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Characteristics of Value Bundles in RFID-Enabled Supply Networks

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CHARACTERISTICS OF VALUE BUNDLES IN RFID-ENABLED SUPPLY NETWORKS

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Abstract

In order to avoid ruinous price competition, companies are intensely seeking new ways to stand out from competitors in a global market scenario. In response to this aim, value bundles provide an approach to grade up existing offerings from isolated goods and services to integrated problem solutions for specific customer needs. This differentiation strategy relies on supply networks as an essential enabler. However, the effect of RFID as a major innovation in supply chain networks on their ability to enable value bundles is widely unexplored. In this paper we use the morphological method to identify typical characteristics of value bundles in RFID-enabled supply networks. The outcome is a set of characteristics which allows for categorization and, based on this, structured comparison of any respective value bundles. The categorization is illustrated and validated with three case studies.

Keywords: value bundles, RFID, supply network, strategic supply networks, supply chain management

Introduction

In the global market scenario offerings from companies are easily comparable. In such competitive markets often price leadership is the answer to gain market shares – a strategy which includes the risk of minimizing contribution margins. Therefore, differentiation could be a more eligible strategy. A promising way for differentiation on the market is providing value bundles as an integrated solution of purchasing goods and services [1]. Although value bundles are partially established as offerings on the market, the management of value bundles with common business processes like supply chain management is not well supported [2]. Research on value bundles management is mainly focused on developing enhancements for established business processes. Only little research in the area of value bundles in supply networks although supply networks are considered as an appropriate way to realize value bundles.

The research objective of this paper is to contribute to reference modeling in the area of value bundles and supply networks by deriving a classification of value bundles in RFID enabled supply networks. For this we derive characteristics from literature and modeling concepts and apply them to several case studies of value bundles. The outcome is a set of characteristics and instances of value bundles in RFID enabled supply networks which should be considered when using RFID technology to improve supply chain management for value bundles.

The paper is structured as follows: in the second section we explain the background of value bundles, supplier networks and RFID according to the existing literature. In the third section we derive the characteristics of value bundles in RFID-enabled supplier networks and consolidate them by using the morphological method. In the fourth section we illustrate and validate our results by the categorization of three case studies from various industries. In the fifth section we reflect on the results with regard to possible standard types of value bundles in RFID enabled supply networks. In the last section we draw conclusions and discuss further research.

Background

Value bundles

To step out of the trap of decreasing margins value bundles are an appropriate way the make a difference in the market [3]. Value bundles are an integrated combination of physical products and services with the goal to solve a specific customer problem [4]. Generally spoken value bundles are combinations of physical products, services and intangible assets like guaranties or accrued rights. From a customer point of view, value bundles occur as integrated solution with mostly no possibility to recognize the single components of the bundle. From a supplier point of view the value bundle can be divided in different components. Depending on the degree of occurrence value bundles can be subdivided in four components: standard physical products, standard services, customer specific products and customer specific services. The cut off between these four components is not dichotomous but the transitions between the elements are linear in the way that there are multiple options in combining different elements to value bundles.
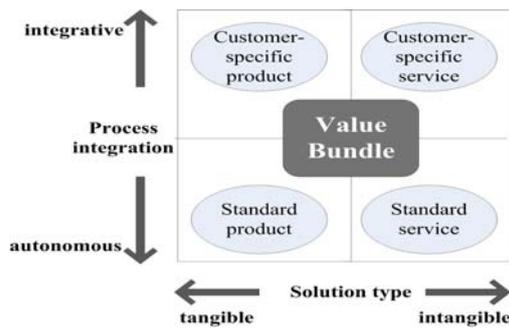
Fig. 1: Definition of value bundles

One central point of the concept of value bundles is that the starting point for the service provision is not the single service but the customers need to solve a problem [4]. Therefore the focus of all modeling concerning value bundles is the customer point of view. In summary a value bundle is a specific combination of physical products, services and intangible assets aligned on customer needs.

Integration is a core characteristic of value bundles. This means not only the integration of products and services to a combined solution but also the integration of processes on the customer side and on the supplier side [5].

