10 Business Models for the Internet of Things

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Abstract The emerging Internet of Things provides a networked infrastructure that enables incremental business transformation as well as radical business changes. So far, the full potential of possible business opportunities has not been leveraged. Within this chapter we propose the concept of business models and business model innovation as a means to align “technological development and economic value creation” (Chesbrough and Rosenbloom, 2002) in the Internet of Things. A central point of this paper is the value and revenue creation in the Internet of Things. We consider information to be the main source for value proposition. To investigate resulting impacts, we draw on the “laws of information” proposed by Moody and Walsh (2002) and deduct specifics for the Internet of Things. Building on this, we describe four exemplary business model scenarios. These are visualised using the business model framework by Osterwalder and Pigneur (2009). This framework, the fundamental rules of value creation through information in the Internet of Things and the provided examples may serve as a tool-set for practitioners to analyse and change their business models when implementing the Internet of Things.

10.1 Introduction

The Internet has significantly changed the way products and services are marketed and distributed and thus let to a series of new types of business models. Similarly, the Internet of Things provides – yet mostly unleashed – potential for business transformations. This will be reinforced by its popularisation through progress in miniaturisation of technical components and falling costs.

The Internet of Things links uniquely identifiable things to their virtual representations in the Internet. Current applications in the Internet of Things generally focus on the optimisation of existing processes and associated cost reductions within companies and along value chains. Product Life Cycle Management, Customer Relationship Management, and Supply Chain Management are typical application scenarios. New application scenarios, sometimes referred to as smart technologies and smart services, are more focused on revenue generation (Fleisch et al. 2005). This chapter builds on findings from e-commerce and traditional business models to derive a new business model understanding for the Internet of Things. Envisioned scenarios, including Product as a Service (PaaS), enhanced end-user consumer involvement through the integration of social platforms, as well as right-time business analysis and decision making, demand an economical rethinking. These changes will have major influence on how companies are involved in the Internet of Things. The cost-centric approach therefore has to be replaced by a value-focused perspective. In the long term, a financial or non-financial pay-off that exceeds the efforts of information provisioning is needed to provide sustainable business models (cf. chapter 1).

This article provides a foundation for discussing the Internet of Things from an economic perspective, based on the business model concept. We will demonstrate that technical innovations in the Internet of Things do have economical and business implications. Moreover, they hold the potential of changing existing or creating new business models. The implications will be illustrated by the use of exemplary cases.

With advancements in the area of mass participation, openness, scalability and security, the personal involvement grows and clear boundaries between business and consumer use are vanishing. Social platforms to share experience and personalised insights will be integrated with business-centric applications. Mash-ups and end-user programming will enable people to contribute to the Internet of Things with data, presentation, and functionality. The success of these changes becomes more and more dependent on "valid" business models rather than on burning venture capital.

The structure of the chapter is as follows. Section 10.2 gives a short overview of the state of the art in business models and business model innovation. To create a common understanding, a framework describing the components included in a business model will be introduced. In section 10.3 we examine the value creation in the Internet of Things. We will have a closer look at the differences between information and product flows that need to be considered for new business models. The economics of information, such as information providers and information flows will be assessed. Potential products and services will be evaluated. Based on the previous findings and considerations, section 10.4 gives exemplary business model scenarios for the Internet of Things. It will be depicted how the configuration of business models can help companies to monetise on the Internet of Things. Finally, section 10.5 summarises the findings and gives an outlook on future research.

10.2 Business Models and Business Model Innovation

The term "business model" has been predominantly coined in practice during the last decades of the 20th century. Only gradually it has been adopted and researched by the scientific world. Thus, the business model can be seen as a "fairly recent concept" (Morris et al. 2006). "Business model innovation creates new or reinvents existing business models. Both terms are described in more detail in the following.

10.2.1 Business Models

For a long time research on firms focused on industry (Porter 1980) and resources (Barney et al. 2001, Wernerfelt 1984). The business model has to be seen as the replacement or complement of the traditional unit of analysis, as a result of the altered surrounding conditions (Amit and Zott 2001, Venkatraman and Henderson 1998). Already in 1998, Sampler called for a redefinition of the traditional value chain. The changed competitive environment, influenced by dramatic technological progress, entailed a series of new types of businesses. Today's business condition is determined by technological progress, service orientation, the digitalisation of products as well as increasing relevance of cooperation and ecosystems of different companies, which blur the boundaries of the individual enterprise. The unit of analysis must therefore be holistic and comprehend various different aspects. A business model can add to the competitiveness of a firm by offering a logical and consistent approach to the (innovative) design and execution of the business. Its increasing popularity with the emergence of electronic commerce and particularly during the dot.com phase can be explained by shortcomings in existing frameworks and theories to address all aspects of the novel possibilities defying conventional ways of doing business (Chesbrough and Rosenbloom 2002). However, the ideas and principles which underlie the concept are not new. Aspects characterising the business model can already be found in Drucker (1954)[1] and in concepts of strategic management (see e.g. Hedman and Kalling 2003, Morris et al. 2005).

Every business activity can be reduced to its core elements, which in the simplest case comprise the value proposition, distribution channels and the customers of the company, explaining how a company produces and sells a good or service. Accordingly, each business is implicitly based on a business model, even though it is not always explicitly presented.

Although the expression "business model" is frequently used both in research and practice, a common definition is missing (Morris et al. 2005). One of the most cited definitions of the term can be found in Timmers (1998). He defines a business model as "an architecture of the products, services and information flows [...]". This includes the involved actors and roles as well as the potential value created for all participants and the source of revenue.

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[1] What is our business? Who is the customer? What is value to the customer? What will our business be? (p.51ff)

Considering existing definitions and the presented characteristic features of business models, we define the business model as an abstraction of the complexity of a company by reducing it to its core elements and their interrelations. It facilitates the analysis and the description of business activities. Besides, the business model is gaining in importance as a starting point for business innovation and transformation. It can serve as means to align "technology development and economic value creation" (Chesbrough and Rosenbloom, 2002). In relation to the Internet of Things we see the business model as a major element to unite its technical developments with its economical business perspective.

