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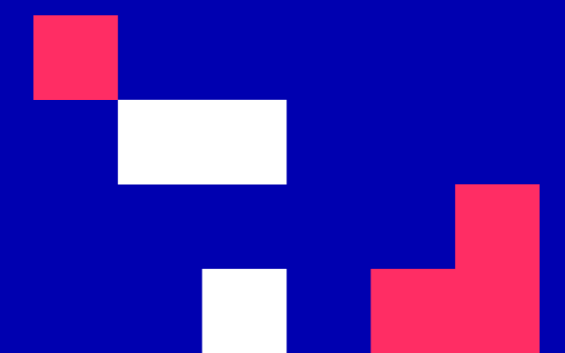


University of Cyprus

MAI650 Internet of Things

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September - December 2023





CS6xx Internet of Things (8 ECTS)

Course purpose and objectives: The purpose of the course is to provide an overview on IoT tools and applications and to introduce to students hands-on IoT communication concepts through lab exercises.

Learning outcomes: Upon completion of this course, students will be able to explain the definition and usage of the term “Internet of Things” in different contexts. More specifically, the students will know how to apply the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis

Teaching methodology: interactive face-to-face lectures, group activities and discussions, in class/lab activities, student presentations and guest lectures or significant recorded public lectures

Assessment: Final exam (50%), midterm exam (20%) and assignments/project (30%).

Main text:

Rajkumar Buyya, Amir Vahid Dastjerdi, Internet of Things Principles and Paradigms, Morgan Kaufmann; 1st edition, 2016

J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media, 2016.

Other reading:

Jamil Y. Khan and Mehmet R. Yuce, Internet of Things (IoT) Systems and Applications, 2019, ISBN 9789814800297

David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, and Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, 2016, Cisco Press.



INTRODUCTION

IoT Business Value - Core

CONTENTS

1. Business Ecosystem
2. IoT Business Ecosystem
3. Business Model
4. IoT Business Model
5. IoT Business Challenges

INTENDED LEARNING OUTCOMES

Upon completion of this introductory unit, students will be :

1. familiar with the IoT Business Ecosystem
2. familiar with the term business model
3. familiar to the different business model types
4. familiar to the different challenges of IoT Business

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Business Ecosystem

Business Ecosystem

“An economic community supported by a foundation of interacting organizations and individuals—the organisms of the business world. The economic community produces goods and services of value to customers, who are themselves members of the ecosystem. The member organisms also include suppliers, lead producers, competitors, and other stakeholders. Over time, they coevolve their capabilities and roles, and tend to align themselves with the directions set by one or more central companies. Those companies holding leadership roles may change over time, but the function of ecosystem leader is valued by the community because it enables members to move toward shared visions to align their investments, and to find mutually supportive roles.”

James F. Moore (1993)

Business Ecosystem

“A business ecosystem is a business network. Business ecosystems are formed by large, loosely connected networks of entities, that interact with each other in complex ways, and the health and performance of a firm is dependent on the health and performance of the whole.”

Iansiti and Levien(2004)

Business Ecosystem

A business ecosystem is a community of organizations and individuals, stronger together than individually, that co-work and co-evolve toward fulfill a shared purpose through both collaboration and competition interactions.

Aspects of Business Ecosystem

- Actors (Species)
- Network (Relations between actors)
- Performance (Health)
- Dynamics (Evolution)
- Roles (Strategies and behavior of actors)

Aspects of Business Ecosystem

Actors (Species)

- The business ecosystem emphasizes on the role of the actors in the business network.
- The role of an actor can be divided into two perspectives.
 - The first one is related to the characteristics of the actors, meaning the identification of roles being played in the network of the business.
 - The second one is related to the behaviour of these actors.
- An actor in a complex system theory represents an active and strategic agent that also has fragmented information
- Actors learn how to perform their tasks by developing their own survival strategies. This behaviour is driven by a set of rules, like:
 - A set of operating rules that drive the performance of the tasks.
 - A set of evaluation rules that help evaluate the operating performance of a task.
 - A set of rules for changing both the operating and evaluation rules.

Aspects of Business Ecosystem

The 7 types of Actors

- Customers
- Markets
- Products
- Processes
- Organizations
- Stakeholders
- Government/Society

Aspects of Business Ecosystem

Roles (Strategies and behavior of actors)

- The roles of an actor in the network can be elaborate on the role of a keystone for maintaining the health of its ecosystem as well as identifying a keystone.
- Many studies have shown that the position of companies in the network influence the behavior and performance of the company.
- From network theory, it also possible to enrich the role and the behavior of actors by occupying certain positions or having certain network resources.

Aspects of Business Ecosystem

Network (Relations between actors)

- The business ecosystem concept can be enriched with the network aspect.
- The function and behaviour of a dynamical system is always affected from the structure of its network.
- In the network theory, network structure is referred to as the pattern of relationships in which the industry is embedded.
- In the complex adaptive system theory, a business network is defined as a self-organized loosely coupled system of interconnected actors.

Aspects of Business Ecosystem

Dynamics (Evolution)

- The dynamics of a network are depending on the characterization of the structure, which provide the starting point.
- The dynamics of a network can be further divided into two categories based on the interconnectedness, namely co-evolutionary processes and non-linear processes.
 - Co-evolutionary processes: The network evolves from random collections of agents to more structured communities. These communities involve interdependent species of organization with endless reciprocal structures. The hallmarks of this process are, adaptation and survival, as well as predatory and prey interactions
 - Non-linear processes: A non-linear behavior of a complex system is shown when many loosely coupled agents interact together. Different future paths can be result due to small changes, that involve emergent structures, patterns and properties arising without being externally imposed on the system.
- The business network evolves through different phases, such as pioneering, expansion, authority/leadership and self-renewal or death.
 - This evolution finds its route on biological evolution that includes mutation, replication, competition and adaptation. In the business world, the mutation phenomenon is represented by innovation or invention.

Aspects of Business Ecosystem

Performance (Health)

- The performance of a business ecosystem, also known as the health of the system, is influenced by the strategic actions of the business through a governance mechanism.
- To measure the performance of the network health, three metrics are defined:
 - Productivity
 - Robustness
 - Niche Creation.

Life-cycle of a Business Ecosystem

1. Birth
2. Expansion
3. Leadership
4. Self-renewal / Death

Life-cycle of a Business Ecosystem

Birth Stage

- The focus should be on the acquisition of critical lead customers, key suppliers and important channels.
- It is important to work with customers and suppliers in order to define the new value proposition around a seed innovation.
- It is important to protect the ideas from competitors that work towards defining a similar offer.

Life-cycle of a Business Ecosystem

Expansion Stage

- In the expansion stage, the focus is on the expansion of the system.
- With the increase of scale and scope, a critical mass can be reached with the partners, as well as by standardization in key market segments.
- With the work of partners and suppliers, the new offer is brought to a large market to scale up supply and achieve maximum market coverage.
- It is important to defeat alternative implementations of similar ideas. Through dominating key market segments, it is ensured that the approach is the market standard in its class.

Life-cycle of a Business Ecosystem

Leadership Stage

- The leadership stage is characterized by authority.
- Provide a compelling vision of the future to encourage the suppliers and the customers to work together to continue the complete offer.
- Maintain a strong bargaining power in relation to other players in the ecosystem, including the key customers and the valued suppliers.

Life-cycle of a Business Ecosystem

Self-renewal / Death Stage

- New ideas are needed to be brought to the existing ecosystem from the work with innovators.
- Prevent innovators for building alternative ecosystems by maintaining high barriers.
- Maintain high customer switch costs in order to buy time so that new ideas are incorporated into the company's products and services.
- It is critical to not create a non-self-renewable ecosystem, since it will lead to the end of the evolution, meaning the death.

3 critical success factors

1. **Productivity:** the network's ability to consistently transform technology and other raw materials of innovation into lower costs and new products.
2. **Robustness:** a business ecosystem is expected to survive all disruptions.
3. **Niche creation:** a business ecosystem suggest the ability to absorb external shocks and the potential for productive innovation.

4 effective strategic roles

1. Keystones
2. Physical Dominators
3. Value Dominators
4. Niche Players

4 effective strategic roles

Keystones

- Keystones aim in improving the overall health of the ecosystem by providing a stable and predictable set of common assets that other organizations use to build their own offerings.
- An effective keystone strategy has two parts:
 - to create value within the ecosystem
 - to share the value with other participants on the ecosystem.
- A value can be created in numerous ways:
 - the creation of a platform
 - share the value created

4 effective strategic roles

Physical dominators

- The physical dominator aims in integrating vertically or horizontally to own and manage a large part of a network directly.
- There is little opportunity for a meaningful ecosystem to emerge, when the dominator becomes solely responsible for most part of the creation and capture of the value.
- As a result, the physical dominator takes over the ecosystem and leave no room for other network members.
- With this behaviour, the health of the ecosystem is damaged by reducing the diversity, eliminating completion, limiting consumer choice and stifling innovation.

4 effective strategic roles

Value dominators

- The value dominator has little direct control.
- It creates little value while it extracts as much as possible.
- It leaves too little value to sustain the ecosystem, which ultimately collapses and brings the value dominator down with it.