The level of integration may vary in value bundles [6]. On the one side there are standardized physical products combines with services directly related to the physical product. The integration is very loose and there would be the possibility to offer the individual parts of the bundling also stand alone. On the other side there is the business case of performance contracting where the offer of a value bundle consists of several service agreements to the customer [7]. These service agreements make use of the physical products and service combined in the value bundle but the customer only deals with the service agreements. From the customer point of view it is not possible to split the physical parts in the value bundle from the service parts.

Value bundles may change their composition during their product life cycle. Product life cycle can be separated in three stages: product construction, product utilization and follow up use [8]. In the first section product construction focus is on identifying, evaluate and establish relationships between the relevant suppliers for the value bundle. In the section of product utilization the attention is drawn on the interaction between the suppliers and the customer, to keep up service agreements and further intangible assets. There is also a need to identify risks in order to fulfill the requirements the customer has on the value bundle. In the follow up use the main concern is on getting the value bundle out of use in an appropriate way or the manage substitution with new value bundles. The summary of the product life cycle

section and the corresponding focus areas are displayed in Tab. 1.

Tab. 1: Product life cycle section and corresponding focus areas

Product Life Cycle section	Focus areas
Product construction	Supplier identification Supplier evaluation Supplier selection
Product utilization	Supplier interaction Customer interaction Risk Management
Follow up use	Decomposition Substitution

High integrated value bundles with a significant fraction of services and intangible assets are considerably integrated in the business processes of the customer. Regarding performance contracting as the highest form of integration value bundles are a direct part of the customers' business processes. By a process perspective again assuming a appropriate information infrastructure there are three possible types of process integration between the customer processes and the supplier processes: by the focal supplier, by a combination of focal supplier and one or more n-tier supplier or even directly by a n-tier supplier (Fig. 2).
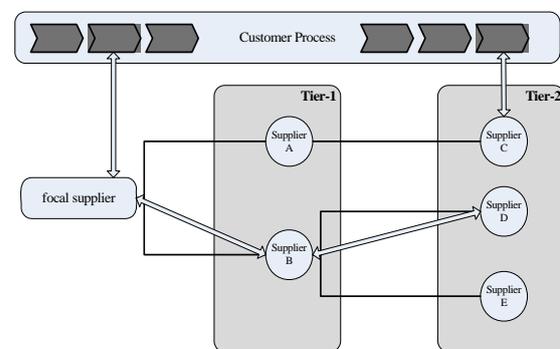
Fig. 2: Current process integration of supplier networks in customer processes

Supply Networks
There are several ways to establish offerings consisting of value bundles depending on the core competencies of the regarded company. Possible forms of the realization of value bundles may be classified in a hierarchical form, a cooperation or a market form [9]. Coming from a very focused structure as a production company it is possible to establish an additional service organization within the company to support value bundling. The same scenario holds vice versa for a company solely

focused on service offerings. This hierarchical organization form is often used in an early stage of offering value bundles. A second option for provisioning value bundles is the generation of combined offerings from the market. The offering company buys additional service or products from the market and combines these purchased services or products with their own offerings to a value bundle. This arrangement works well in situation where there is only a tight integration of the individual parts of the value bundle und with no significant integration of the value bundle in existing customer processes. The third option is to establish tight cooperation between different supplier companies [10]. This option leads to supply networks to support the construction and use of value bundles.

Supply networks base upon the concept of supply chains management. The supply chain has been defined as 'the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer' [11]. Supply chain management aims to increase transparency and alignment of the supply chain's coordination and configuration by looking not only at the next entity or actor but looking across the entire supply chain, regardless of functional or corporate boundaries [12].

Supply networks consist of several independent suppliers from whom one of these suppliers is considered to be a focal supplier having the offering for the customer. The focal supplier organizes all aspects of the value bundle in the supply network. Although the organization of supply networks is slightly complex the benefits of this organization form for value bundles are immense. The attention of this organization form is in the linkage of business process and therefore a useful method to organize value bundles. Concerning highly integrated value bundles the delivery of these bundles happens in a service process which is tightly integrated to relevant customer processes.