According to Afuah and Tucci (2000), "a business model can be conceptualised as a system that is made up of components, linkages between the components, and dynamics". Components refer to the elements to be addressed by a business model. Just like the definitions of the term "business model" the proposed components vary largely between different authors.

In the following, we will base our work on the framework by Osterwalder and Pigneur (2009), which is referred to as the "business model canvas". The applicability of the model is proven by its use in practice, but it has also been referenced by a number of publications (e.g., Chesbrough 2009).

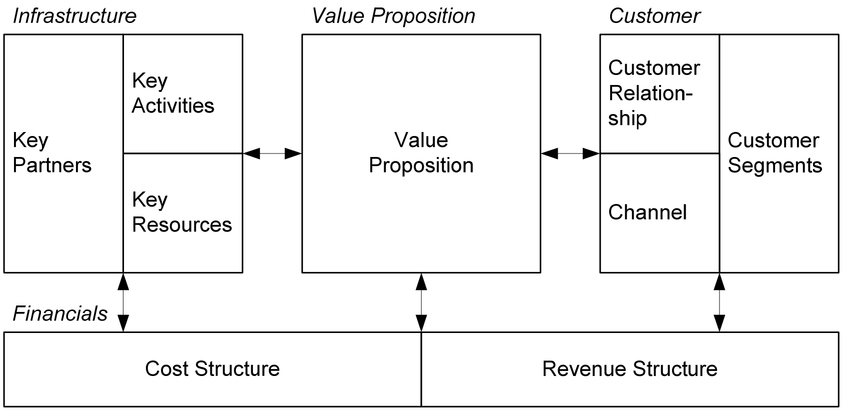

Fig. 10.1 Business Model Framework (Adapted from Osterwalder and Pigneur 2009)

The business model framework depicted in Figure 10.1 includes four main perspectives of the business model, namely the value proposition, the customer, financials and the infrastructure. The components are not stand-alone but mutually influence each other.

The *value proposition* specifies what is actually delivered to the customer. This goes beyond the product or service offered. It describes which customer needs are satisfied and details what other quantitative (e.g., price or speed of service) and qualitative aspects (e.g., brand, design, cost/risk reduction) contribute to the offered value. In the Internet of Things we consider raw data about physical objects as well as any aggregated or processed information a core component of the value proposition.

The *customer perspective* includes the *customer segments* addressed by the company, such as related channels and customer relationships. The customer segments define the different groups of people that are served. Different types of customer segments can be distinguished: mass market vs. niche market, segmented vs. diversified or multisided platforms. Multisided platforms will exist, if two or more interdependent customer segments are served by the company (e.g. credit card companies). The company can reach its customers, respectively customer segments through different *channels*. These can be direct or indirect and owned by the company itself or by partners. Channels can be aligned to the different phases of the lifecycle, such as creating awareness for the value proposition, evaluation of the value proposition through the customer, purchase, delivery and after sales. *Customer relationships* are often determined by the channels used. Relationships can range from very loose (self-service, automated services) to highly engaged (personal assistance, communities, co-creation).

The *financial perspective* comprises the costs as well as the revenues. The *revenue structure* depicts the sources and ways of revenue generation. Here, too, different types of revenue streams can be distinguished: asset sale, usage fee, subscription fee, lending / renting / leasing, licensing, brokerage fee, and advertising (see section 10.3.2). The *cost structure* describes the most important costs (variable and fixed) inherent to the business model. The business model can be rather value or cost driven (cost leadership vs. differentiation strategy). Companies can use economies of scale or economies of scope to create a successful business model.

Key partners, *key activities* and *key resources* can be referred to as the *infrastructure components*. The *key resources* are the assets required to make the business model work. Key resources can be physical, intellectual, human or financial. The *key activities* describe the most important actions to be performed by the company in order to create, offer and market the value proposition. These can be producing, problem solving or developing and maintaining a platform, respectively network. *Key partners* are the network of suppliers and collaboration partners (strategic alliances, outsourcing partners, co-creation) the business model depends on.

10.2.2 Business Model Innovation

Business model innovations are becoming increasingly critical in practice. In a study conducted by IBM (2008) 98% of the CEOs interviewed stated that their company would undertake extensive (69%) or moderate (29%) business model innovation within the following three years. In order to stay competitive in times of change, companies have to adapt and innovate in every dimension. Mere product and process innovations are seen as insufficient (e.g., Chesbrough 2007). The new business conditions require companies to change their whole way of doing business.

External factors, such as technological innovations, increased competition, and market changes as well as legal or regulatory changes are seen as the dominant triggers of business model innovation (IBM 2008, Linder and Cantrell 2000). Through business model innovation companies can differentiate from competitors and establish a competitive advantage. By pursuing an opportunity driven approach, companies can benefit from the first-mover advantage.

> "When external changes undermine a model, it typically cannot be recalibrated, a new model must be constructed" (Morris et al. 2005).

However, once the existing model is undermined, it can already be too late to change course. We therefore suggest a forward looking approach, where business model innovation is used proactively to capture new market shares or enter new markets.

Business model innovation can help to align innovation activities within the company (Venkatraman and Henderson 2008):

> "Innovations have been piecemeal and disconnected across different functions and locations without overarching logic for corporate-wide innovations. Best practices exist for localised, incremental innovations, but there is a clear lack of management frameworks for business model innovations that create new rules of competition."

A general deficit in business model innovation literature seems the discrimination of product or service innovation from business model innovation. The specifics of business model innovation need to be researched and pointed out in more detail, as for example done by Venkatraman and Henderson (2008):

> "[...] we need to innovate more holistically – namely: the entire business model (which encompasses customer value proposition, operating model, management processes, and roles and responsibilities of multiple partners with shared incentives and decision rights)."

In line with the definition of innovation by Hauschildt (1997), we see business model innovation as a process resulting in a qualitatively new business model, which differs distinctively from the previous. A deliberate change of one or more key elements of the business model, respectively their interrelations, has to take place. The resulting business model can range from an incremental improvement to a radical new way of doing business.

Some of the most successful companies that have used a distinctively new business approach based on the Internet are shown in Table 10.1.

