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The Internet of Things – disruptive opportunities

Business models at stake

Three industrial revolutions that have brought epic changes to the world of business are steam engines, mass production, and internet technology. Today, we are in the midst of what is often called the fourth industrial revolution – the convergence of physical things with the world of the internet: The Internet of Things (IoT). Let us give you three figures that show why the IoT creates challenges both long-term and immediate. First, consider the number of IP-enabled devices such as cars, heating systems or production machines. The research database of the analyst firm Machina Research is expected to deliver around 14 billion of those connected things by 2022. Second, the ITU predicts that by 2015, 75 percent of the world’s population will have internet access. And third, the omnipresent mobile revolution: according to the mobile forecast from Cisco's Visual Networking Index, more than 3 billion smartphones and tablets will be in use globally by 2017. Managers need to envision the valuable new opportunities that become possible when the physical world is merged with the virtual world and where potentially every physical object can be both intelligent and networked. And, starting now, they must create the organizations and IoT-based business models that can turn these ideas into reality.

The IoT is the next generation of the internet. It is a global system of IP-connected computer networks, sensors, actuators, machines, and devices. Merging this physical world with the virtual world of the internet and software enables companies and consumers to create and enjoy new services that are founded on web-based business models. This will have a big impact on the way we do business.

Your biggest competitor: Do nothing

The internet has transformed the communications business, the media landscape, retailing, and the music industry. Digitization and new technological developments have made big, unprepared players disappear – even market leaders and long-standing companies like the German mail order company Quelle or the American imaging products company Kodak. As consumers, we have all seen how quickly things change, and how new technologies appear that challenge well-established products and standards. Nobody carries a Walkman and cassettes these days; instead, we stream music with our smartphones.

Challenges for existing business models

For many companies, the mere prospect of remaking traditional products into smart and connected ones is daunting. But embedding them into the digital world using services-based business models is much more fundamentally challenging. The new business models impact core processes such as product management, operations, and production, as well as sales and channel management. And given the dynamism of the net, innovations will have to come more quickly. However, expecting too much too fast won’t help: changing the business in the physical world takes longer than in the internet world, because there is a huge installed base and a lot of investment in real hardware, which requires a solid business case.
Lucrative IoT-based services: The study 'Service Business Development: Strategies for Value Creation in Manufacturing Firms', undertaken by researchers from the Institute of Technology Management at the University of St. Gallen, Switzerland, concludes that these services are most definitely lucrative for traditional manufacturers. Considering the example of a papermaking machine, they note that the sale of the machine itself generates a margin of around 1 to 3 percent, while selling a related service yields five to ten times as much. The ratio is much the same for the sale of rail cars versus related mobility and maintenance services.

Product / lifecycle management: For manufacturers in particular, the overall challenge in the IoT is securing and extending their existing hardware business: This means first IP-enabling their products and then providing new services based on these connected products. The industrially manufactured product is no longer the focus, but rather the web-based services that users access through the device itself or by using smartphones and tablets. The focus is also on developing solutions that enhance the quality of life instead of providing pure technology.

Competition / sales channels: Imagine an arena full of new competitors, all jostling for position and attempting to shape the future, and of course, trying to win over the same customers. Well established producers in traditional industrial fields – whether they make coffee machines, cars, air conditioners or home fitness equipment, or run big vehicle fleets or even electric utilities – are suddenly not only competing with companies like themselves but are also confronted with players the likes of which they have never seen before.

This is easy to visualize when looking at a simplified manufacturer’s traditional value chain (see Dave Gray’s sketch below on today’s line of production): The manufacturer relationship might terminate at the warehouse or, at the very latest, at the point of sale.

![Figure 1: The Line of Production](source: Dave Gray with Thomas Vander Wal, 'The Connected Company', 2012)
Adapting sales and marketing approaches is necessary because the IoT might create channel conflicts.

The IoT will change this perspective significantly – from a linear approach with clearly allocated roles to what might be called a ‘sales arena.’ Now suppliers and manufacturers are also targeting the customer with connected devices and new value-added services. Before the IoT, this was limited to other players on the market. This creates channel conflicts when approaching the customer – for selling the product, the service or both elements together.

**Customer interaction:** The points where customers and companies come together change. Instead of ‘meeting at the point of sales,’ it becomes a continuous interaction as long as the customer uses a product or services. When a product becomes an agent interacting with humans and providing multiple services over a lifetime, it provides a new perspective on business.