4 effective strategic roles

Niche players

- A niche player aims in developing specialized capabilities that differentiate it from other companies in the network.
- A niche player can leverage complementary resources from other niche players or ecosystem keystones, so all its energies are focused on enhancing its narrow domain of expertise.
- Niche players are responsible for most of the value creation and innovations, and also represent the bulk of the ecosystem, only when they are allowed to thrive
- A niche player is naturally dependent on other businesses, so it needs to analyse its ecosystem and identify the characteristics of its keystone and dominators, both current and potential.

8 Dimensions of Business Ecosystems

1. Strategy
2. Openness
3. Participants
4. Relationships
5. Value exchange
6. Industries
7. Complexity
8. Technology

8 Dimensions of Business Ecosystems

1. Ecosystem Strategy

- The most important challenge of a business is to decide how it will survive and thrive in its ecosystem.
- A business exists in multiple business ecosystems, which are dynamic networks of entities that interact with each other in order to create and exchange sustainable value for the customers.
- A business ecosystem can emerge in:
 - The organically business ecosystem is created based on evolving industry, government and market trends
 - the deliberately business ecosystem emerges in a more planned manner.

8 Dimensions of Business Ecosystems

2. Degree of Openness

- The degree of openness in a business ecosystem is defined by the strategies, common goals and shared interest.
- An ecosystem can be categorized into:
 - Private
 - Public
 - Hybrid
- The ecosystem defines:
 - The degree of change
 - The nature of the relationship
 - The way it is formed and maintained
 - The nature of collaboration and competitions

8 Dimensions of Business Ecosystems

3. Engagement of Diverse Participants

- The businesses need to add into their ecosystems, how to integrate things like smart advisors and artificial intelligence, due to the increased connectivity.
- It is important to notice that the diversity of an ecosystem and the roles that the people, the business and the things play, will have to change and also evolve based on the situation that needs solution.

8 Dimensions of Business Ecosystems

4. Types of “Relationships”

- A new challenge for the ecosystem will arise in terms of interconnections, due to the increase of connected devices and peoples to the internet.
- Ecosystem mediate relationships with digital platforms
 - participants that have different goals and objectives are connected on a commission basis.
 - They provide to the participants the core integration, the application and the management services.

8 Dimensions of Business Ecosystems

5. Form of Value Exchange

- An ecosystem can dynamically leverage information, reputation, services and other non-monetary forms of values.
- It is important to understand the changing definition that ecosystems create for the term value.
- Ecosystems enable business to exchange products and services for information or analytics.

8 Dimensions of Business Ecosystems

6. Diversity of “Industries”

- Unexpected partnerships can result from ecosystems.
- A business can partner with other business that include businesses with the primary industry, adjacent industries or even far-neighbour industries outside of the business’s industry.

8 Dimensions of Business Ecosystems

7. Complexity of Multiple Ecosystems

- Multiple ecosystems are involved in most cases in large companies.
- The key is to understand the way these ecosystems interact, identify potential fractures and overlaps and acknowledge constraints as well as implications.
- In some cases ecosystems that overlap can either create a new ecosystem or highlight redundancy.

8 Dimensions of Business Ecosystems

8. Technologies

- A business ecosystem is responsible for the technology strategy for now and the future.
- To make a successful business ecosystem, a strategic integration of technology, information and business processes are required.

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IoT Business Ecosystem

IoT Ecosystem

IoT ecosystem is comprised on a smart device, like smartphone or tablet, that functions as a remote and sends a command or request for information to an IoT device over the network. The IoT device will perform the command or responds to the request by sending information back over the network, so that the data will be analyzed and displayed on the remote.

Business Insider

IoT Ecosystem

- The central elements of IoT include the concepts of the ecosystem, the ecosystem core and the business model.
- The IoT ecosystem includes all the components that enable businesses, governments and consumers to connect to the IoT devices.
- The ecosystem includes remotes, dashboards, networks, gateways, analytics, data storage and security.

IoT Ecosystem

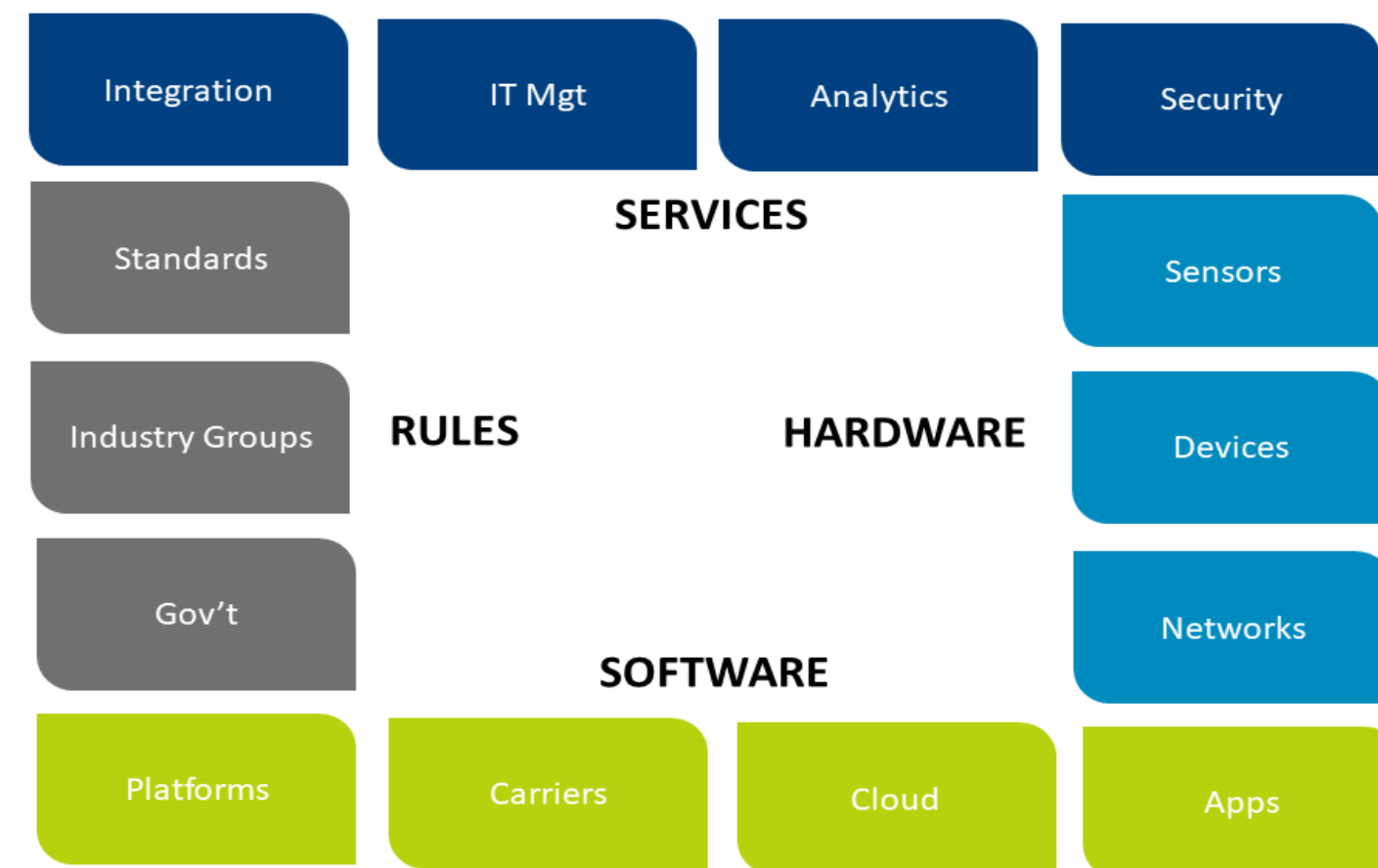
- The core of an IoT ecosystem can be defined as the interconnection of the physical world of things with the virtual world of the Internet, software, hardware and network platform, as well as standards that enable this interconnection.
- The IoT ecosystem core can focus on the following aspects:
 - The connected devices and gateways that include both hardware and software platforms, as well as the related standards.
 - The connectivity between the devices and the Internet.
 - The application services that are built on top of the connectivity with the help of software platforms and standards.
 - The supporting services that are needed for the provisioning, assurance and billing of the application services and related standards.

IoT Business Ecosystem

An IoT business ecosystem can be defined as a special type of business ecosystem, which is comprised of the community of interacting companies and individuals along with their socio-economic environment, where the companies are competing and cooperating by utilizing a common set of core assets related to the interconnection of the physical world of things with the virtual world of Internet

IoT Ecosystem Components

- Hardware
 - Sensors
 - Devices
 - Networks
- Software
 - Platforms
 - Carriers
 - Cloud
 - Apps



- Rules
 - Standards and Protocols
 - Industry Groups
 - Government/ Regulations
- Services
 - Analytics
 - Integration / Solutions
 - Security
 - It Services / Management

IoT Ecosystem Components

Hardware

- The first piece of the IoT Ecosystem puzzle is the hardware.
- The hardware consists of three further subcategories:
 - Sensors
 - Devices
 - Networks

IoT Ecosystem Connectivity Layer Components

Hardware : Sensors

- Both sensors and computing components can be affordably placed in any type of device.
- Sensors that are inexpensive can measure everything, from geolocation to temperature to blood pressure, and then translate this information to digital format.
- The information can be either processed at the sensor or the sensor will send the information collected to a central location to be processed there.