Company	Traditional business	Initial business model innovation	Further developments
Amazon[2]	Book trade	Online shopping	Shopping portal

[2] http://www.amazon.com

		Automated distribution model Collaborative filtering	Digitalisation (mp3, books) Terminals (Kindle) Mobile payments Amazon web services (incl. billing)
eBay[3]	Classifieds Flea markets Auctions	Online auctions	Shopping portal Payment services (PayPal)
Google[4]	Yellow pages	Hypertext web search Prioritised advertisements	Terminals (Android) Video (You Tube) Maps (Google Maps) Web based software (e.g. Google Docs) Digitalised books Payment services (Checkout)
Apple iTunes[5]	Music shops	Music digitalisation Terminals (iPod, iPhone, iPad) Applications (apps)	Videos, Newspapers

Table 10.1 Traditional Business vs. Business Model Innovation

Their success builds on a technological innovation (the Internet) and on services that replaced some traditional businesses, such as online shopping or online auctions. When physical goods are shipped, a fast and agile logistic service provides an advantage over traditional concepts. The growing digitalisation of music, books and videos allows instant delivery. Another key to success is based on well accepted billing systems, such as PayPal or Checkout. These have lead to the increased usage of Amazon and eBay as shopping portals. Lately, there is a clear move towards mobility to allow ubiquitous access to digital content. Google (Android), Amazon (Kindle) and Apple's iPod, iPad and iPhone are some of the examples for further integration of mobility platforms and web based services.
It can be expected that new business models based on the Internet of Things will change and replace some of the traditional business approaches in a similar manner.

3 http://www.ebay.com
4 http://www.google.com
5 http://www.apple.com/itunes

10.3 Value Creation in the Internet of Things

A typical business transaction today is defined by a physical product, information stream, and money stream (Alt and Zbornik 2002). It should be noted though, that business transactions may be focused on services instead of physical product transactions, as well. However, in the Internet of Things, there always is a link to a physical product. The product stream includes order processing from procurement via storage and production to distribution of products to the customer. The information stream includes processes, such as order processing, supply chain and product life cycle data sharing.

The Internet of Things may be seen as an approach to align these different streams. It provides a higher level of visibility and control mechanisms. Moreover, in the Internet of Things, information itself may become a major source for value creation and thus the value proposition. This includes information only made possible through Internet of Things technologies as well as the association of existing information to physical products.

Traditionally, the money stream is exclusively dependent on the product stream prices. A separate price for the information is not defined. Instead, information is most often expected to be free of charge. It is obvious that the costs of information are hidden in the product price. However, the reluctance to pay for information may change over time. In B2C-markets, the willingness to pay for digital goods has increased to 88%, according to a survey with more than 15.000 participating consumers (Krüger et al. 2008). Even though digital goods (e.g. software, tickets, travel, songs, and videos) and information are not synonymous, it is still obvious that there is a change in society to accept the Internet as a business transaction platform. In addition to direct information payments, alternative revenue streams should be considered. Approaches, such as advertising or the less well known idea of freemium have untapped potential, even for B2B relationships. Freemium – a word derived from the terms “free” and “premium” – refers to the offer of free basic services and the revenue creation through paid premium services (see Anderson 2009).

10.3.1 Laws of Information

Even though information is recognised as an asset on its own right, quantitative measurements are difficult to achieve. It consumes a growing number of organisational resources for data capturing, storage, processing and maintenance. While hardware and sometimes software may be capitalised, the value of information in general is not financially recognised in the balance sheets. Information may be considered a product that is produced out of raw data through hard- and software utilisation. The cost of information is mainly not related to hard- and software, but to the people that feed the information systems with data. Their salary is usually hidden in the budgets of the corresponding departments. Therefore, a way of measuring the value of information is required (Moody and Walsh 2002).

Moody and Walsh (2002) define seven "laws of information", explaining the specifics of information compared to other (physical) assets. From these "laws" we can deduct approaches to the value creation in the Internet of Things. These "laws of information" provide opportunities for new business and pricing models for the Internet of Things:

First Law of Information: Information is (Infinitely) Shareable and Can Be Shared with Others Without a Loss of Value

The Internet of Things eases the sharing of product related information and allows information distribution to all participating stakeholders. The information provided through the Internet of Things can be monetised through paid access to the provided information. A win-win situation is achieved, when the *cumulated* amounts of accessing information exceeds the efforts of information provisioning. Therefore, the individual amount of accessing information may decrease with the number of information consumers.

Second Law of Information: The Value of Information Increases with Use and It Does Not Provide Any Value, If It Is Not Used at All

The mayor cost factors are related to data collection, storage and maintenance, while marginal costs of using are considerably small. The Internet of Things eases and consequently increases the distribution and usage of information. However, people have to be aware of the existence of information. Discovery services can be used as an "information asset register", as requested by Moody and Walsh (2002). Additionally, decision-makers have to be capable of interpreting and using the information in a beneficial way. The Internet of Things therefore needs integration to existing and proven business applications as well as new tools that visualise and analyse information and assist in decision making processes. If a pay-per-use model for information access can be applied, it will be possible to charge the users per information request, thus leveraging the second law of information to its full extend.

Third Law of Information: Information Is Perishable and It Depreciates Over Time

The Internet of Things provides real-time information and thus provides high value information. However, one of the beneficial applications in the Internet of Things is focused on life cycle information access. Therefore, historical information about a product may keep or even increase its value over time. Pay-per-use pricing models for information with decreasing or increasing prices over time would correspond to the time-dependency concerning value of information.

Fourth Law of Information: The Value of Information Increases with Accuracy

However, "*100% accurate is rarely required in a business context*" (Moody and Walsh 2002). The Internet of Things provides a fine grained view of the real world and therefore enables "high resolution management". Automatic identification helps to avoid mistakes from manual data entry, but the corresponding product information needs to provide a high level of accuracy as well. In Electronic Data Interchange (EDI) product data contracts are a common instrument to agree on data quality standards. Pricing models can be based on service level agreements and reoccurring assessments of information accuracy compliance.