Value bundles in terms of supply networks are value bundles with the elements of the bundle are coming from more than one supplier. Suppliers for different parts of the value bundle are considered to be independent companies. To pay attention to the customer perspective of the value bundle in the following one supplier will be identified as focal supplier. The focal supplier is the supplier with the commercial contact to the customer and is furthermore the head of the supplier network. Every other supplier is directly or indirectly (via another supplier) connected to the focal supplier (Fig. 3).
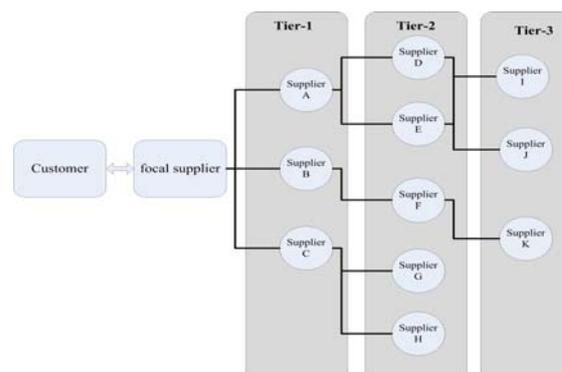
Fig. 3: Concept of a supplier network for value bundles

With the concept of a focal supplier it is natural to assume that the service provision is solely made by the focal supplier whereas every other supplier in the supply chain makes his service provision directly or indirectly to the focal supplier. By establishing a suitable information infrastructure it would be possible to consider three forms of service provision: by the focal supplier, by a combination of focal supplier and one or more n-tier supplier or even directly by an n-tier supplier.

RFID in Supply Chain Management

RFID is an automatic identification technology [13] which is expected to enhance many of the supply chain operations, affecting both intra- and inter-company processes. Core opportunities of using RFID in supply chain processes are cost reduction and the improvement of service levels. The standards for implementing RFID technology in the supply chain are set by EPCglobal [14]. One central part of the standardization is a globally unique electronic product code (EPC) [15]. By using an EPC each instance of a product may be uniquely identified in the supply chain and may include more information e.g. the producer of the product or the product type. EPCglobal suggests building information systems architectures in which unique product code observation data are globally available. Thus, every participant in the value chain can ask information about a specific product code from the appropriate company that holds this information.

RFID enhances core supply and demand chain management operations. The range is from warehouse management systems over retail distribution systems up to customer service systems [16]. Concerning supply networks the full benefits of RFID will be achieved only when all members of the supply network implement the technology.

Identification of the characteristics

In the following we follow the morphological method [17] in order to identify the characteristics of value bundles in RFID-enabled supply networks and find an exhaustive set of instances for each of them. Finally, the results will be combined to a morphological box. The characteristics are organized in three groups: strategic, assembly and utilization issues.

Strategic issues

First, we have to analyze, in which part of a supply chain process a value bundle may increase value through RFID technology. The decomposition of a complete supply chain management process delivers the sub-processes production, procurement, redemption, shipment, customer service, delivery and return [18].

Another crucial question is the impact of RFID on the supply chain management process. Regarding the general impact of IT on business processes like automation, information enhancement and transformation [19], in a RFID context the impact of the technology on the supply chain management process can be separated in handling time reduction, resource usage reduction, shrinkage reduction, failure reduction, process information and customer satisfaction [20].

In a supply network for value bundles added value may arise for different participants of the supply network. The value added may be solely at the customer side, solely at the supplier side or may be comprehensive of both customer and supplier. It would be preferred to derive clear intersections of the bandwidth of value add between customer and supplier. Following the examined examples no further classification can be detected. This will be part of further research.

A supply chain involves different actors to establish flows of goods and information [21] [22]. It is necessary to analyze every actor of the supply chain for the impact of RFID technology. Supply chain actors will be divided by raw-material supplier, supplier, producer, center of distribution, carrier and customer following a classification from [23].

Value bundles arise in different e-commerce business models. Thinking of mobile phones combined with a particular contract as one prominent example of value bundles the B2C business model deals already many years with value bundles. But there are a large number of examples already in B2B as well as in B2A business models. The abbreviations B2C, B2C and B2A stand for the interaction type in the business model ("C" means "Customer, "B" means "Business", "A" means "Administration").