IoT Ecosystem Connectivity Layer Components

Hardware : Devices

- Devices are the “things” in the IoT world.
- Devices are able to carry from a small to a big amount of sensors.
- In general, every device that had never before had a computing capability or connectivity, is now able with the help of sensors.

IoT Ecosystem Connectivity Layer Components

Hardware : Networks

- IoT is based on transmitting data, so a critical part of strategy is to create a robust network.
- The network is created by the connection of all sensors and devices of IoT.
- It is important to create a network that will successfully connect all its components.

IoT Ecosystem Components

Software

- The second piece of the IoT ecosystem puzzle is the software.
- The software consists of four further subcategories:
 - Apps
 - Cloud
 - Carriers
 - Platforms

IoT Ecosystem Connectivity Layer Components

Software : Apps

- APIs are the mean used to make the software available to third parties.
- APIs are dependent on both the cloud software and the access a cloud provider is willing to grant.

IoT Ecosystem Connectivity Layer Components

Software : Cloud

- The cloud is a primary tool in facilitating IoT.
- An important role, in the overall solution, plays the software created by cloud providers to construct their offerings.

IoT Ecosystem Connectivity Layer Components

Software : Carriers

- Traditional carriers that were operating in the telecom area, are now looking to provide cloud solutions, as well as offering network capabilities.
- Modern computing models are enabled with cellular and Wi-Fi networks. However, these networks come with a cost that needs to be considered when building new data streams plans.

IoT Ecosystem Connectivity Layer Components

Software : Platforms

- The software component begins with new platforms. The primary example of this, are the operating system created for the mobile devices landscape.
- While, during the Internet 1.0 era, Microsoft Windows was the dominant OS, in terms of front-end and consumer computing, now iOS and Android are becoming major players in the market with the rise of smartphones and tablets.
- Since consumers are expanding their notion of computing to include wearables, homes and cars, vendors are also seeking to expand their operating systems to these areas.

IoT Ecosystem Components

Rules

- The third piece of the IoT ecosystem puzzle are the rules.
- This category consists of three further subcategories:
 - Standards
 - Industry Groups
 - Regulations/Government
- A company needs to establish rules in order to implement projects. These rules include standards and regulations. It is also important to invest in industry groups, where several different organizations are involved in helping to build rules for IoT.

IoT Ecosystem Components

Services

- The last piece of the IoT ecosystem puzzle are the services.
- This category consists of four subcategories:
 - Analytics
 - Integration/Solutions
 - Security
 - IT services/Management.
- The true value of IoT lies in the data being generated, collected and analyzed. Without services, this data does not hold much value.
- On this data, the services performed the analysis and present either findings or insights in a usable way.
- It is also important that the data is tightly protected and at the same time be highly available.

IoT Ecosystem Connectivity Layer Components

Services: Analytics

- The data generated from the IoT devices will require new data warehousing techniques, as well as new analytics tools.
- These new functions are often complementary to existing techniques that only require a strong foundation in data management.

IoT Ecosystem Connectivity Layer Components

Services: Integration/Solutions

- Integration services are already provided by many channel firms.
- These firms recognize the integration typically by constituting the bulk of the effort for a new IT product and built the planning practices necessary for integrating complex systems.
- The only new skills that will be required for IoT integration are the APIs that connect various devices and services.
- The channel firms that will take full advantage of IoT opportunities, need to continue their transformation along with the path forged by cloud and mobility.
- IoT solutions are for the most part, an ongoing process with recurring revenue, in order for business models to account for these things.

IoT Ecosystem Connectivity Layer Components

- The IoT ecosystem connectivity layer consists of the following nine main components:
 1. Gateway
 2. Analytics
 3. Connectivity of Devices
 4. Cloud
 5. User Interface
 6. Standards and Protocols
 7. Databases
 8. Automation
 9. Development

IoT Ecosystem Connectivity Layer Components

1. Gateway

- Gateway enables easy management of data traffic that flows between protocols and networks.
- It translates the network protocols and ensures that the devices and sensors are connected properly.
- When the gateway is configured properly, it can also preprocess the data from the sensors and also send them to the next level.
- The gateway gives proper encryption with the network flow and data transmission.

IoT Ecosystem Connectivity Layer Components

2. Analytics

- The analog data from the devices and sensors are converted into an easy to read and analyzed format.
- The most important function of the IoT technology is the real-time analysis.
- Irregularities are easily observed and any losses or scams are prevented.
- Large companies use the data collected and analyzed, to see future opportunities. Future trends are easily extracted from this analysis, with ultimate goal to rule the market.

IoT Ecosystem Connectivity Layer Components

3. Connectivity of Devices

- Sensors and devices are the main components of the connectivity layer.
- Sensors are responsible for collecting the information and sending them to the next layer to be processed.
- The main components of such devices are:
 - Proximity detection
 - Humidity or moisture levels
 - Temperature sensors and thermostats
 - Pressure sensors
- Various ways of connection are used to connect these modern smart sensors and devices. The most common way of connection is wireless networks, like Wi-Fi and Bluetooth.

IoT Ecosystem Connectivity Layer Components

4. Cloud

- Various tools exist that are used for collecting, processing, handling and storing the data efficiently in real time. This all is done by one system, the IoT Cloud.
- The IoT Cloud is an intimidating high-performance network, which connects servers together to optimize the performance of data process that is done by many devices at the same time. It is also responsible for controlling the traffic and delivering accurate data analytics results.
- All these systems are used by companies in order to improve the efficient data analysis to help the development of the services and products. Additionally, it helps to form an accurate strategy which will result in building an ideal business model.

IoT Ecosystem Connectivity Layer Components

5. User Interface

- It provides a visible and physical part that is easily accessed by the user.
- The final product of the development must be a user-friendly interface that can be accessed without any extra effort and provides an easy interaction.
- The user interface is the first thing that a user pays attention to before buying a device.
 - Customers are oriented in buying a device that is user-friendly, less complex and uses wireless connectivity.

IoT Ecosystem Connectivity Layer Components

6. Standards and Protocols

- IoT platforms need to choose to determine the way the platform will interact with the system.
- For a successful interaction, same protocols need to be used for the devices and networks.

IoT Ecosystem Connectivity Layer Components

7. Database

- The IoT is all dependent on data used in the data centers.
- To store and manage the data, it is essential to have a database system that gathers all data from various devices and end-users.
- Many management tools exist that offer automated features to help storing the data and managing the bulk at the same place.

IoT Ecosystem Connectivity Layer Components

8. Automation

- Automation is part of the IoT. As mentioned before, in the database management system, automated features are used to help improve the interaction with the data.
- The wireless things allow automatic adjustments from its developments that make it easier to used.
- Examples:
 - The light is easily controlled by clicking the remote.
 - The air-condition is controlled form the user's smartphone
 - the user can switch it off or on, as well as play with the temperature.

IoT Ecosystem Connectivity Layer Components

9. Development

- As IoT is the latest advancement in technology, the need for the development is growing and increasing.
- Many automotive devices and smart sensors are launched in the market in their prototype version to be deployed and run for their testing phase.
- Because IoT does not work only on one device, it is important that the test phase is completed according to the compatibility of the device, as well as its wireless connectivity is checked thoroughly.

Business Model

Business model

A business model is the way in which a company “creates, delivers and captures values”

(Osterwalder and Pigneur, 2010)

and the

“blueprint of how a company does business”

(Osterwalder et al., 2005)

What is a business model?

- The business model describes the operating logic of the company.
- A business model describes:
 1. What a company does
 2. How the company does it
 3. How the company makes money