Fifth Law of Information: The Value of Information Increases When Combined with Other Information
For example the identification number of an electronic component may have little value, if it is not combined with its firmware release number or its service history. In this respect standardisation of small percentage of *identifiers* and *coding schemes* can lead to high benefits in information integration (Moody and Walsh 2002). By its nature, the Internet of Things links different sources of information to specific objects (things). This provides new business opportunities for third party data aggregators and information service providers. Data sharing between different information providers is favourable in order to increase the value of aggregated data. End-user participation and co-creation further add to the overall value of information in the Internet of Things. Freemium models offer the ability to provide basic information for free, while access to enriched or aggregated information would require a premium account.

Sixth Law of Information: More Information Is Not Necessarily Better
While the value of information increases to a certain level if more information is supplied, it decreases, when more information than can be processed is provided (information overload). The linkage of things and related information binds information to a specific object and therefore eases information consumption in the Internet of Things. Filtering, personalisation, customised information feeds, and pre-processing can help to further reduce the information overload and to tailor the information to specific user requirements. A business opportunity exists for monetising customised or pre-processed information, such as alert messages.

Seventh Law of Information: Information Is Not Depletable.
Information instead is rather self-generating as summarising, combining or analysing information leads to more information. All possible sources of information generation and data processing that provide value to the Internet of Things should be considered, including for example sensors, users, software agents, and business intelligence software. Co-creation models, where for example access to information is free, if this information is further enriched through data analysis, may provide a win-win business situation in this context. Data-mining will enable further business opportunities for companies with access to multiple data sources.

Other opportunities can be achieved through reinvention of classical business models (e.g., PaaS), based on better information capabilities provided through the

Internet of Things. In these cases benefits are not directly generated through the value of information. Instead, the Internet of Things rather acts as an enabling technology. The following major consequences for business models result from the new possibilities offered.

10.3.2 Revenue Generation in the Internet of Things

As stated above, information may become the main source of value creation and thus a major part of the value proposition in the Internet of Things. More and especially more detailed information is made available. Information can be directly associated to things or products and instances of products. The usage, status, and location of things become traceable. This allows for new value proposition scenarios, such as the provision of additional product-related data to the consumer (e.g., carbon footprint) or the exact billing of products or services based on the actual use (e.g., rental car, returnable transport items).
The following requirements constitute the specifics for the value proposition:

- **Providing the *right information* ...**
  - Linked through a unique identifier to a physical product
- **... in the *right granularity* …**
  - High information granularity, providing a new dimension of clarity and insight
- **… and the *right condition* …**
  - High information accuracy
  - Aggregation of information from various sources, such as tags, sensors or embedded systems
  - Correlation, integration, and further analysis of information in a way that allows new insights to be derived
  - Defined syntax and semantics
- **... at the *right time* …**
  - Timeliness of information
  - Access to real time information as well as to historical data for business analysis
  - Real-time analytics and business intelligence for high resolution management
  - Intelligent real-time decision-making capability based on real-time physical events
- **... *anywhere* in the network …**

  - Online access and possibly offline usage
  - Mobile access

- **... at an *appropriate* price.**
  - Price transparency
  - Low premium for billing service, the price should be paid for the information rather than the infrastructure

New value propositions require a rethinking of financial aspects. Historically cost discussions have dominated the Internet of Things. Costs for tags, sensors, actuators, readers, soft- and hardware can be calculated quite well. An ROI, instead, has been more difficult to find, as only small parts of the overall financial benefits could be raised within an enterprise.

Therefore, revenue generation should play a more important role in the Internet of Things, to generate new money streams. Pricing of information as well as other benefits or bonuses provide the basis to compensate for the provided infrastructure and information generation. Usage based pricing will require usage data acquisition, including metering and collection of data. Subscription fees are an easier alternative to usage based billing or may be combined as known from offerings in the telecommunications industry. Information brokers may be included in the framework through brokerage fees. Advertising is another source of income but requires manual interaction with the Internet of Things and does not provide a valid business model in machine-to-machine (M2M) scenarios.

Considering that mechanisms to measure, collect and bill information may be integrated in a future architecture of the Internet of Things (see chapter 9), the separated billing capability for physical products and information, and thus a decoupling of information and product prices, will enable new business models.

Whereas the exchange of physical products spans along the value chain and usually ends with the delivery to the consumer, the exchange of information in the Internet of Things goes beyond and may include different actors. In order to fully understand the information exchange on the Internet of Things the information flows and actors involved have to be considered. Figure10.2 depicts information providers in the Internet of Things and information flows between them.

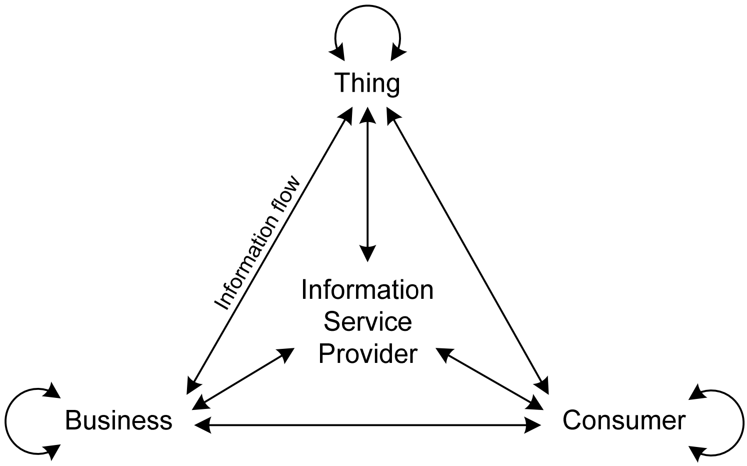

Fig. 10.2 Information Providers and Information Flows in the Internet of Things

The actors, respectively information sources identified, include things, consumers, businesses and a special form of business, the service provider or information service provider. They can be depicted as a triangle of information exchange. Information flows can be direct, such as for example thing-to-thing, business-to-consumer or consumer-to–thing, or indirect, such as from thing-to-business through an information provider or from business-to-business through a thing. Things include products that communicate their ID and status through sensors as well as data processing units and actuators. Additional information is provided by businesses or consumers. This covers information from information systems (e.g., ERP systems) or manually entered data (e.g., product ratings). Information service providers aggregate information from different sources. Additionally, they may combine and enrich data to add value.

In case of thing-to-thing (including M2M) relations it has to be kept in mind that there are companies or consumers owning these things. But still the distribution channels for information will require different interfaces than used in classical B2B and B2C scenarios.

