth in RFID. A market research report, which is executed by this firm, contains the predictions in Table 4 about the deployment of RFID tags from 2005 to 2015 (Raafat et al., 2007). In an environment, in which the use of RFID increases rapidly, companies have to use RFID in order to outmatch and not to lose market share.

Year Categories in which tags are used	2005	2010	2015
Item	0.5	27.0	1,000.0
Pallet/Case	0.4	30.0	35.0
Other	0.4	5.7	12.5
All Categories Total	1.3	62.7	1,047.5

Table 4. Forecast for global sales of RFID tags in billions between 2005-2015 (Raafat et al., 2007)

7. Conclusion

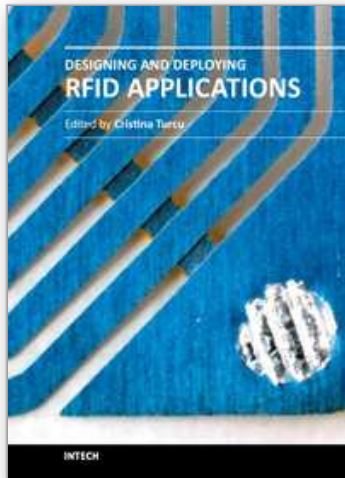
In order to gain advantages over competitors, companies or network of companies can use technological innovations to reshape their business models or to create new ones. RFID is one of these innovations. This technology reshapes business models through automating transactions (e.g. contactless checkouts). Thereby it contributes to increase transactional efficiency. RFID can also be used to create a new business model through developing new ways to make money. For example, a firm that offers business intelligence solutions with the use of data mining techniques can integrate its business intelligence software with RFID and start to analyze data collected from RFID systems. Thereby the firm can offer its customers a new information-based service that brings it money. RFID users can propose an added value or a new value for their customers. Added or new value increases customer satisfaction that has a positive impact on the revenue stream of RFID users. Naturally to create the mentioned value certain resources as well as capabilities and sometimes changes at organizational structures are required. As these requirements cause costs, it will be logical to invest in RFID if the impact of created value on revenue is greater than its impact on costs that arise to create the value. Only those organizations that consider this relation can benefit from RFID business models.

Technological developments contribute much to decrease especially the infrastructure costs of RFID technology. It is expected that this will increase the utilization of RFID in the near future. As a result of this companies will apply RFID technology to compete with their rivals. RFID adversaries declare that RFID threatens data privacy. Despite this declaration it seems that the rapid deployment of RFID cannot be prevented, because both technical and regulative countermeasures are available to protect data privacy.

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Designing and Deploying RFID Applications

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Radio Frequency Identification (RFID), a method of remotely storing and receiving data using devices called RFID tags, brings many real business benefits to today world's organizations. Over the years, RFID research has resulted in many concrete achievements and also contributed to the creation of communities that bring scientists and engineers together with users. This book includes valuable research studies of the experienced scientists in the field of RFID, including most recent developments. The book offers new insights, solutions and ideas for the design of efficient RFID architectures and applications. While not pretending to be comprehensive, its wide coverage may be appropriate not only for RFID novices, but also for engineers, researchers, industry personnel, and all possible candidates to produce new and valuable results in RFID domain.

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