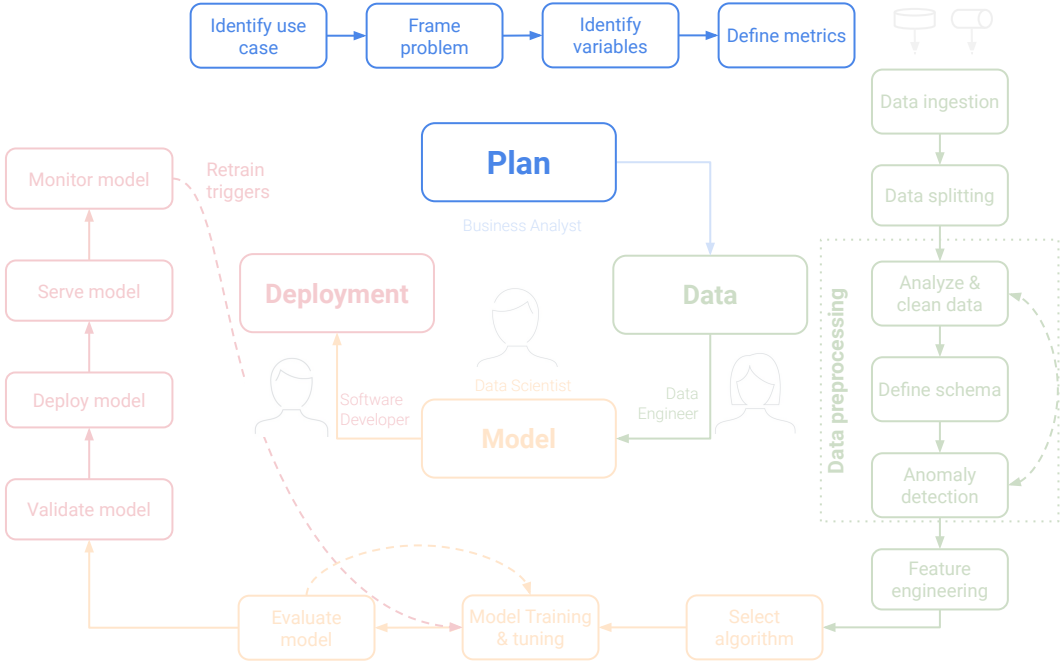
# Data Science Lifecycle

## Planning phase

Prof. Dr. Jan Kirenz
HdM Stuttgart

# Data Science Lifecycle

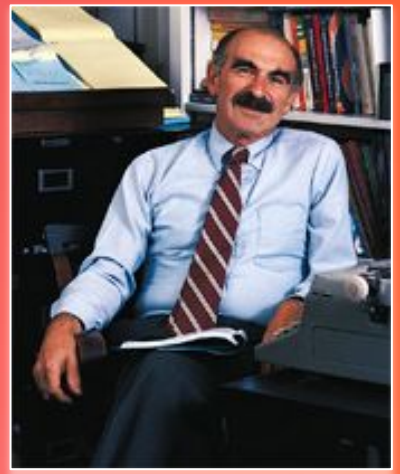
**Plan** | Data | Model | Deployment



# Customer centricity

# 1960

Companies are too focused on producing goods or services and don’t spend enough time understanding what customers want or need.



T. Levitt

Source: Levitt (1960); Picture credit: Harvard Business School

# From customer experience (CX) to business of experience (BX) 2021


Source: Accenture (2021)

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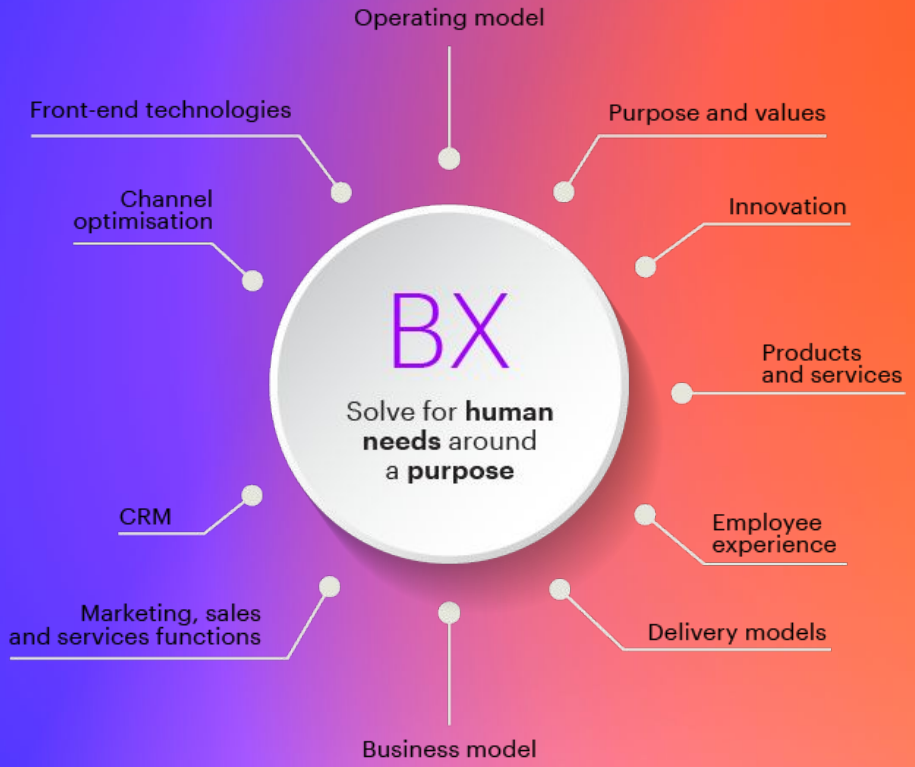
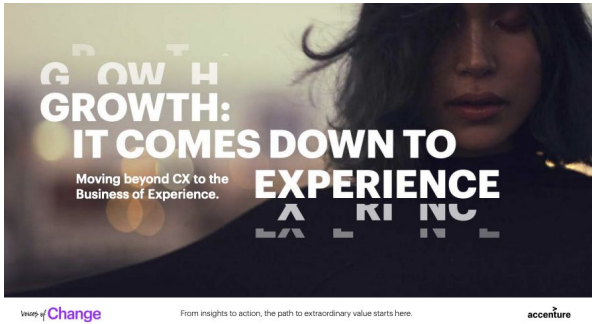