The resulting customer relationships may be structured according to the information flow, including unidirectional, bi-directional and multi-directional information flows. While the Internet of Things is designed to support multi-directional information flows, there are still only few applications that utilise its full potential. Additionally, self-servicing and automation play an important role in the customer relationship.

The question that has to be asked here is how to create a win-win situation for all stakeholders involved in the information exchange? The consideration of different business model scenarios might help in answering this question and helps to understand how new possibilities can be commercialised through businesses or information service providers.

10.4 Exemplary Business Model Scenarios for the Internet of Things

Based on the previous considerations and findings, different exemplary business model scenarios are developed within this section. The field of application for Internet of Things technology is much wider then we have seen so far. The control of processes and the quality of goods in manufacturing, logistics, service and maintenance are still valid applications. Moreover, new areas of applications have to be considered. End-user integration through data provision and end-user programming as well as the implementation of autonomous services will take the Internet of Things to the next level, where the Internet of Things is more than a pure B2B infrastructure.

The following exemplary scenarios will include the use of Internet of Things technology to support the offer of *PaaS*, the role of *information service providers* in the Internet of Things, the *integration of end-users* and opportunities through *right-time business analysis and decision making*. With the help of the business model framework, it will be depicted how the configuration of business models can help companies to monetise on the Internet of Things.

10.4.1 Scenario 1: Product as a Service (PaaS)

The shift from providing products to providing services is a major trend in business model innovation. Not only software companies provide SaaS instead of selling software licenses, but more and more manufacturers follow this trend. As a reaction to increasing competition through low-cost manufacturers, Hilti[6], an international manufacturer and supplier of professional construction tools, launched what they call “Fleet Management”. The customer is no longer required to own a tool. Instead, Hilti offers its customers access to a range of tools on a contract basis and monthly fee, including additional services, such as repairs. Customers benefit from lower upfront investments, no cost repairs, flexible inventories, less downtime and up to date tools (Johnson et al. 2008). In a further step the pricing schemes can be based on service performance. Popular examples are Power by the Hour (PbH) or Performance Based Logistics (PBL) (Kim et al. 2007). Consequently, measureable performance values are needed to provide a reliable calculation fundament.

[6] http://www.hilti.com

Problem Statement

Today, the shift to PaaS is often hindered by missing means of performance measuring and billing as well as unsuitable pricing models. Current implementations are only isolated instead of integrated offerings.

The Internet of Things as Enabler

The Internet of Things offers a range of possibilities to support such PaaS scenarios. Sensors allow for the tracking of a product and the location of its current position. In addition, the usage times of a product can be exactly documented as well as the condition under which a product was used (e.g. the speed at which a car has been driven). Sensors also enable a company to monitor the condition of the product or parts and tools and thus support maintenance and repairs. Through an open Internet of Things infrastructure, different offerings can be combined.

Possible Scenario

A scenario that utilises the Internet of Things can be envisioned in the sector of car rental (a similar scenario is currently implemented by Daimler under the name of Car2Go[7]). Up to now, usually time-based fees depending on the class of car plus gasoline are charged for. In a future scenario the pricing could be based on the exact usage of the car, with the calculation based on actual emissions as well as on (engine) speed, acceleration, transport weight, streets used or any other measurable value. This would motivate an environmentally friendly usage of rental cars if a direct feedback channel to the driver, such as a current meter for cost per distance, accumulated costs, and current as well as average emissions is provided. All services such as refuelling, insurance and possibly toll payments may be included in the usage fee. Third party provider can remotely monitor the condition of the cars through the Internet of Things and can react to emergency signals emitted by the cars. Finally, when returning the car, it is not necessary to bring it to a local car rental station. Instead, it can be parked at third-party service stations (e.g., gas stations) for cleaning and visual inspection as the real location and technical status is always known through the Internet of Things. In a longer term, even visual inspection can be automated through a corresponding drive-through video gate.

[7] http://www.car2go.com/

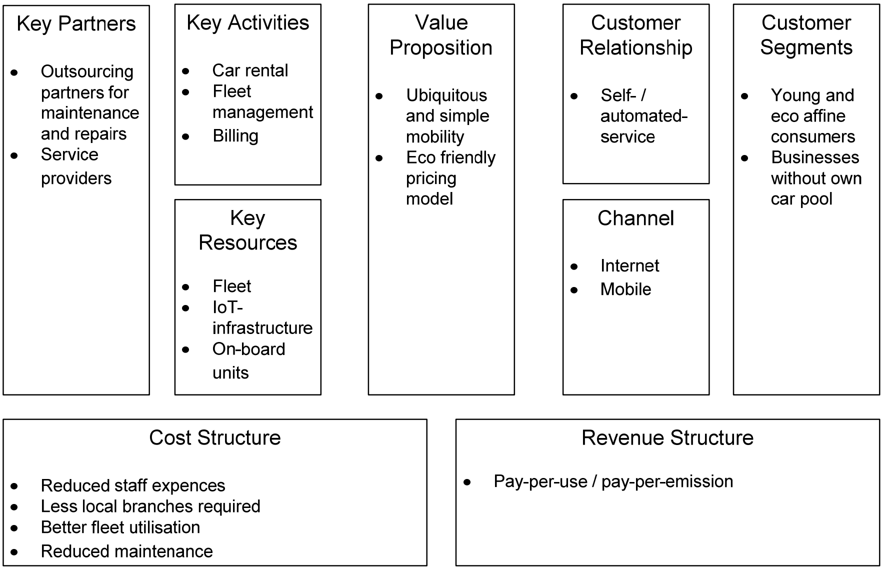

Fig. 10.3 Business Model for a Car Rental Scenario in the Internet of Things

Compared to the traditional rental car business model, the proposed business model results in viewer fixed costs through the omission of local subsidiaries and a decreased need in staff as the car rental process is implemented as an automated self-service. New costs originate in particular in the Internet of Things infrastructure employed. The monitoring of the cars' conditions through an outsourcing partner allows for timely repairs, less downtime, and reduced maintenance costs of cars.