The distinction whether RFID is supported in only parts of the supply network or in the whole network completes the discussion of the strategic factors.

Assembly issues

Assembly factors describe key issues in the stage of construction of value bundle. In a supplier network the focal supplier issues his demand to the members of the network. Those members which are able to fulfill the demand partially or complete answer back with their product and service information. In a following negotiation phase all contracts will be evaluated and selected. Then the value bundle is established and may be presented to the customer.

One critical issue is the categorization of the value bundle. Components of value bundles may be classified in four categories: standard purchasing goods, standard services, customer-specific purchasing goods and customer-specific services [24]. The value bundle combines parts from these categories to one single offer to the customer. Therefore it is necessary to investigate the influence of RFID-technology in these categories.

Another critical question is the ratio of integration of the value bundle service provisioning. Following [24] there is a continuum from small to high depending on seven criteria of the value bundle service provisioning. Criteria range from the type of customer value over ratio of technical integration up to the variableness of the service provisioning on a timeline. Although in a sense of a continuum there is no clearly intersection there is a need to take the criteria of value bundle service provisioning integration in account for investigating the influence of RFID-technology in the different scenarios. Therefore we make a breakdown of the continuum in three parts: small, medium and high. Small and high follows the definition in [24]. Medium will be defined when the value bundle service provisioning tends in four of the seven criteria to one side of the continuum and tends in three of the seven criteria on the other side of the continuum.

Looking at the outcome of the value bundle there are different possibilities how the service provisioning of the value bundle is combined. These different combinations of the outcome are named as intangible asset ratio. The first possibility is a product orientation. An example for a product oriented value bundle is the selling of a machine combined with a service contract. A second possibility is an availability orientation. An example for this kind of orientation is the selling of a machine in combination with a availability guarantee. Output-orientation is a third type of orientation. This type of orientation holds true when selling not a machine plus different services but selling the output of the machine as production factor [25].

Utilization issues

One goal of value bundle is to increasing the value of the bundle for the customer in contrast to the offer of the single components of the value bundle [26] [27]. Therefore the customer appreciates a higher value for the value bundle which is an important selling factor for providers of value bundles. The appreciate value of the value bundle may be distinguished in appreciate benefit and appreciate costs [28].

Value bundles may differ in their composition during their product life cycle. To investigate the issue of RFID technology related to the product life cycle there will be a segmentation of the life cycle process in the steps pre-use, use and after-use.

Consolidation

As a last step we combine the resulting characteristics of value bundles in RFID-based supply networks and their instances to a morphological box [17] as displayed in Fig. 4.

	characteristics	instances						
strategic	RFID-relevant core processes in SCM	production	procurement	redemption	shipment	customer service	delivery	return
strategic	RFID impact type	handling time reduction	ressource usage reduction	shrinkage reduction	failure reduction	process information	customer satisfaction	
strategic	value added supplier network participant	customer		both		supplier		
strategic	supply chain actors	raw-material supplier	supplier	producer	center of distribution	carrier	customer	
strategic	interaction type	B2B		B2C		B2A		
strategic	RFID supply network support	partial			complete			
assembly	solution categorization	standard purchasing goods		standard services	customer-specific puchasing goods		customer-specific services	
assembly	integration ratio of service provisioning	small		medium		high		
assembly	intangible asset ratio of outcome	product-orientated		availability-orientated		output-orientated		
utilization	preceived value	preceived benefits			preceived costs			
utilization	product life cycle phase	pre-use		use		after-use		

Fig. 4: Morphological box of value bundles in RFID-enabled supply networks

Exemplary application

In the following chapter we illustrate and validate the categorization with three typical examples from plant engineering and construction, ICT hardware vending and HVAC.