**Exploratory management:** Top-level and middle management have to adjust to the idea of taking an exploratory approach toward advancing their IoT business ventures. They must be engaged in shaping the future. However, the connected world is a highly volatile and dynamic one which can also bring setbacks.
Integration gap: This needs to close. In IoT business models, you, your customers, and suppliers are all players, but so are connected devices. They have to become active participants in business processes and integrated into the company’s existing systems in order to run services efficiently. Consider the following comparison: in conventional offline business models, objects provide users with a simple piece of information. For example, a car’s odometer provides the following information: “50,000 kilometers. Time for service!” IoT business models go a step further and connect the vehicle data up with additional information in the cloud, services, and processes: “50,000 kilometers. Time for service! Shall I arrange an appointment for you at the nearest garage offering the best value?” Or, taking it even further, a vehicle platform evaluates on the basis of sensor data and algorithms if service is really necessary, and suggests which parts have to be replaced.

Market feedback from our IoT blog

► “I’ve worked for Fortune 500s that view the IoT as either a threat or a complete mystery.”

► “My belief is that business models will be ‘discovered’ and, more importantly, the value of the IoT will be determined by companies that start playing an active role and participate in the value chain of first connecting everything to the internet, and then realizing the unlocked value.”

M2M – recast for the age of the IoT

Machine-to-machine (M2M) technologies are how we refer to communication between mechanical or electronic technologies. M2M has been used for improvement measures for years. One example for M2M use is found in transportation companies that track packages by using sensors and embedded technologies. Today, M2M implementations are stand-alone and proprietary systems used in special environments.

Many discussions around the topics of M2M and the IoT focus on how large the future market is for both. This white paper tries to give an answer to this question in a later chapter, too. After all, we think it is not so much a question of whether the market in 2022 will include over 10 billion or 100 billion connected devices or whether revenue is over or below a certain amount. We believe the development from M2M to IoT is already happening, so the most important questions for every decision-maker are: How does this affect my organization? Does the IoT offer new opportunities for my organization to save money or to make money?

The development from M2M to IoT will proceed primarily within three layers – hardware, connectivity, and applications. M2M hardware is often very specialized, expensive, and offers low processing power. IoT hardware has to become cheaper with increased processing capabilities and intelligence. The availability of edge nodes and edge controllers suitable for specific use cases and deployable in different environments is a cornerstone for the development from M2M to IoT. Affordable and reliable connectivity with sufficient coverage also counts. We expect solutions to take advantage of mobile ubiquity and increased network quality and speed. Finally, the development of innovative applications and the availability of appropriate application platforms is a critical factor for the recast of M2M to IoT. Traditional M2M applications have been customized and provided minimal data analytics capabilities. One of the primary measurements of a successful IoT application will be its ability to extract useful information from a mountain of data collected from many different sources, so that organizations, users, and devices are able to act faster. In an IoT
world, we expect cloud-based applications enabled by virtualization to make application deployment across common platforms feasible.

While the uses for the IoT seem to be limitless, getting the ecosystem to work harmoniously will be challenging. For integrated IoT solutions to succeed, platforms have to connect applications and devices via any network. Additionally, platforms have to connect new and existing but disparate systems in one location.

The right amount of creativity and the courage to think unconventionally and not just focus on the next quarter will be the most important success factor.

**Four key parts of an IoT ecosystem**

In order to provide for the IoT’s multi-faceted challenges, the most important thing to do is develop business ecosystems. A business ecosystem is comparable to a coral reef, where we can find diversity of species, symbiosis, and shared development. This doesn’t mean a reef is necessarily a pleasant place; it has its share of predators and prey. Nevertheless, the reef infrastructure allows species to keep each other alive and adapt to changes. In such an ecosystem, there are many participants (companies and consumers), decisions are made collaboratively, and competitors are often partners at the same time, with a shared understanding of the market and values.

For example, automakers and car rental companies have introduced new car sharing business models enabling customers to locate cars using their smartphones, rent them for a short time, and then park and return them anywhere within a defined zone (e.g. DriveNow and Car2Go in Europe and ZipCar in the US). Another example is electromobility, where companies, energy suppliers, public utility firms, the public sector, charge spot and parking lot operators, retailers, and the drivers of electric vehicles are all cooperating closely.
There are four key parts of an ecosystem that play an essential role in our emerging connected world.