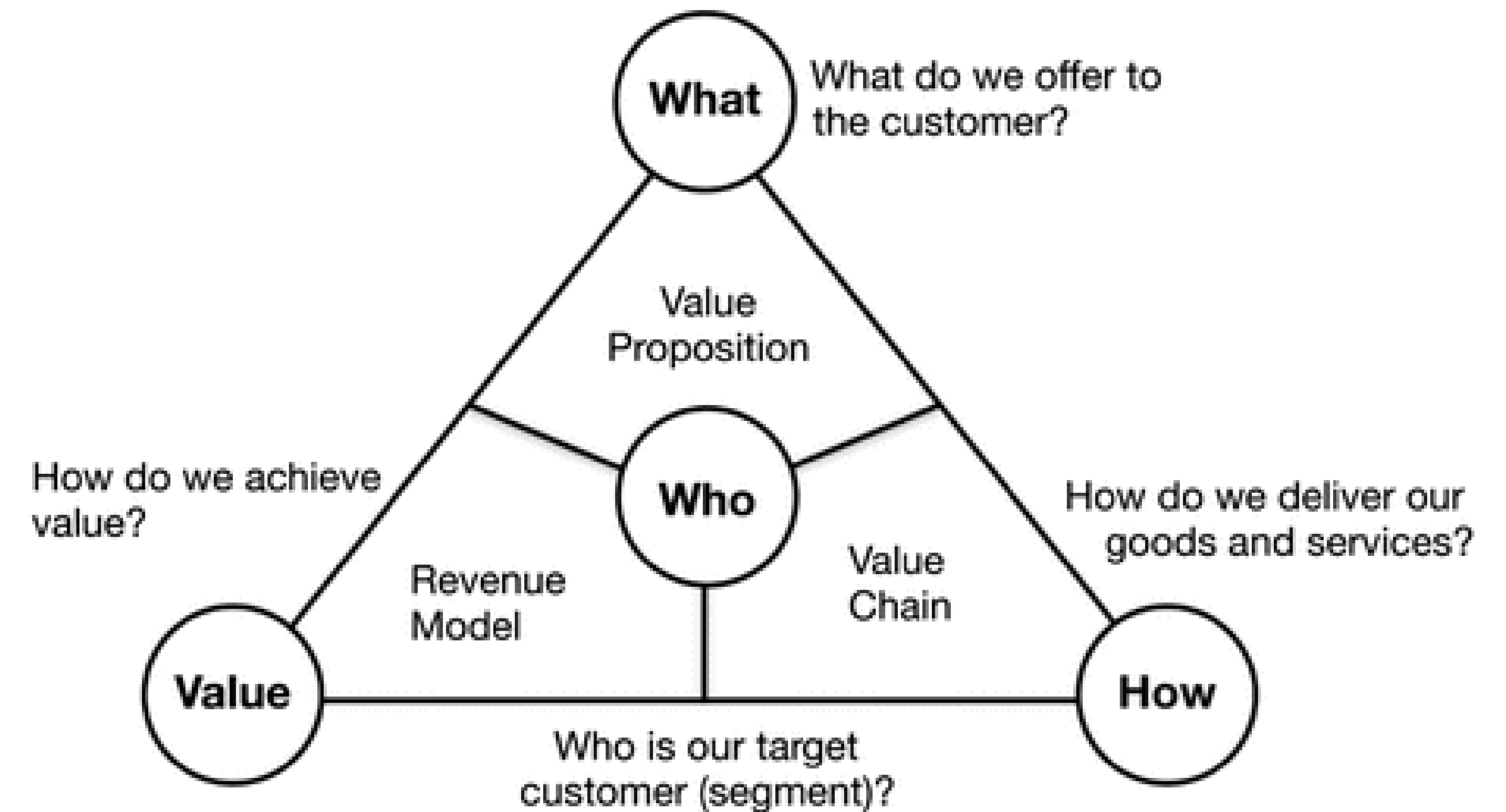
Business model history

Teece

- The business model is defined as a reflecting management's hypothesis.
- The reflecting management's hypothesis is about
 - What customers want
 - How they want it
 - How the enterprise can best meet those needs and be paid

The magic Triangle

- The magic triangle by Gassmann, Frankenberger and Csik.
- It consists of four central dimensions.
 - The who
 - The what
 - The how
 - The value



The magic Triangle

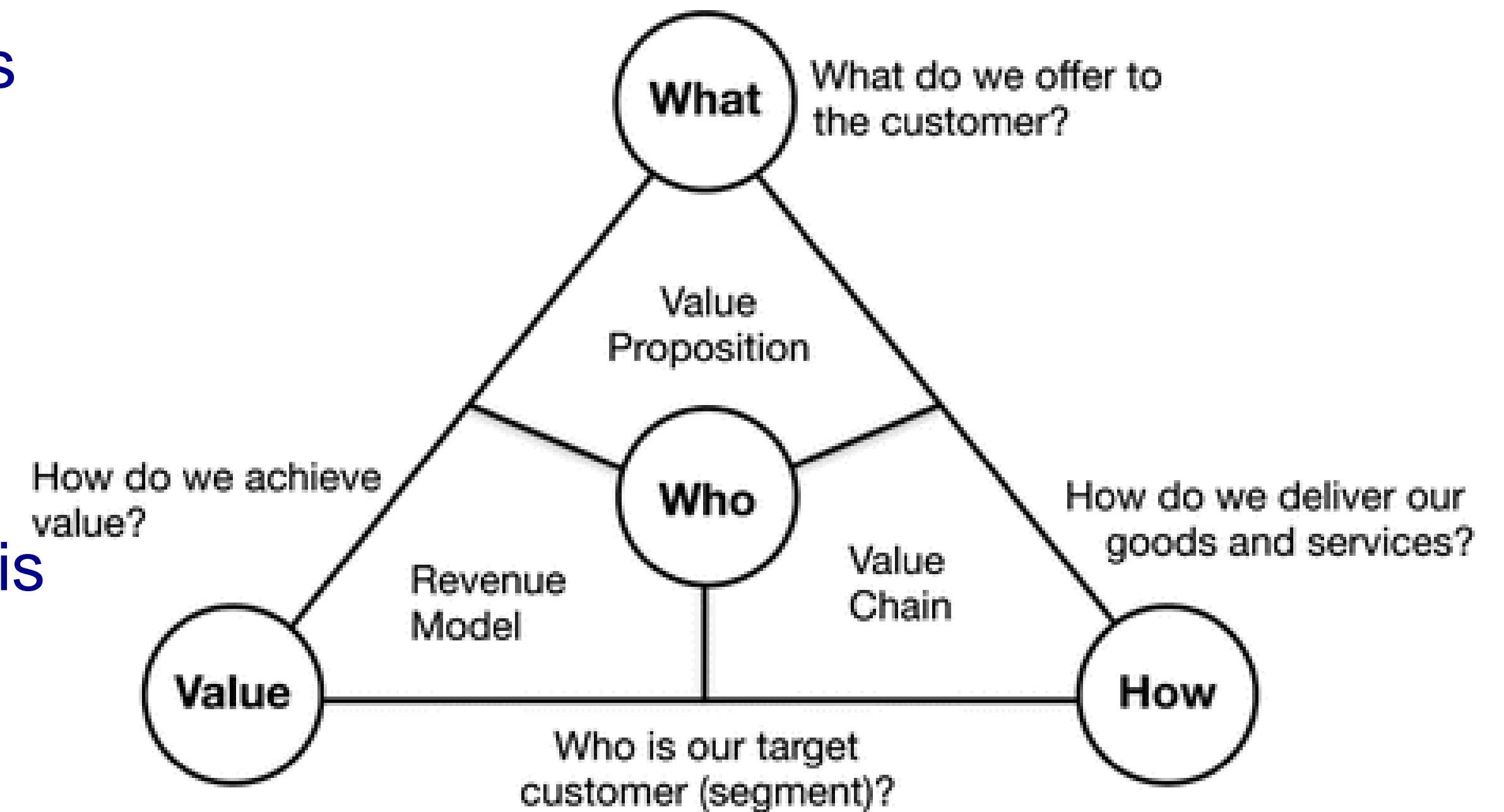
- Who: it answers the question “Who is the customer?”
 - Each business model serves a certain customer group.
- What: it is the customer value proposition or the value proposition
 - Describes what is offered to the target customer.
 - “What the customers values”
 - A holistic view of the products and services of a company that are of value to the customer.

The magic Triangle

- How: the processes, activities, involved resources and capabilities.
 - Several processes and activities have to be mastered in order to build and distribute the value proposition.
- Value: it answers “why is the business model financially viable?”
 - The question of how a company can make money in the business by unifying aspects like the cost structure and the applied revenue mechanisms.

The magic Triangle

- The business model of a company becomes tangible by answering the four associated questions and explicating:
 - The target customer
 - The value proposition towards the customer
 - The value chain behind the creation of this value
 - The revenue model that captures the value



The Business Model Canvas

- Osterwalder, Pigneur et al. 2010
- The most popular way to create a business model is to break it down into components.
- This component view is based on the business model framework called business model canvas.

Osterwalder, Alexander, and Yves Pigneur. *Business model generation: a handbook for visionaries, game changers, and challengers*. John Wiley & Sons, 2010.