Case study 1: Remedial action in the plant engineering and construction industry

In the plant engineering and construction industry remedial action is a typical process. In case of a malfunction of a plant it is necessary to evaluate the problem and to initiate the process of remedial action. This process can be concerned as a value bundle [29]. Looking in detail at the process following the example in [29] by the view of the results for RFID-enabled networks there is a clearly classification of this process into the morphological

box. The plant is expected to function properly. Therefore the value bundle is product oriented. The identification of the problem may be done by the customer or, if it not possible, by the supplier of the plant. If there is a part of the plant out of order there will be a repair service or a substation of the broken part. This takes a procurement process to order the new part. The RFID impact type is customer satisfaction and the supplier network participant is both because of the interaction in the process of failure detection. It is a B2B scenario with the possibility of partial supporting of supply network with RFID technology. The value bundle consists of standard purchasing goods on the one side and customer-specific services on the other side. The customer appreciates the benefits of the value bundle. The corresponding morphological box is displayed in Fig. 5.

	characteristics	instances						
strategic	RFID-relevant core processes in SCM	production	procurement	redemption	shipment	customer service	delivery	return
strategic	RFID impact type	handling time reduction	ressource usage reduction	shrinkage reduction	failure reduction	process information	customer satisfaction	
strategic	value added supplier network participant	customer		both		supplier		
strategic	supply chain actors	raw-material supplier	supplier	producer	center of distribution	carrier	customer	
strategic	interaction type	B2B		B2C		B2A		
strategic	RFID supply network support	partial			complete			
assembly	solution categorization	standard purchasing goods		standard services	customer-specific puchasing goods		customer-specific services	
assembly	integration ratio of service provisioning	small		medium		high		
assembly	intangible asset ratio of outcome	product-orientated		availability-orientated		output-orientated		
utilization	preceived value	preceived benefits			preceived costs			
utilization	product life cycle phase	pre-use		use		after-use		

Fig. 5: Morphological box for remedial action in the plant engineering and construction industry

Case study 2: Proposal process from an ICT vendor

Value bundles are common in the ICT industry [30]. Examples therefore are operating, maintenance and support of an IT network infrastructure. To create an offering to the customer is often very complex. Generally customers do not know their requirements in detail [31]. Furthermore the supplier must have knowledge about the business models and the business processes of the customer to customize the offer to the potential requirements of the customer in the future [32]. Value bundles are an appropriate possibility to support these interactions between customer and supplier to size the right offering. Looking at the case study in [33] the example of the value bundle proposal preparation can be categorized in the morphological box as follows. The whole process serves as customer service and the RFID

impact type is the optimize process information and therefore lead to customer satisfaction. The main participant in the value added supplier network is the customer, whereas the supply chain actors are the customer and the supplier who handles all possible combinations of products and services in terms of a value bundle. The described scenario is a B2C interaction but it might as well be a B2B interaction for business customers. RFID technology might enhance partial subnets of the relevant supply network.

The value bundle consists of standard purchasing good e.g. telephones and telephone modules and standard services according to the selected modules. The interaction ratio is small because of the low complexity of the value bundle. It is product oriented with the goal to serve as a basis for the following process steps implementation and operations support. The customer will appreciate the benefits of the value bundle, the product life cycle is pre-use. The corresponding morphological box is displayed in Fig. 6.

characteristics	instances						
RFID-relevant core processes in SCM	production	procurement	redemption	shipment	customer service	delivery	return
RFID impact type	handling time reduction	ressource usage reduction	shrinkage reduction	failure reduction	process information		customer satisfaction
value added supplier network participant	customer		both		supplier		
supply chain actors	raw-material supplier	supplier	producer	center of distribution	carrier		customer
interaction type	B2B		B2C		B2A		
RFID supply network support	partial			complete			
solution categorization	standard purchasing goods		standard services		customer-specific puchasing goods		customer-specific services
integration ratio of service provisioning	small		medium		high		
intangible asset ratio of outcome	product-orientated		availability-orientated		output-orientated		
preceived value	preceived benefits			preceived costs			
product life cycle phase	pre-use		use		after-use		

Fig. 6: Morphological box of a proposal process from an ICT vendor

Case study 3: Customer Service reports from a company in the HVAC industry
Looking in the HVAC industry (Heating, Ventilating and Air Conditioning) in Germany one can see typical value bundles in supply networks. Generally customers receive a value bundle consisting of technical equipment and services for the support of the equipment. The technical parts come from production companies whereas the service comes from small and midsize service companies [34]. In the case study [35] the customer service report as part of the value bundle is described which will be categorized into the morphological box.