A connected thing might consist of a multitude of connected things. A variety of connected things are increasingly IP-enabled and equipped with different sensors or actuators to gather information from the asset or control their behavior. Connected things can be things such as a car, a security camera, a production machine or a household appliance. However, when talking about connected things, do not forget that one connected car can consist of a multitude of connected things such as sensors, actuators or control units.

In the area of connected things, one key driver is the ubiquity of mobile communication networks, including carrier networks like GSM, Edge and UMTS, as well as the abundance of available short-range communication technologies like WiFi, ZigBee, Z-Wave, Bluetooth, NFC, and RFID.

Another key driver is the continuous reduction of hardware costs and the accompanying enormous increase in hardware performance for small devices. Instead of having to use cumbersome, low-level embedded system technologies, more productive environments are available, including software stacks like embedded Linux and embedded Java. And finally, an increasing amount of all kinds of sensors and actuators are available at ever-decreasing cost.

Next to connected things, the users of those things are playing an important role in a connected world. For example, they use the car sharing service, the smart pill dispenser or the Square credit card service. Users of networked things have a special role: in many cases, it is no longer the industrially manufactured product that is the focus, but rather the web-based service that the user accesses through the device over the lifetime of the product.
Looking at the user side of things, there are also a number of important trends. First, the mobile revolution has dramatically changed the world in the last five years. A business model such as a real-time car sharing service becomes possible only with the ability to locate the nearest car using a smartphone. Social networks are also providing interesting potential in a connected world. For example, manufacturers now consider creating an individual Facebook page for each produced asset (“a home page for my car”). Finally, localization services such as FourSquare (“John Doe just checked in at the local Starbucks”) provide a huge business potential.

Enterprises are typically responsible for providing services and processes related to the connected things and to users. For example, a car sharing company needs to provide customer-oriented services like car reservation, billing, etc. In addition, the car sharing company has internal processes, such as car maintenance and repair. In the enterprise area, we need to be able to efficiently manage processes related to connected things. Established approaches such as Business Process Management (BPM) and Business Rules Management (BRM) provide valuable tools and techniques in this area.

Partners play an increasingly important role in a connected world, from integrated supply chains to lively ecosystems created by platform operators such as Salesforce or by mobile app stores. In diverse sectors of the global economy, new web-based business models are bringing together market players who previously did not do business with each other. For example, a car sharing company might outsource the car repair process to an external partner.

An IoT ecosystem in practice in the area of mobility: Connected fleet

Leasing and car rental companies are facing multiple challenges today. In a highly competitive market, margins can be improved only through cost savings. At the same time, customer requirements and expectations are increasing. Driven by increased fuel prices and general sustainability efforts, fleet managers expect additional solutions from car leasing companies to help them go green and save costs. Another example is an increased interest in dynamic leasing contracts with flexible mileage and duration terms, offering better flexibility. In a project with a leading leasing provider, Bosch Software Innovations implements a connected fleet solution addressing many of these challenges and therefore enabling the leasing provider to successfully compete in this market.

The connected things in this solution are represented by the vehicles in the fleet. Leveraging an on-board, built-in unit and remotely connecting this unit with a backend application allows the fleet operator to get real-time information about fleet performance, individual vehicle status, and so on. In the enterprise backend, this information is consolidated and fed into the relevant backend processes. Web-based access to vehicle information can be provided to the individual car lessees. Other mobility providers, such as gas station operators, are also integrated into the enterprise processes.
An IoT ecosystem in practice in the area of manufacturing:  
**Predictive maintenance**

Manufacturers and industrial enterprises of various kinds are facing similar challenges. They are selling products on highly competitive markets. Almost all companies feel the pressure to increase their results, and reducing costs is always one possible way to achieve better net operating results. New options to reduce operational costs are limited. Most plants and production processes are already optimized. Connecting and integrating things might offer new options. One option for more efficiency is predictive maintenance.
The connected things in this ecosystem are various sensors integrated into machines, to log and transfer machine and production data in real time to backend systems. The enterprise is establishing backend systems, which collect and analyze the transferred data. Failures and malfunctions can be predicted via rule-based data evaluation, before they occur. Maintenance processes can be optimized and efficiently steered based on the real-time information about machine conditions. The user is the service engineer or operations manager who receives real-time access to all necessary information through a service portal. The partners are suppliers who are integrated into the operation and maintenance processes of the enterprise. A new degree of automation and efficiency is possible – e.g. new parts are automatically ordered on time before replacement via the enterprise maintenance platform and service staff is directly allocated only when necessary.