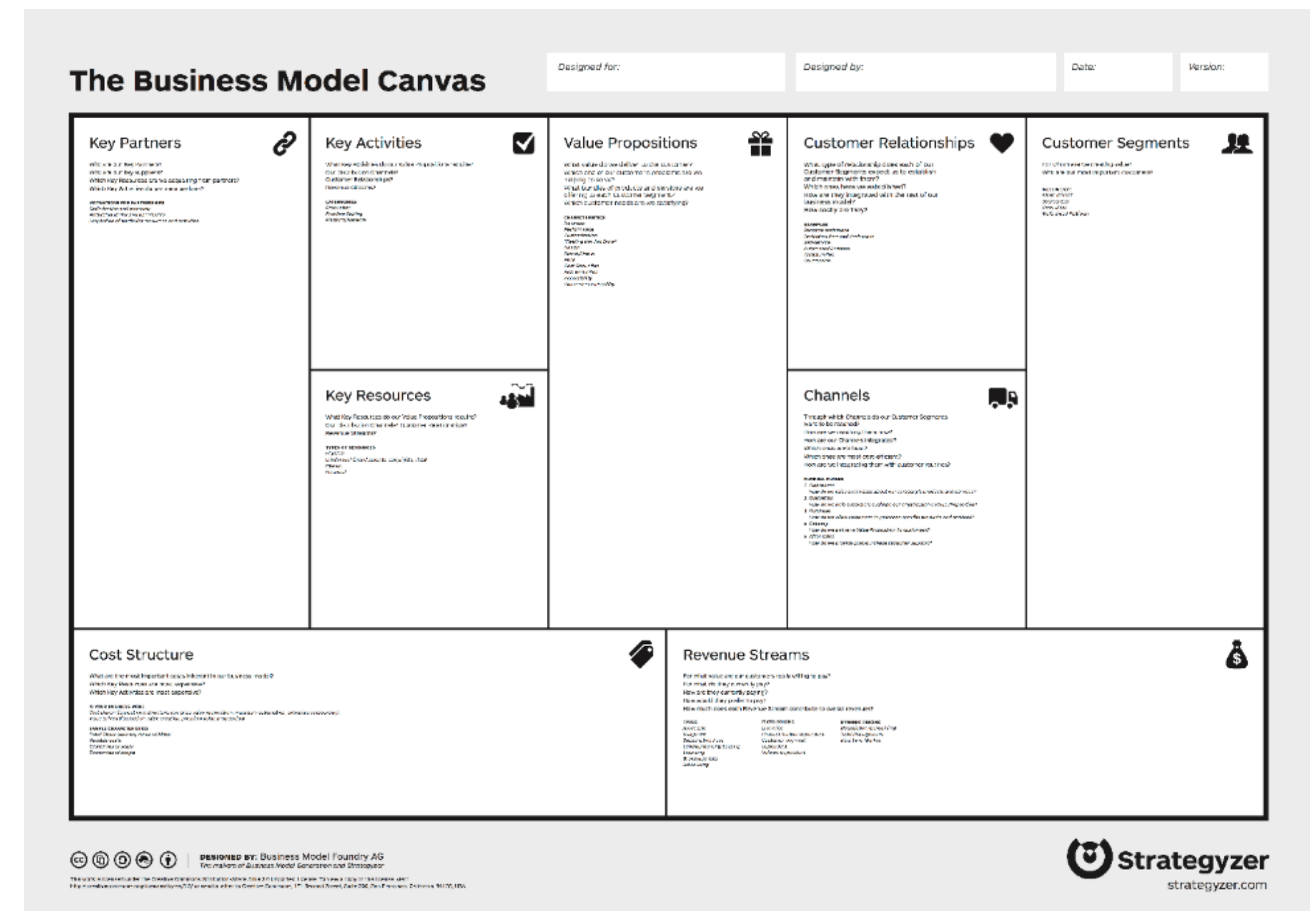
The Business Model Canvas

- A strategic management and lean startup template for developing new or documenting existing business models.
- A virtual chart that describes the company's or product's value position, infrastructure, costumers and finances.
- The business model canvas is created in two methods:
 - It can be printed out on a large surface where different groups of people can jointly sketch and discuss the business model elements with post-it notes or board markers.
 - It can used online, on a web-based software format.

Osterwalder, Alexander, and Yves Pigneur. *Business model generation: a handbook for visionaries, game changers, and challengers*. John Wiley & Sons, 2010.

The Business Model Canvas

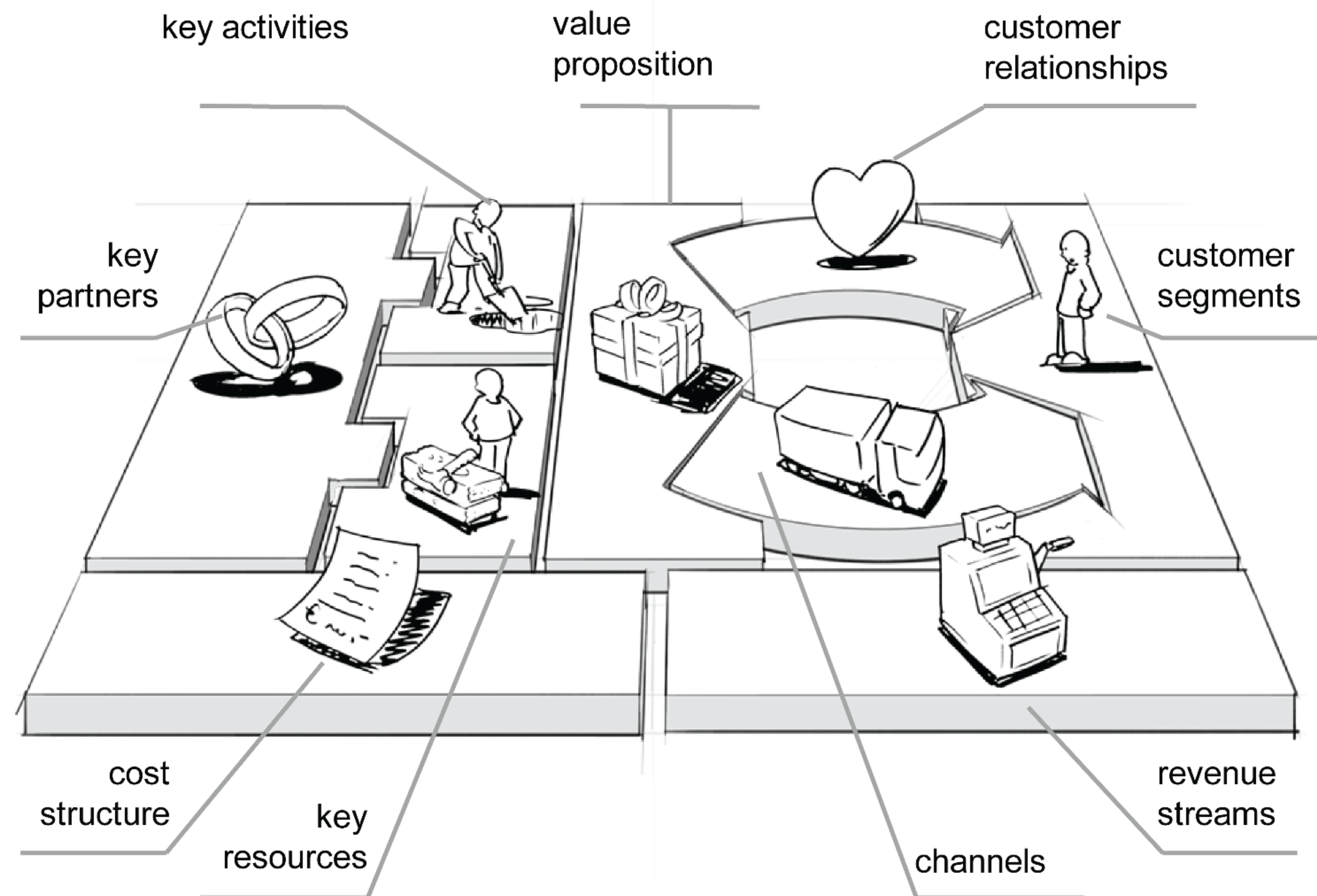
- It consists of four elements and nine components:
 - Infrastructure
 - Key activities
 - Key resources
 - Key partners
 - Offer
 - Value propositions
 - Customers
 - Customer segments
 - Channels
 - Customer relationships
 - Finances
 - Cost structures
 - Revenue streams



Business Model Canvas: nine business model building blocks, Osterwalder, Pigneur & al. 2010



The 9 Building Blocks



The Business Model Canvas

Infrastructure: Key Activity

- *What activities are required to deliver the value proposition?*
- The most important activities in executing the value proposition of a company and be successful
- The key activity can be categories as follow:
 - Production
 - Problem solving
 - Platform/network

The Business Model Canvas

Infrastructure: Key Resources

- *What resources are needed to create value for the customer?*
- These resources allow a company to create and offer value proposition, reach markets, maintain relationship with customer segments and earn revenue.
- The key resources can be categorized as follows:
 - Physical
 - Intellectual
 - Human
 - Financial

The Business Model Canvas

Infrastructure: Key Partners

- ***Who is the company partnering up with and what is required of the partners?***
- Different types of partnerships:
 - Strategic alliances between non-competitors
 - Coopetition: strategic partnership between competitors
 - Joint ventures to develop new businesses
 - Buyer-supplier relationship to assure reliable supplies
- Three motivations for creating partnerships:
 - Optimization and economy of scale
 - Reduction of risk and uncertainty
 - Acquisition of particular resources and activities

The Business Model Canvas

Offer: Value Propositions

- ***What value is delivered from the company to its costumers?***
- The collection of products and services a company can offer to its costumer to meet their needs.
- It is the one point that will distinguish it from its competitors.
- The value is provided through various elements:
 - Newness, performance, customization, “getting the job done”, design, brand/status, price, cost reduction, risk reduction, accessibility and convenience/usability.
- Two methods to measure it:
 - Quantitative: price and efficiency
 - Qualitative: overall costumer experience and outcome

The Business Model Canvas

Customers : Customer Segments

- *Who does the company target and create value for?*
- It defines the different groups of people or organizations, a company aims to reach and serve.
- An effective business model is build when the company identifies the costumers it wants to serve.
- Based on the different needs and attributes there are various sets of customers.

The Business Model Canvas

Customers : Customer Segments

- The different types of customer segments are:
 - **Mass Market:** a wide view of potential customers. It is often found in the consumer electronics sector.
 - **Niche Market:** the costumers are classified based on specialized needs and characteristics. It is often found in supplier-buyer relationship.
 - **Segmented:** the costumer classification is further distinguished based on other classification methods. . It serves three different customer segments, the watch industry, the medical industry and the industrial automation sector.
 - **Diversify:** multiple classifications based on different needs and characteristics.
 - **Multi-Sided Platform/Market:** it will serve mutually dependent customer segments. In this type all different segments are required to make the business model work.