10.4.2 Scenario 2: Information Service Providers

If information can be measured and billed, new business opportunities for information service providers will be enabled. IT departments can become profit centres instead of cost centres. Data centres can provide storage and processing capabilities for Internet of Things-related data. Additionally, information service providers can aggregate and process information from different sources, thus providing a higher value of information.

Information service providers in the Internet of Things may revolutionise market research, as sample sizes are increased, costs of information collection are reduced and real-time analytics provide instant feedback. A potential application scenario for information service providers is anti-counterfeiting. The problem of anti-counterfeiting is prevalent in the consumer goods market. Brand items, such as apparel and accessories or even worse drugs or spare parts are copied and sold as original products. This results in economic damage and can have severe impacts on the consumer side.

Problem Statement

Hitherto, the definite and non-manipulable identification of product instances is most often impossible. Product identification is mostly restricted to the product category. The EPCglobal Network allows identification and tracking of products along the value chain. However, setting and maintaining the infrastructure is still costly and incentives for sharing product data are missing.

The Internet of Things as Enabler

The Internet of Things supports this scenario through the association of information to a product instance. In addition, it allows easing sharing information across different parties, especially if billing capabilities are added as a core functionality.

Envisioned Scenario

To fight the problem of counterfeiting, the following service could be offered to a manufacturer by an independent information service provider. The information service is aimed at the verification of the originality of a certain product in order to detect counterfeits. In our case, the information service provider has specialised on the verification of spare parts in the machinery and equipment industry as well as the automotive industry. He thus collaborates with a series of manufacturers and their business partners, supplying them with the needed information. The consumer – the buyer of the spare part or a service partner installing it – can submit a request to the information provider through the Internet of Things. Another important customer segment is customs. The verification of the product can be based on the serial number. The information service provider could query its information systems where information from different sources is aggregated and find out whether the serial number is valid, whether the spare part had been already used by another client and which route the spare part had been taken through the value chain. Two different pricing models are offered for this service: pay-per-use or subscription for customers who want to use the service more often. A similar scenario is currently implemented by "Original1"[8], a joint venture of SAP, Nokia, Giesecke and Devrient. This can be achieved by for example. the EPCglobal Network, but major problems in this context are the cost for the corresponding infrastructure and the missing incentive for sharing data. Both issues can be tackled by integrating billing and balancing capabilities. The service provider needs to acquire the information at a price (or non-financial benefit) that is worthwhile to the information provider and needs to offer his service at a price to the information requesting party that is exceeded by the potential benefits of the aggregated and processed information.

[8] http://www.original1.net/

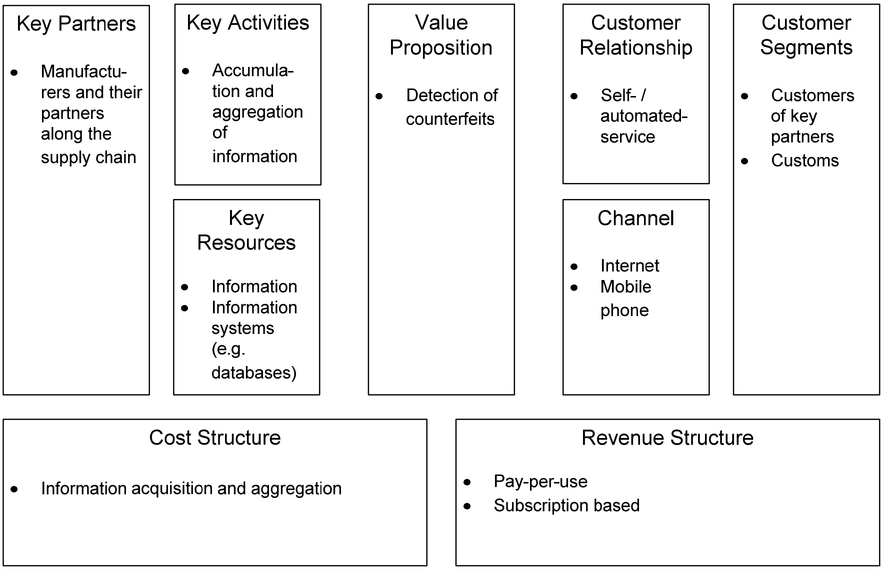

Fig. 10.4 Business Model for Anti-counterfeiting Based on the Internet of Things

The business model of the investigated case of a service provider on the Internet of Things does not differ much from a traditional service provider business model. However, the value proposition which was only made possible through unique identification and billing in the Internet of Things differs significantly. Most important cost factors are the acquisition and aggregation of information (data) and the purchase and maintenance of needed information systems.

10.4.3 Scenario 3: End-userInvolvement

The Internet of Things provides a new level of consumer integration into co-creation processes. While "living labs" have been used to integrate limited user groups into product and service development at a certain stage in the product life cycle, the Internet of Things will link all consumers across the life cycle of a product. Companies that will know how to utilise this huge potential will be in the lead for new business models in B2C scenarios.

The motivation to participate in co-creation can be motivated through financial and non-financial benefits. Again, an integrated billing solution in the Internet of Things would allow a seamless bi-directional flow between businesses and consumers. Currently, vouchers, e-coupons, lotteries and free products are used in lack of an integrated billing system. Available offerings include Stickybits[9] and my2cents[10]. Other services include a payment scheme for product reviews, that is based on positive review ratings. Ciao[11] is offering their users a small financial benefit as low as 0.5 pence every time their product rating is positively reviewed (Ciao 2009). There may be other, non-financial benefits, such as personalised products. Sometimes end-users are motivated only because the Internet (of Things) provides a platform for their self-expression. In any case a high level of security and privacy as well as the freedom of choice to participate are mandatory.

In B2B scenarios, mandating is a common instrument to motivate participation. Sometimes mandates include financial penalties in case of non-compliance.

Problem Statement

To date, there are only few interconnections between information collection, buying and product rating. Amazon.com is one of the exceptions where consumers look to obtain information, buy and rate their products. Still, a direct identification link to the product is missing. Different firmware released on electronic equipment, for example, may lead to different ratings and cannot be distinguished without unique identification.

The Internet of Things as Enabler

Through the Internet of Things information can be related to specific product instances. In addition, the local access to automatic unique identification increases particularly through the integration of Near Field Communication (NFC) and bar code reader software into mobile camera phones. Another important innovation is the use of image or sound recognition.