Increased efficiency is one result of a predictive maintenance scenario: all maintenance applications are applicable in one portal while the integration of all operation and maintenance processes, combined with the machine data, are on one platform, which enables an end-to-end process solution. Maintenance and repair costs can be optimized, incident reaction time can be accelerated and maintenance windows are scheduled only if necessary. As a result, uptime can be significantly increased, unplanned downtime can be decreased, and loss of production can be avoided. In parallel, parts are replaced only when necessary and service staff can be allocated more efficiently. Predictive maintenance is a new option for decreasing maintenance costs and increasing uptime.

Market size and number of devices

Based on an evaluation carried out on basic information provided by the Machina Research database, we are expecting approximately 14 billion connected devices worldwide by the end of year 2022, starting with more than 2 billion connected devices by the end of 2013. These numbers are based on the assumption that a device connected directly or indirectly with the internet is a connected device. That means a connected car is one connected device, which can itself consist of numerous connected things such as sensors, entertainment or navigation units and so on. Furthermore, the number is based on the assumption that smartphones and tablets are not IoT connected devices. Even if smartphones and tablets are connected to the internet, they are interfaces integrating the user into the IoT ecosystem.
Figure 6: Total number of connected devices by 2022
Source: Machina Research database, 2014
Figure 6 points out the tremendous growth of connected devices in the coming years for all relevant industries. If we did not take smart buildings into consideration, the number of connected devices would be approximately 6 billion in 2022, starting around 900 million at the end of 2013. However, since buildings consist of many independently connected devices, the smart building sector incorporates a relatively high number of connected devices. That does not necessarily mean that the intelligent building industry is the automatic winner in the growing world of IoT opportunities; the potential for increasing efficiency or developing new services or even new business models is not linked to the number of connected devices. Connecting and managing a manufacturing machine or various parts of a power plant might provide greater opportunities than connecting one refrigerator.

Based on this evaluation, we assume that the highest amount of IoT connected devices will be concentrated in four industries in 2022 – intelligent buildings, automotive, healthcare, and utilities.

But it’s not just the number of connected devices in specific industries that should matter. It’s even more interesting to consider which applications will have the greatest importance.

A more detailed look at the utility industry reveals that more than 90 percent of all connected devices will be related to smart metering applications. Electric vehicle charging and transport & distribution will be of only minor importance with regard to the number of connected devices. But even application areas with comparably low numbers of connected devices might provide huge opportunities for developing new solutions and enjoying greater success in the marketplace. In smaller application areas, the number of competitors and competitive pressure will likely be lower, and the effect that efficiency or revenue have on new solutions is not necessarily linked to the number of connected devices.

The automotive industry provides a similar picture. 90 percent of all connected devices will be used for vehicle platform applications. Other applications – emergency call, entertainment, navigation and security & tracking – will prove important for the development of new business models and increased efficiency in this industry. The IoT evolution in the automotive industry has already started when you consider connected fleets, car-to-go solutions, and on-board entertainment offerings.

The sector manufacturing and supply chain will require a relatively low number of connected devices compared to other industries. But the potential effect of device management and IoT solutions in this sector is comparably high. For example, predictive maintenance applications have shown high potential for reducing costs or increasing uptime and productivity. An evaluation of this sector shows that all application areas are equally important. It will be dominated by applications in the field of processing, transmission and distribution, warehousing, and predictive maintenance.
The IoT maturity model

The IoT maturity model illustrates the different levels a solution can reach on the IoT value curve. Enterprises are not adopting IoT solutions and new business models overnight. Many of our customers and partners are actually embracing the opportunities of a connected world in a stepwise approach.

At the start, there are isolated things connected with the internet. The gathered data is processed only for a very isolated purpose (e.g. monitoring a pipeline). That means that early IoT applications often follow a stovepipe approach and the value of data collected from connected things is mostly locked.

In a first step of adoption, these assets are connected to the internet, but only to isolated backend systems. This enables remote access to the assets, albeit often with limited data available, and a more reactive approach to act on this data. On this level, only fragmented device information is available and thus only a reactive event reaction is possible.