The Business Model Canvas

Customers : Channels

- *How does the company reach its costumers?*
- The value proposition is delivered from the company to its targeted customer through different channels.
- Effective channels can distribute the value proposition of the company in ways that are fast, efficient and cost-effective.

The Business Model Canvas

Customers : Channels

- Channels have five distinct phases. Each channel can cover some or all of these phases. The channel phases are the following:
 - Awareness
 - Evaluation
 - Purchase
 - Delivery
 - After Sale
- Different types of channels:
 - Own channel (store front)
 - Direct
 - Indirect
 - Partner channel (major distributors)
 - Combination of both

The Business Model Canvas

Customers : Customer Relationships

- *What kind of customer relationships does the company create and maintain?*
- It ensures survival and success of the company.
- Different forms of customer relationships:
 - Personal Assistance: employee-customer interaction, which is performed during or/and after sales.
 - Dedicated Personal Assistance: all the needs and questions from a specific set of clients is assigned to a sales representative.
 - Self Service: an indirect interaction between company and customer, where the company provides the tools the customers need to serve themselves easily and effectively.
 - Automated Services: similar to self service, but more personalized. It has the ability to identify preferences for individual customers.
 - Communities: direct interactions of the company with different clients by sharing knowledge and problems.
 - Co-creation: a personal relationship created because the customers have a direct input in the final outcome of the product/service.

The Business Model Canvas

Finances: Cost Structure

- *What are the costs of the business model?*
- Classes of Business Structures:
 - **Cost-driven:** the focus is on minimizing all costs and having no frills.
 - **Value-driven:** the focus is on creating value for products and services and less on the cost.
- Characteristics of Cost Structures:
 - **Fixed costs:** unchanged costs across different applications.
 - **Variable costs:** varies depending on the amount of goods or services.
 - **Economies of scale:** costs goes down as the amount of goods are ordered or produced.
 - **Economies of scope:** costs go down due to incorporations with other businesses that have direct relation with the original product.

The Business Model Canvas

Finances: Revenue Streams

- *How is income generated from the customer segments?*
- Different ways:
 - **Asset sale:** ownership rights are sold to a physical good.
 - **Usage fee:** generate money from the use of a particular service.
 - **Subscription fees:** generating revenue from selling access to a continuous service.
 - **Lending/Leasing/Renting:** exclusive right is given for a particular period of time to an asset.
 - **Licensing:** generating revenue for charging the use of a protected intellectual property.
 - **Brokerage fees:** generating revenue for an intermediate service between two or more parties.
 - **Advertising:** generating revenue for charging fees to advertise a product.

The Business Model Canvas

Customers : Revenue Streams

- *Fixed Pricing*
 - *Predefined prices that are based on static variables.*
- *Different types:*
 - *List price*
 - *Product feature dependent*
 - *Customer segment dependent*
 - *Volume dependent*
- *Dynamic Pricing*
 - *Price change based on market conditions*
- *Different types:*
 - *Negotiation*
 - *Yield management*
 - *Real-time market*
 - *Auctions*

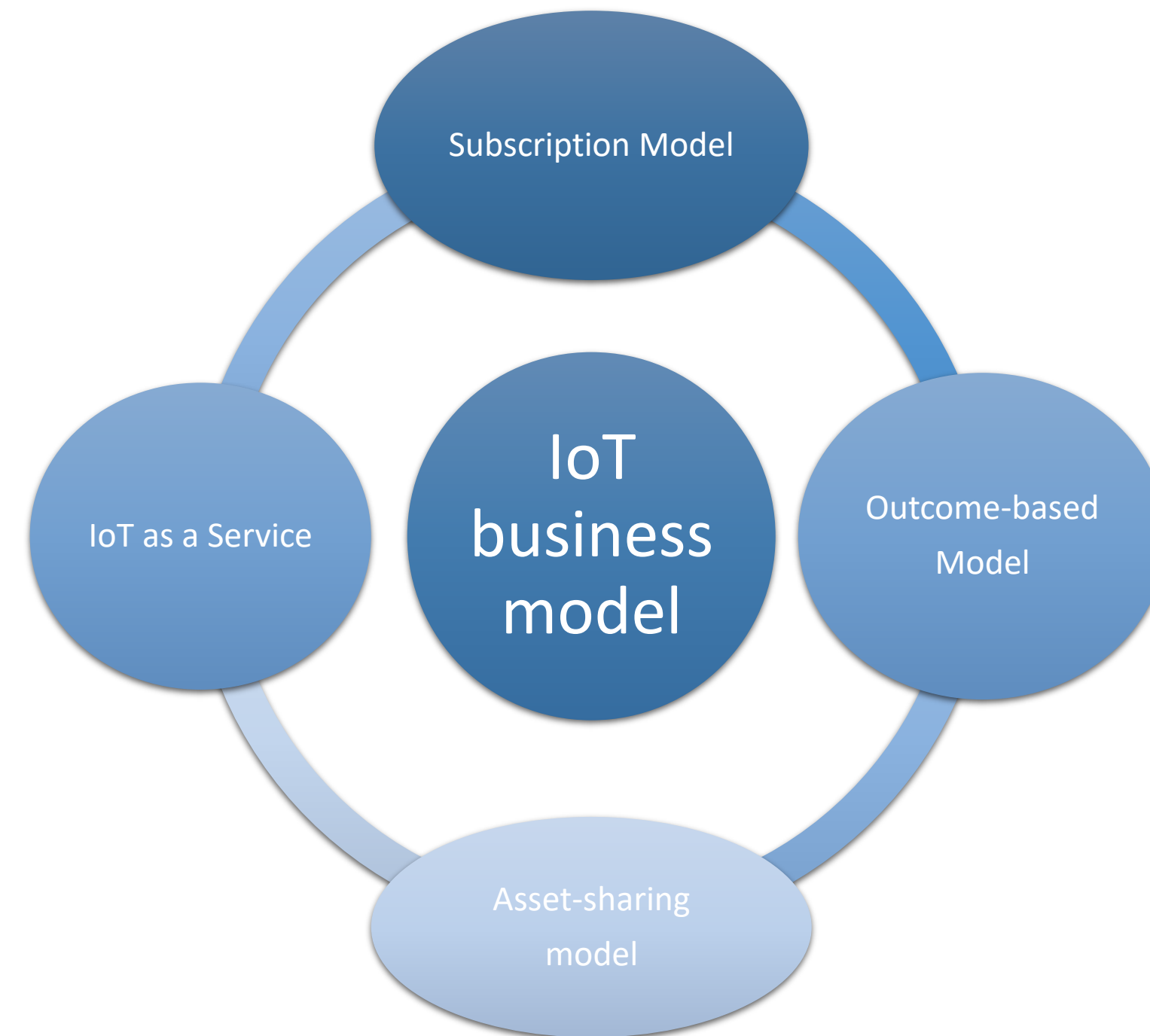
IoT Business Model

IoT Business model

It focuses on capturing and delivering value and at the same time leverages the unique characteristic of IoT products of being 24/7 connected to the customer's environment for producing innovative and differentiated value.

IoT Business models

- Subscription model
- Outcome-based model
- Asset-sharing model
- IoT as a Service



Subscription model

- It allows companies to offer a subscription for the costumers to pay a fee in return for periodic usage.
- Except monthly subscription, the company can also provide paid upgrades or even a free version model.
- The subscription model, is used in the following common IoT applications:
 - Monitoring as a service.
 - Predictive maintenance as a service.

Subscription model

Challenges:

- Customer management: deal with managing all records of the subscribers.
- Automatic invoicing: invoicing customers with different payment options, subscription plans or add-ons.
- Plan management: deal with managing the subscription plans (initial and terminal dates, price, services of the plan, etc).

Benefits:

- It empowers the company to have an active relationship with their customers.
- A great way to gain access to the product/information/solution in good prices.
- Each customer is provided with specifically tailored valuable features.

Outcome-based model

- Idea: customers pay for the outcome the product provides and not for the product itself.
- The company does not sell a product or service to the customer but delivers only the results.
- The customers do not need to collect, analyze, process and generate the output, but are only charged for the outcome.

Outcome-based model

Challenges:

- Infrastructures or current business processes are required to change.
- The price of the outcome needs to be balanced between the quoted price to the client and the actual cost involved in the process of generating it.
- Deliver a safe, pure and unaltered result.

Benefits:

- High margin: use the existing infrastructure and already available tools.
- Reduced negotiation cycle: eliminates the time-consuming negotiation cycle for the delivery of the outcome.
- More satisfied customers: a mutual trust is created with the delivery of a quality output.

Asset-sharing model

- It allows companies to share their IoT-enabled assets with other companies.
- The sharing method can be charged based on the usage, time for the usage and nature of the usage.
- The goal is to maximize the utilization of the IoT product across multiple customers.

IoT Business models

Asset-sharing model

Challenges:

- Security: threats like theft, damage and data manipulation.
- Mutual arrangements: what will be shared of the asset in based on usage, tasks, time and number.
- Configuring the asset: configure with whom the asset will be shared.