Envisioned Scenario

Through the use of a mobile phone, the end-user is enabled to supply and retrieve product related information at the point of sale – in this scenario a large supermarket chain. Both actions are supported by the use of RFID-chips or barcodes. The supermarket supplies the customer with information from internal systems, such as ingredients of a product or the price history. In addition, information related to the product instance, such as its carbon foot print can be retrieved. The user can enter additional information for a product, such as a rating, using the mobile phone or an internet connection at home. In return the supermarket may reward end-users with special bonuses.

To make this service more individual, the user can create a profile with his / her preferences and needs. This allows the supermarket chain to inform the user about current promotions, suggest new products or warn the user in case of food intolerance. The information entered by the customer can be made available to other cus-

[9] www.stickybits.com

[10] www.my2cents.ca

[11] www.ciao.de

tomers but it can also be used for internal analysis. By supplying information, the customer can earn bonus points that can be redeemed for discounts.

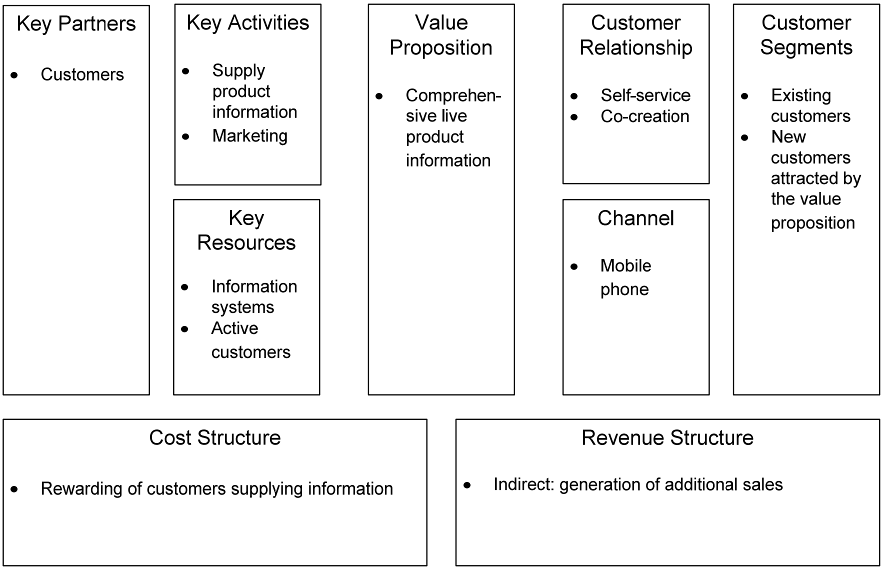

Fig. 10.5 Business Model for End-user Involvement in a Supermarket Scenario

The business model described above is part of a higher-level business model of the supermarket. The particularity of this business model is the generation of revenue through the indirect increase of sales. Successful end-user participation always requires the offer of an incentive and the usefulness of end-user participation for business. Low-quality product providers may not have an interest at all in product ratings. Only highly competitive companies will be interested to distinguish there offerings from their competitors'. Vice versa, expenditures for financial or non-financial benefits of end-users have to be justified by an increase on the revenue side. The question remains if the consumer is willing to pay for additional information directly or indirectly through product buys. From experience we know that consumers are willing to pay more for organic food and for products that comply to quality standards. With the Internet of Things consumers can instantly drill down on related information rather than being limited to rely on simple and sometimes meaningless "compliance labels".

10.4.4 Scenario 4: Right-time Business Analysis and Decision making

In production engineering, real-time usually refers to M2M-systems that record events and responds within milliseconds. In logistics, the time frame is not as well-defined, yet seconds, minutes, or even hours are sometimes still considered real-time, compared to longer traditional processes, such as transportation that causes information gaps of days or weeks. Real-time is often used as a qualitative rather than a quantitative value to differentiate timely from out-of-date information distribution thus allowing acting instead of reacting. Therefore, it is more appropriate to use *right-time business analysis and decision making*. The amount of time between a business event and a decision is influenced by time periods, including data capturing latency, analysis latency, and decision latency (Hackathorn 2004). Real-time business analysis capability remains a core requirement of each enterprise, as it provides the basis for agile management strategies. In the Internet of Things perishable goods represent an interesting research topic for real-time business analysis, especially during long transportation processes that may lead to drastic quality changes. Depending on the current status of the goods and the calculated best-before-date, different management strategies may be applied. As part of the *Collaborative Research Centre 637 "Autonomous cooperating logistic processes – a paradigm shift and its limitations"*, scenarios about intelligent trucks and intelligent containers have been evaluated, based on RFID, sensor integration, communication infrastructures and decentralised decision making through software agents (Jedermann et al. 2007). While these scenarios where based on autonomous strategies and are not directly linked to the Internet of Things, a further integration of both concepts would enable a higher level of agility in logistic processes (Uckelmann et al. 2010).

Problem Statement
Today, right-time business analysis and decision making is mostly restricted to internal processes or bi-directional business relations. For perishable goods manual spot tests and visual inspections are common, but these cannot provide real-time monitoring or proactive strategies.

The Internet of Things as Enabler
The Internet of Things provides real-time access and analysis opportunities across supply-chains or product lifecycles. Data analysis can be provided in proximity to things (smart objects), at the business premises or anywhere in the Internet of Things. Agile management strategies are enabled based on real-time availability and analysis of data.

Envisioned Scenario
The envisioned scenario is based on an intelligent truck that combines different technologies and applications to increase the value of information (*5. law of information*) and to a boost utilisation of the Internet of Things infrastructure. The

truck communicates data to the Internet of Things and receives responses in real-time. While some easy tasks, such as navigation and dynamic routing, can be achieved without the Internet of Things, more complex tasks, such as tracking and condition monitoring, would largely benefit from it.