In the second step, managed connectivity is established to approach serviceable devices. Devices are remotely accessible and initial proactive monitoring approaches are in place. Additionally, it is possible to deliver software and manage change and configuration remotely. Reduced service costs are an important result of serviceable devices. Managed connectivity also makes intelligent services possible, which means that the analytics results from the data gathered by the connected devices can be used to predict failures or perform predictive maintenance. Enhanced monitoring and reporting capabilities are available in addition to a much more detailed view on usage data.
The result of the third step is **optimized** connectivity. Applications, users, things, and enterprise systems (e.g. CRM, ERP, PLM, etc.) are integrated all on one platform. That way, a new ecosystem develops on one software platform based on the integration of all distributed players via internet protocol. This new ecosystem could be integrated into another ecosystem via cloud-to-cloud integration, evolving into an even bigger ecosystem.

The highest level of maturity in this model is called **differentiated**. Because of integration and optimization, new revenue-generating capabilities are possible, based on cloud-delivered customer applications and the capabilities to manage and control complete products remotely and in a differentiated way. In this way, each product or service can be customized and managed on behalf of differentiated user demands. Differentiated audits and reports are easy to perform and visibility reaches a new level. Clouds are not only integrated into another, but various clouds are meshed and the barriers between ecosystems are torn down. This level of maturity has not yet been fully accomplished by most organizations today. Even advanced business models have achieved no more than optimized connectivity and are only now beginning to develop into differentiated models.

### Introduction to IoT business model innovation

Enterprises are continuously looking for ways to sharpen their existing business models or even develop completely new ones. Sooner or later, most enterprises will therefore evaluate the opportunities based on IoT technologies. The question is how to benefit from connecting things and how to measure the return on investment (ROI), which is multidimensional: ranging from cost savings to increased or even new revenues generated by improved customer satisfaction and brand differentiation.

To expand and intensify the relationships with existing customers is one of the main objectives for most companies. Value-added services and new business models are important methods for achieving this objective and are bringing fundamental new opportunities for enterprises. IoT technologies create new ways for companies to enrich their services, gain customer insights, increase efficiency, and create differentiation opportunities. Business models based on ‘connecting things’ bring companies closer to their customers and deliver real ROI.

However, the majority of successful business models in the IoT will not follow the pattern: ‘A vendor sells a physical item to a customer.’ Also, conventional Web 2.0 business models – advertising being the most outstanding – don’t have the potential to scale or work for the IoT. The IoT connects non-physical items such as data and services to physical things. This is why more sophisticated (‘evolutionary’) and maybe even completely new (‘disruptive’) business models will play a major role.
But how do you come up with these business models? Good news: it’s not the Quest for the Holy Grail. For us, an executive IoT skill set rests upon three pillars: entrepreneurialism, joint innovations, and systematic tools for business model innovation.

**Entrepreneurialism**

The connected world is a highly volatile and dynamic one, and the task for entrepreneurs is to actively shape this world and make the most of the opportunities it presents. This includes being ready to deal with high-speed change. From what we have seen, IoT entrepreneurs also need to follow exploratory approaches as they face limited predictability and want to minimize risks.

**Joint innovations**

With the IoT, the economic order and the competitive landscape will increasingly be subject to change. Digital networking offers undreamed-of technological possibilities. Companies of all sizes and from all industries need to work together to seize the opportunities and possibilities presented by networking over the internet. It is about working together in both interdisciplinary and cross-sector ways. Collaborations between companies with complementary know-how are a major driver of this connectivity trend. Executives need to learn and adapt quickly within their ecosystem(s).

**Systematic, tool-based business model innovation**

The Business Model Innovation Lab at the University of St. Gallen provides executives with a very useful basic business model innovation tool, the ‘St. Gallen Business Model Navigator™.’ The lab analyzed some 300 cases of industry-changing business models from American Express Travelers Cheques to Zara and found 55 underlying, repetitive patterns for successful business models.

These patterns serve as building blocks for new business models. They provide external inspiration in the process of creating new ideas for a company’s business. Combining or transferring them to new industries creates new solutions.