Benefits:

- Allows to reduce the costs of usage and maintenance.

IoT Business models

IoT as Service model

- “as a Service“ is the way we like to consume things
 - Flexible way, as many as needed, according to the need scaling up or down.
- The company provides its IoT product/solution/information on lease and generates revenue.
- It can also be part of the subscription model when the revenue generated is recurring.

IoT Business models**IoT as Service model****Challenges:**

- **Compatibility:** optimum productivity means compatibility with the customer side.
- **Incorrect data capture:** anomalies generated during run-time may cause capturing incorrect data.
- **Data security:** ensure the data is safe from ransomware attacks.

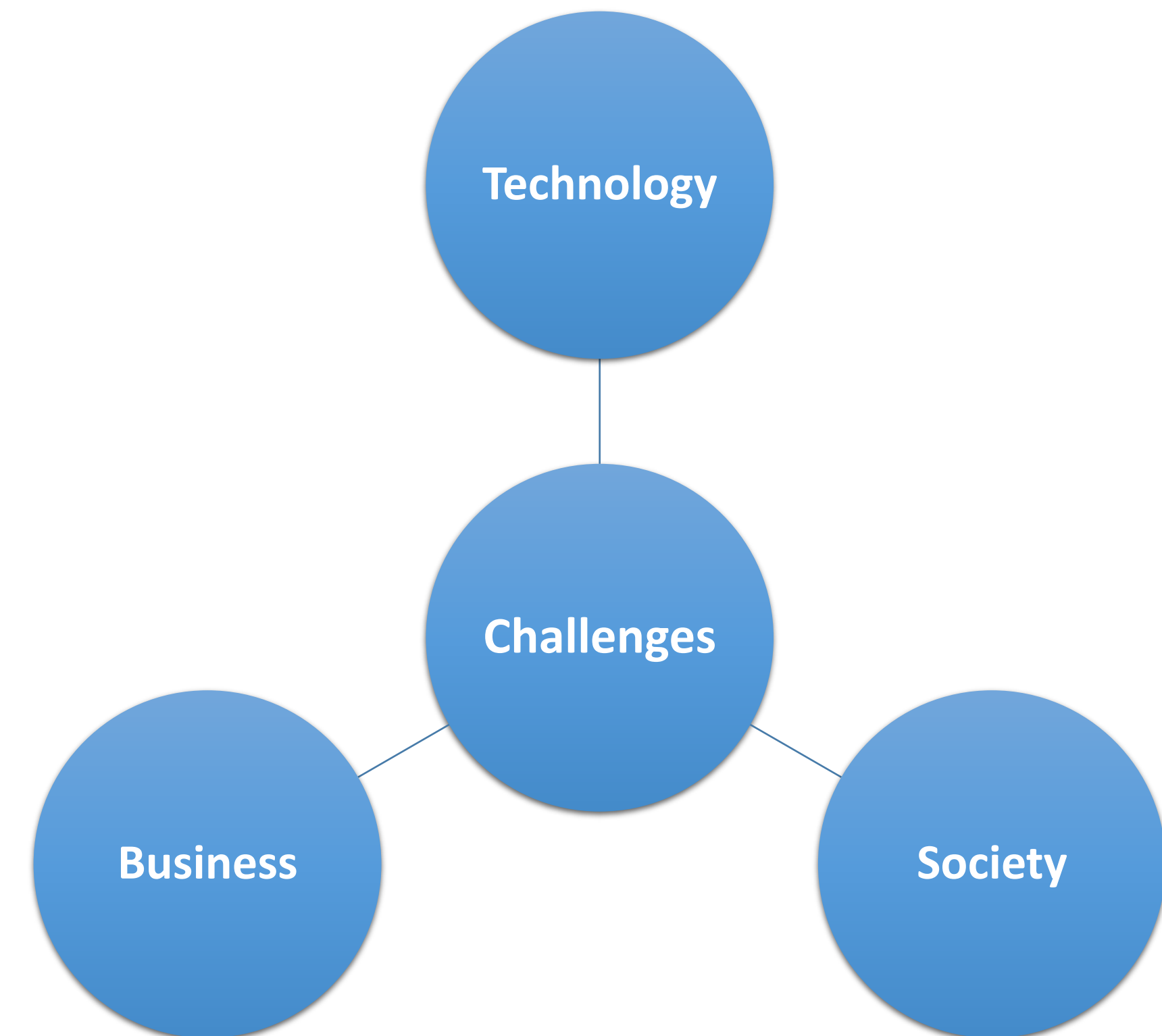
Benefits:

- **Generate revenue by upgrading the existing solution.**
- **The costs are low due to shared or multitenant environment where the hardware and software license cost low.**

IoT Business Challenges

Challenges of IoT Business

- Three categories exists:
 - Technology
 - Business
 - Society



Challenges of IoT Business

Technology

- Covers all the technologies needed to make IoT systems function smoothly as a standalone solution or part of existing systems.

- Technological challenges include:

- Security
- Connectivity
- Compatibility and Longevity
- Standards
- Intelligent analysis & actions



Challenges of IoT Business

Technology: *Security*

- The protection of sensitive information and assets.
- The “golden rush” state of companies
- The next innovative connected gadget is seeking to dish out before the one from the competitors.
- Result: functionality becomes the main focus and security takes a back seat.

Challenges of IoT Business

Technology: *Connectivity*

- The connection of many devices which will defy the structure of current communication models and the underlying technologies. The future depends on decentralizing IoT networks.
- Centralized systems turn into bottleneck when the need of handling more than billions devices. As a result decentralized systems are required.

Challenges of IoT Business**Technology: *Compatibility and Longevity***

- Deal with the compatibility issues when connecting different types of devices.
- The lifetime should be long and remain even if their manufacturer goes out of service.

Challenges of IoT Business

Technology: Standards

- Technology standards include network protocols, communication protocols and data-aggregation standards. All together create the activity of handling, processing and storing data that are collected from the sensors.
- This challenge can be divided into:
 - **Standards for handling unstructured data:** data that are stored in different types of databases and have no standard querying approach.
 - **Technical skills to leverage newer aggregation tools:** there is a need for talents in planning, executing and maintain systems for big-data tools.

Challenges of IoT Business**Technology: *Intelligent analysis & actions***

- The last stage of IoT implementation is to extract insights from data for analysis.
 - The analysis is driven by cognitive technologies and the accompanying models that facilitate the use of cognitive technologies.
- The second phase of this stage is intelligent actions
 - Expressed as machine-to-machine and machine-to-human interfaces.
 - Examples: all the advancement in UI and UX technologies.

Challenges of IoT Business

Technology: Intelligent analysis

- Adoption of intelligent analysis within the IoT:
 - Artificial intelligence
 - Real-time data processing and analysis:
 - Growth in crowdsourcing and open-source analytics software
- Challenges of adopting intelligent analysis:
 - Inaccurate analysis due to flaws in the data/model
 - The ability to analyze unstructured data
 - The ability to manage real-time data

Challenges of IoT Business

Technology: Intelligent actions

- Adoption of intelligent actions within the IoT:
 - Machine prices are lower
 - Machine functionality is improved
 - Deep learning tools
 - Behavioral-science rationale, where machines influence human actions.
- Challenges of adopting intelligent actions:
 - Information security and privacy
 - Machine interoperability
 - Actions of the machine in unpredictable situations
 - Slow adaption of new technologies
 - Mena-reverting human behaviors