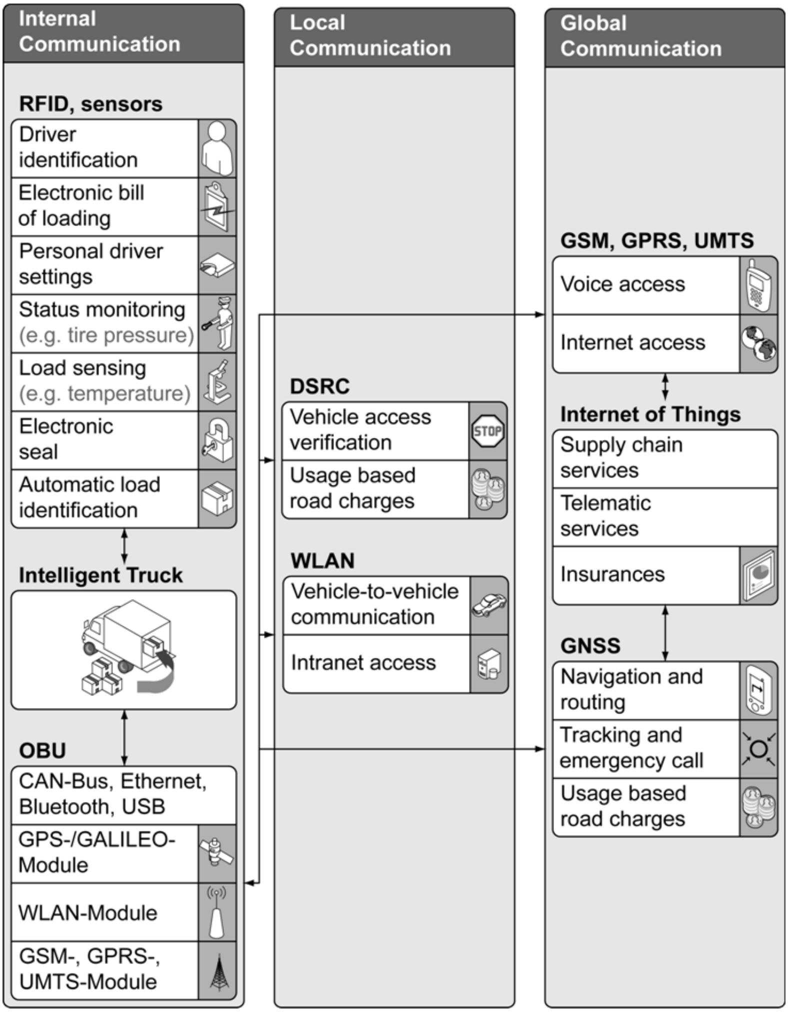

Fig. 10.6 The Intelligent Truck Scenario as an Example for Real-time Analysis and Decision making

The business model depends largely on monetising the benefit from information that depreciates in value over time (*3. law of information*). The goal is to achieve an optimum between proactive (agile) acting and cost of infrastructure required. Therefore, the best response time to a business event is not necessarily the fastest possible response time.

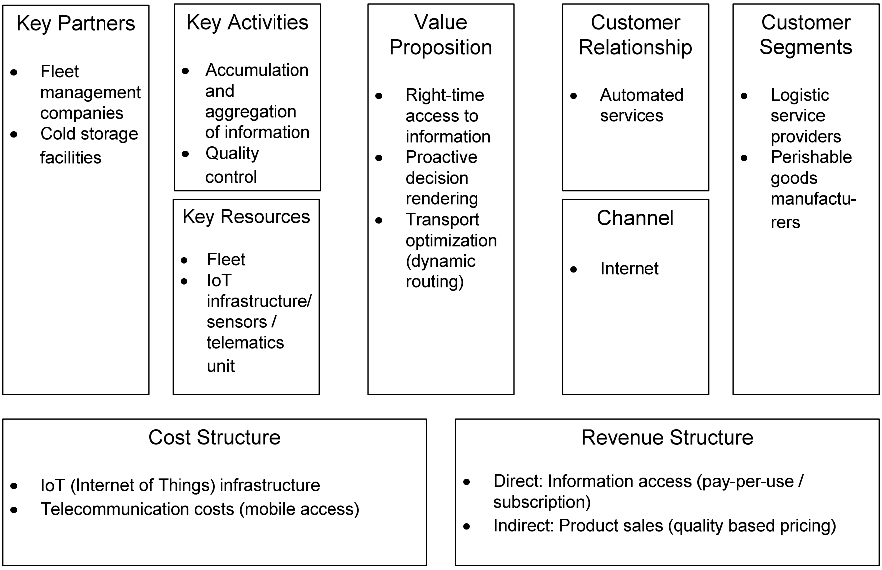

Fig. 10.7 Business Model for the Intelligent Truck

10.5 Conclusion

Moody and Walsh (2002) claim that *"of all the corporate resources (people, finances, assets, information), information is probably the least well managed"*. While the Internet of Things currently helps to overcome some of the more technical problems, such as finding the right information and providing anywhere and anytime access, the business perspective of information as an asset in its own right remains an open issue.

This chapter provided an overview concerning business models and business model innovation and their relation to the Internet of Things. The value of information in relation to its specific "laws" has been explained. Additionally, the value proposition of the Internet of Things and possible effects on existing or new business models have been investigated in detail. The business model concept helps to gain a holistic overview and may serve as a means to identify new opportunities for business model innovation. Based on the given scenarios, we derived that business models can be an important driver for the Internet of Things, to motivate companies to invest, reach new markets and generate new revenues.

While we have investigated the role of business model innovation in the Internet of Things, we have left out user-acceptance for new business models. Numerous approaches, such as the “Intelligent Refrigerator”, have failed up to now, because of missing end-users acceptance. This may partially be due to the inconsistencies and media brakes that may be overcome by the future Internet of Things. For this, common interfaces and standards are required. It may also take time for users to adapt to new technologies and opportunities of the Internet of Things. Just as mobile Internet access and e-commerce have taken years to be successful and are still far from their full potential, the Internet of Things will take time to be actively used by end-users. One pre-requisite will be an easy to use automatic identification device that links objects and the Internet of Things. Current mobile phones with integrated barcode reader software that utilise the camera module provide poor reading capability. Even NFC is far from being ubiquitous. If these technical problems are solved in the Internet of Things and new business models can be found that provide win-win situations for all stakeholders, the boundaries between businesses and consumers will be diminishing.

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