**Example from the Bosch Group:** For Bosch, one viable way to enter new and generally highly dynamic markets is with units that are small, agile, and independent. Currently, Bosch has four innovation clusters for Connected Mobility, Connected Energy, Connected Building, and Connected Things. The clusters take on the role of incubators, which then test out business ideas beyond the normal constraints of established businesses. The Connected Things innovation cluster recently became Bosch Connected Devices and Solutions GmbH.
Technical accelerators for the IoT

There is a tipping point in the growth curve of many technologies when they break out of closed domains and into the world at large. Solutions now have to be engineered to put the potential of proactively and automatically managed devices to work. The value of the data tsunami gathered from connected devices has to be unlocked as well. Both managed devices and the value of data have to be integrated into business processes.

Device management

Service solutions that remotely detect, identify, and resolve various kinds of issues are the catalyst for a superior service level. Improved uptime, reduced onsite visits, and shorter service calls can be achieved through proactive service processes. This is made possible through a connected device strategy based on collecting and analyzing device data in a systematic and targeted way. The data, collected from devices and systematically analyzed by specialized backend systems, build the bridge to proactive service processes and value-added services.

Remote diagnosis and repair

A main objective of device management systems is to enable experts to remotely access connected things and to diagnose problems without user intervention. Incidents should be automatically identified, even before they become manifest, in order to eliminate them remotely and to minimize downtime and service delays. Remote troubleshooting and repair applications enable experts to fine-tune and regulate devices without on-site visits. Proactive and remote software updates are another benefit, applying to a wide range of various devices at different locations with no need for travel to the site. It is easy to transform proactive fault notification, remote problem diagnosis, and remote repair applications into successful business cases.

More resource efficiency

Service resources are expensive, and the right expertise is not available everywhere. Device management monitoring allows diagnosis and remote repair to be performed from anywhere in the world. It gives companies new ways to put their service resources to work more efficiently. When utilized intelligently, the best service experts can be put on the right job, regardless of the expert's location; this reduces working time per incident as well as travel costs. Service staff are then allocated only when necessary rather than being planned around a prearranged maintenance window.

Reduce configuration and change management effort

Remote software management on isolated devices or on a complete array of devices allows software updates without costly software duplication or on-site visits. By storing detailed information about the configuration of each device, it is possible to map the specific software releases and installed software configuration on each device. This assures that each device always has the correct and most up-to-date software configurations. Errors, security issues, latencies, downtimes, and so on can be avoided.
Device management employs connected devices such as actuators. But connected devices can be sensors as well, collecting and transferring huge amounts of data that were not available before. The question is how to unlock the value of these data.

**Better decisions through data analytics**

By utilizing tools and applications in order to get insights into the data provided by connected things, organizations are able to create even greater value beyond improved services.

**Quality improvements**

By analyzing data across multiple systems, organizations can reduce costs and downtime or increase the quality of products and services. Analyzing trends over whole systems allows quality issues or design faults to be identified. Manufacturing or service processes can be optimized and faults in third-party supplied parts can be recognized faster. Data analytics helps us to understand the relationships between problems and specific parts. Problematic production outputs can be identified early and unhappy customers or even expensive recall processes can be avoided.

**Product design**

Data gained from user behavior allows the identification of usage patterns. This enables product managers to design products and features that not only fulfill customer demands in a much better way but also increase market share by offering a superior product design that takes real-time customer information into consideration.

**Predictive maintenance**

Analyzing data history helps us to predict necessary maintenance cycles for devices and machines and their components. The analysis of sensor data uncovers archetypes and failure indicators. That way, failures and incidents can be identified even before they occur. Maintenance cycles need not be scheduled on a time frame basis and unnecessary maintenance assignments can be avoided. Exactly tracking a device’s usage and wear means maintenance and replacement of parts need only be done if truly necessary. As a result, the work force can be allocated more efficiently and the costs of parts to be replaced can be reduced to a minimum.
Machine data integration into business systems

The real value in connecting things is that it allows the data collected from connected devices to be analyzed and integrated into already established enterprise systems (CRM, ERP, PLM, data warehousing, etc.). As a result, business processes can be optimized, service calls reduced, and warranty claims minimized.

Data collected from connected things in combination with other enterprise systems are the key to a new level of transparency and efficiency across enterprises and their partner ecosystems. For example, real-time usage data can be integrated into a CRM system, or data collected from a production unit can be forwarded to a supply chain management system. Error-prone manual steps can be reduced, supply chains can be optimized, and new sales opportunities can be identified (e.g. replenishment for consumable goods, cross- or up-sell opportunities or replacements for written-off assets). Based on real-world data, usage patterns or issues and incidents can be identified, opening up new possibilities for quality assurance, product lifecycle management, and enhanced product features and services.