Challenges of IoT Business

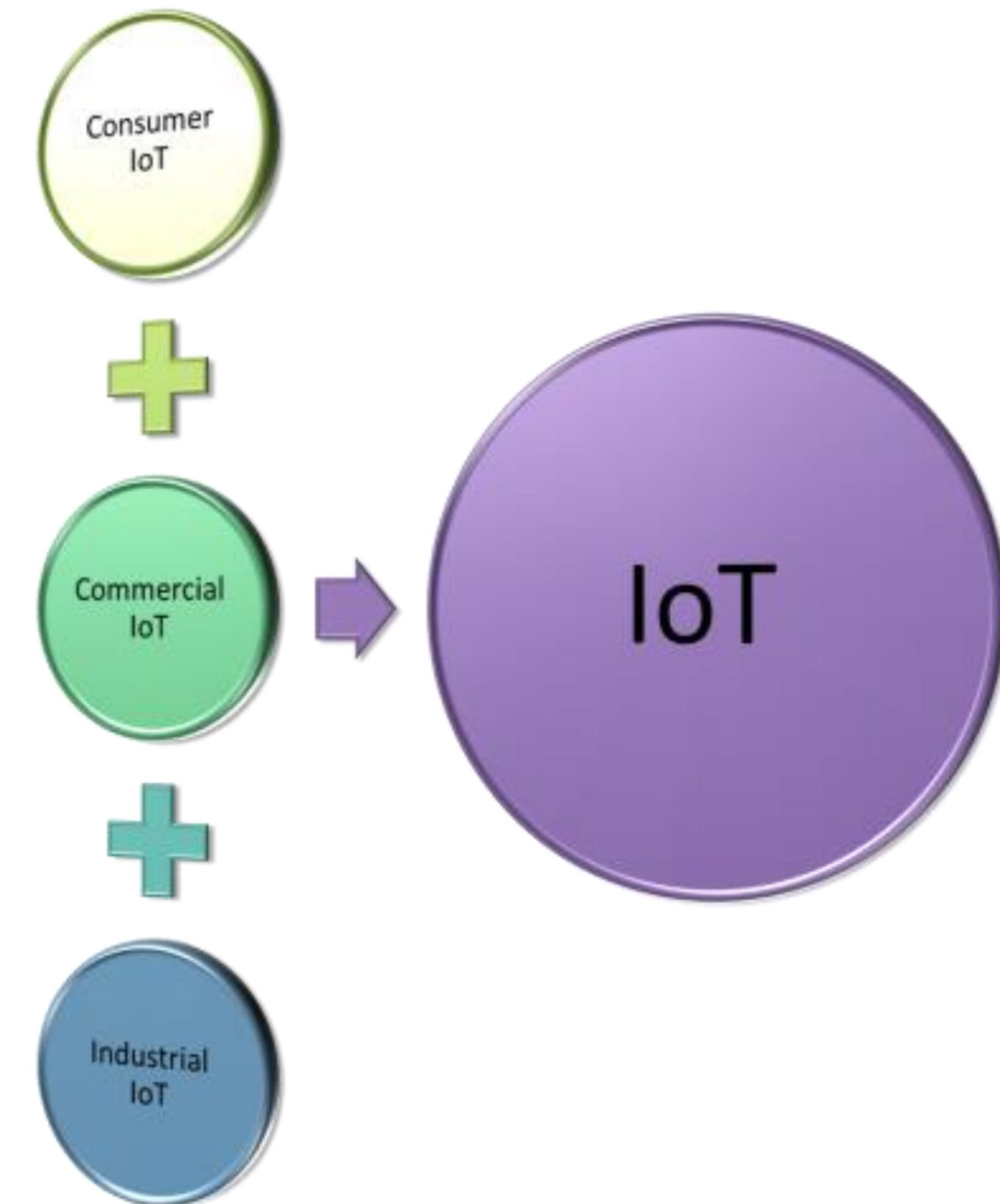
Business

- Business model for IoT: a big motivation for starting, investing in and operating any business.
- The chosen model must satisfy all the requirements for all kinds of e-commerce, vertical markets, horizontal markets and consumer markets.
- Always a victim of regulatory and legal scrutiny.
- The most successful at monetizing a large portion of the IoT value are end-to-end solution providers that operate in vertical industries and deliver services using cloud analytics.

Challenges of IoT Business

Business

- This category can be divided based on usage and client base into:
 - Consumer IoT includes the connected devices
 - Commercial IoT includes things like inventory controls, device trackers and connected medical devices.
 - Industrial IoT involves all connected industrial devices and systems.



Challenges of IoT Business

Business: Consumer IoT

- Consumer IoT include connected devices, like wearables, smart homes and personal monitoring devices.
- These devices are likely to have a shelf life measured in months or years.
 - new versions quickly replacing older products on store shelves.
- Many devices can be unique per consumer, although some of them may require more than one.

Challenges of IoT Business

Business: Consumer IoT - Example

- Amazon Echo voice-control system.
- A smart gadget by Amazon for home use
- It consists of the hardware Echo and the software Alexa.
- Echo is an expertly tuned speaker with Wi-Fi and Bluetooth connectivity.
- Alexa is the software part of the Echo and is cloud based, that consist the brain of Echo.

amazon echo

Always ready, connected, and fast. **Just ask.**



Challenges of IoT Business

Business: Commercial IoT

- Commercial IoT includes things like inventory controls, device trackers and connected medical devices.
- It can be categorized between consumer and industrial IoT.
- It resides at the company or organization level.

Challenges of IoT Business

Business: Commercial IoT - Example

- Verdigris' Einstein system.
- Verdigris is an artificial intelligence company.
- Einstein is a next-generation IoT smart sensor and metering solution.
- The goal is to hook it into existing building power infrastructure and provide smart metering as well as monitoring for minimizing power consumption in large commercial buildings.



Challenges of IoT Business

Business: Industrial IoT (IIoT)

- Industrial IoT involves all connected industrial devices and systems.
- IIoT solutions target existing automated industrial systems.
- The sensors are used to provide sufficient information to control the industrial process.
- The deployment of an IIoT solution will take longer due to the customization involved in the systems.

Challenges of IoT Business**Business: Industrial IoT - Example**

- Nexeed Track and Trace
- It is a digital travel log in the cloud.
- This solution enables the freight to record a digital travel diary that shares regularly its current location and status to the cloud.



Challenges of IoT Business

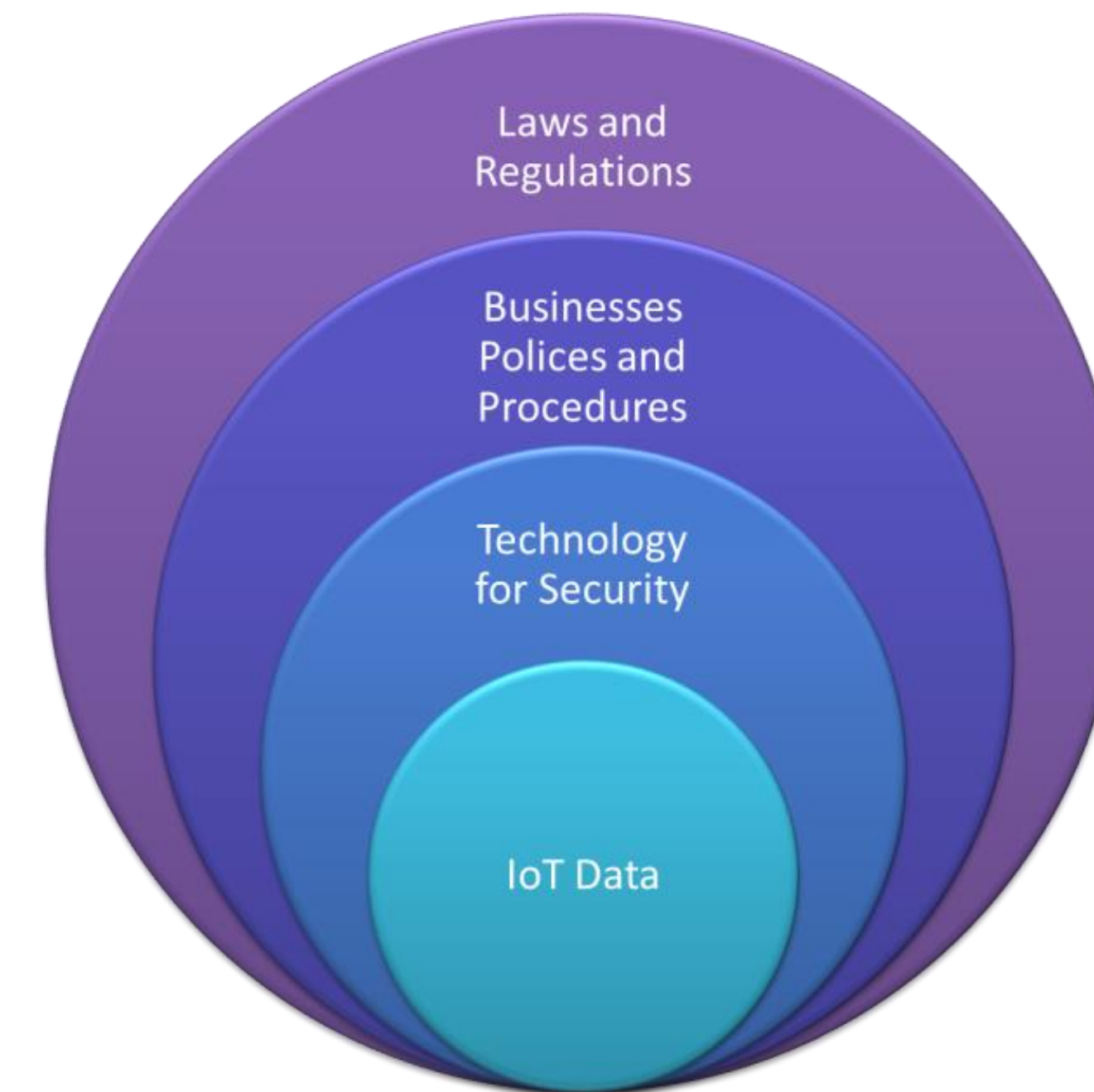
Society

- To understand IoT from the perspective of customers and regulator is not an easy task, for the following reasons:
 - Customer demands and requirements change constantly.
 - New users and devices sprout and grow at breakneck speed.
 - It is expensive and takes time and resources to invent and reintegrate must-have features.
 - The IoT technology users expand and change.
 - Consumer confidence.
 - Lack of understanding or education by consumers.

Challenges of IoT Business

Society: Social and Legal

- Laws and regulations
- Business policies and procedures.
- Technology for Security
- IoT Data



Challenges of IoT Business

Society: Privacy

- Social and cultural boundaries are crossed with activities that are multinational or global.
- Develop strategies that respect individual privacy choices across a broad spectrum.

Challenges of IoT Business

Society: Regulatory Standards

- Who gets access to data?
- How are these data used?

Summary

- Business Ecosystem
- IoT Business Ecosystem
- Business Model
- IoT Business Model
- IoT Business Challenges