The customer service report is done by service engineers at the customers place. In theses service reports the engineers report their work, their working time, used material and measured data from the plants. The reports are issued to a central server and will be stored in a database for further reporting and analyzing. The value bundle can be categorized in the RFID-relevant processes customer service and delivery. The impact is to reduce handling time by identifying technical parts by RFID technology, to reduce failure by reducing manual data collection and to enhance process information. The value add is mainly on the supplier side whereas the supply chain actors are the supplier and the customer. The business case may be applicable in B2B, B2C and B2A and there may be a RFID support for the complete process.

The value bundle is highly user specific both in the purchasing goods and the services. The interaction ratio of service provisioning is medium in the case that the operating of the plant is done by the customer. The outcome is availability-oriented. The customer appreciates the benefits of the solution and the value bundle is in the life cycle phase of use. The corresponding morphological box is displayed in Fig. 7.

characteristics	instances						
RFID-relevant core processes in SCM	production	procurement	redemption	shipment	customer service	delivery	return
RFID impact type	handling time reduction	ressource usage reduction	shrinkage reduction	failure reduction	process information		customer satisfaction
value added supplier network participant	customer		comprehensive		supplier		
supply chain actors	raw-material supplier	supplier	producer	center of distribution	carrier		customer
interaction type	B2B		B2C		B2A		
RFID supply network support	partial			complete			
solution categorization	standard purchasing goods		standard services		customer-specific puchasing goods		customer-specific services
integration ratio of service provisioning	small		medium		high		
intangible asset ratio of outcome	product-orientated		availability-orientated		output-orientated		
appreciate value	appreciate benefits			appreciate costs			
product life cycle phase	pre-use		use		after-use		

Fig. 7: Morphological box of customer service reports in the HVAC industry

Reflection
After classifying examples of value bundles in different industries, we will now try to identify some recommendations for the enhancement of supply networks for value bundles by RFID technology.

We can see in the three different scenarios that there are several possibilities to increase the value of the supplier network through RFID technology. Example 1 is a mixed scenario. Customer and supplier work together on a common issue. The value bundle consists of quite standard products and

services and is product oriented. RFID technology is able to improve the logistic chain of the business case. The process of dealing with the shipment of spare parts will lead to faster replacement cycle and an improvement of customer satisfaction.

Looking at example 2 it is a very customer-centric example providing relevant and useful information to the customer to allow him to configure an optimal proposal. As one can see on the RFID impact type RFID technology is able to improve customer satisfaction and to increase the quality of process information to the customer. It is a product-oriented scenario with low complexity in the structure of the value bundle.

Taking example 3 this is a supplier-focused scenario where RFID technology is mainly able to improve the logistics chain of the value bundle. It's a complex scenario with highly customer-specific components of the value bundle. The chance of RFID technology in this example is to reduce handling time and to reduce failure which leads to a higher customer satisfaction.

Regarding this it might be obvious that by classifying more examples of value bundles this may lead to standard types of value bundles suitable for different RFID enabled supply networks.

Conclusion

The research objective of this paper was to develop a set of characteristics and instances for value bundles in RFID enabled supply networks. Based on existing reference models and modeling concepts of value bundles, supply networks and RFID technology we developed a full set of 11 characteristics in three areas and consolidated them to a morphological box. The characteristics have been illustrated and validated by the categorization of three case studies from various industries.

The results of our paper allow for categorization of any given value bundles in RFID-enabled supply networks as well as for their structured comparison. It is not unlikely that the application of our categorization tool to a higher number of case studies will show typical patterns and thus lead to a derivation of standard types of value bundles in RFID enabled supply networks.

Furthermore, our results help practitioners to systematically identify benefits of RFID technology in their supply networks for a differentiation strategy based on value bundles. According to this, the improvement of existing networks as well as an optimized selection process for sub-suppliers can be endorsed.

Beyond the abovementioned analysis of a larger case study sample and derivation of standard types, further research comprises reference modeling. According models would allow practitioners to introduce an engineering approach to finding,

evaluating and selecting optimal supply networks for a given value bundle as well as to identifying potential value bundles for given supply networks . Besides the obvious advantages, this could improve stability and long-term- relationships in supply networks for value bundles.

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