By monitoring expandable parts in production plants, maintenance units can exchange parts proactively to avoid downtime. Sales and marketing units can monitor sales, usage, and consumption over a long period of time and can offer the right service at the right time. Observing critical data points in a device allows proactive recognition of failures and notification of service teams to avoid outages for customers.

IoT business model matrix

To identify and develop the business model that suits your organization, customers, partners or competitive environment might be a challenge. Many parameters and variables have to be taken into consideration. This chapter aims to give you some initial ideas about how to start identifying the risks and opportunities related to the IoT. For business models in general, we see two fundamental characteristics: business models can be either ‘disruptive’ or ‘evolutionary.’

The fundamental difference is that evolutionary business models will help you primarily to save costs in a first step, speeding up your time-to-market and improving quality. This will increase competitiveness, revenue, and market share. But it is also a fundamental starting point for manufacturers new to the IoT. This is the right stage to challenge the existing business model: what about adding connectivity to products? Which services are possible? Where do we see potential use cases? However, there are limitations. From our conversations, we observe that many companies look at the potential of the IoT only through the glasses of their existing business model. A very common mistake is waiting to make fundamental decisions, such as waiting until a market is big enough to enter (according to the existing business model’s definition). This can lead to an unrecoverable disadvantage.
Disruptive business models present the opportunity for completely new revenue streams, for creating an open business environment or allow for disaggregating and reassembling entire value chains.

**How to use the IoT business model matrix**

- To help you get started on your either evolutionary or disruptive IoT business model, we abstracted nine typical IoT use cases.

- Based on the 55 successful patterns identified by 'The St. Gallen Business Model Navigator™', we added this information to each broader category. Note that not all mentioned patterns per category will fit with every use case of the particular category.

- Each pattern has four central dimensions, as outlined in the 'Magic Triangle' below: the Who, the What, the How, and the Revenue. This will help you to sharpen your particular starting position.

- Play around with your use case, the patterns, and their dimensions to customize your individual IoT business model.

![Magic Triangle](image)

*Figure 8: Business model definition – the Magic Triangle
Source: University of St. Gallen, Institute of Technology Management, 2013*
## Evolutionary business models

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<th>Description</th>
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<td>Improve the status quo to be ready for the IoT</td>
<td>Optional prep phase – good to put out feelers to the IoT and ready the organization for disruption.</td>
</tr>
</tbody>
</table>

## Disruptive business models

<table>
<thead>
<tr>
<th>Description</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Create new revenue by adding services to connected products</td>
<td>No longer is the product the focus, but rather the web-based services that users access through the device.</td>
</tr>
<tr>
<td>Open up business by connecting things</td>
<td>Connected things and users become part of production and business processes. This allows mass customization and lot size 1.</td>
</tr>
</tbody>
</table>

## Abstract IoT use cases

1. Remote access & monitoring  
   Devices know more about themselves (e.g. real-time location tracking).
2. Self-awareness  
   Devices are able to evaluate and analyze environmental conditions and react accordingly.
3. Resource efficiency  
   Because of gathered device data and remote device management capabilities, maintenance resources can be allocated much more efficiently.
4. End user product/service design  
   Interfaces and business processes permit the user to act as product manager.
5. Quality improvements  
   Data analytics helps to understand the relation between problems, parts, and processes, which increases product and service quality.
6. Product design  
   Data about real user behavior and feedback help to identify usage patterns and design better products.
7. Aggregation of products & services  
   Connectivity allows for expansion of a conventional distribution channel and offers more services along the value chain.
8. Technology platforms  
   IoT platforms that connect and integrate all parts of an ecosystem are the key to new business models.
9. Partner integration in value chain  
   Opening up own sales channels to third parties makes them business partners. Sharing data and eliminating strong competitive efforts are sidelines.

## Successful business model patterns based on 'The St. Gallen Business Model Navigator™' for the IoT

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<tr>
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<th>1 – Add-on</th>
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<td>buy</td>
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<td>45 – Reverse Innovation</td>
<td>48 – Shop-in-Shop</td>
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<td>48 – Shop-in-Shop</td>
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<td>25 – Layer Player</td>
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<td>31 – Mass Customization</td>
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<td>32 – Multi-sided Platform</td>
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<td>47 – Self-Service</td>
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<td>52 – Trash to Cash</td>
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</table>
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