Source: Accenture (2021)


80%
of CEOs

| | CX thinking | BX thinking | Ways BX comes to life |
|---|---|---|---|
| CEO | Maximize profitability. | Profit from purpose + experience. | Prioritizing purpose, innovation and delivering holistic experiences to drive business success (i.e., profit). |
| **Marketing and Brand** | Making people want things. | Making things people want. | Shaping brand evolution by recognizing brand is built on experiences that connect customers to what they want, not the other way around. |
| Sales | Focus on the product the company wants to sell. | Focus on the outcome the customer wants. | Ensure the experience is available at defining moments that matter in a consumer's life |
| Product Development | Making products easy to use. | Making products that continually adapt to how customers use them. | Investment in insight/design research combined with big data to spot user-driven opportunities. |
| Talent | Using traditional metrics based on employee performance within a function (onboarding, annual reviews, etc.) | Inspiring and incentivizing behaviors that drive better outcomes for the entire organization. | Empowering employees to feel accountable for customer outcomes. |
| Tech and Data | Enabling business processes at greater scale. | Enabling customer-centricity at greater scale. | Unlocking efficiencies that can be reinvested to drive continuous performance and innovation. |
| Operations | Providing efficiency for the company that often limits growth. | Providing efficiency for the customer and the experience that enables them to drive growth. | Measuring customer operational efficiency, engaging operations in innovation from the get-go. |
| Supply chain | Moving products and goods to consumers. | Making it easy for consumers to get products and services when and where they want them. | Providing customers with visibility into sourcing and progress of their orders, and innovating last-mile experience to exceed expectations. |

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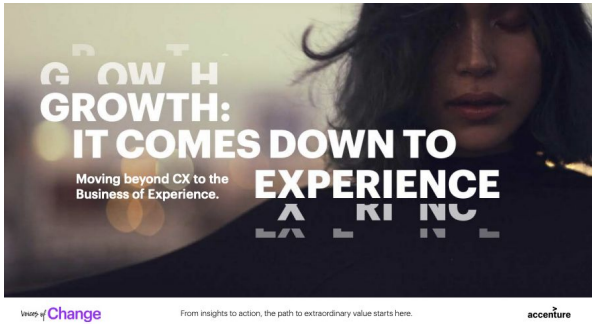


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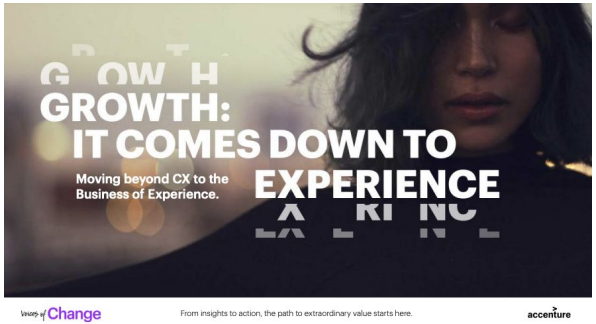


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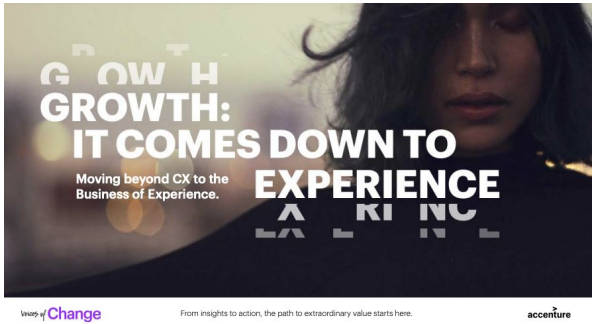


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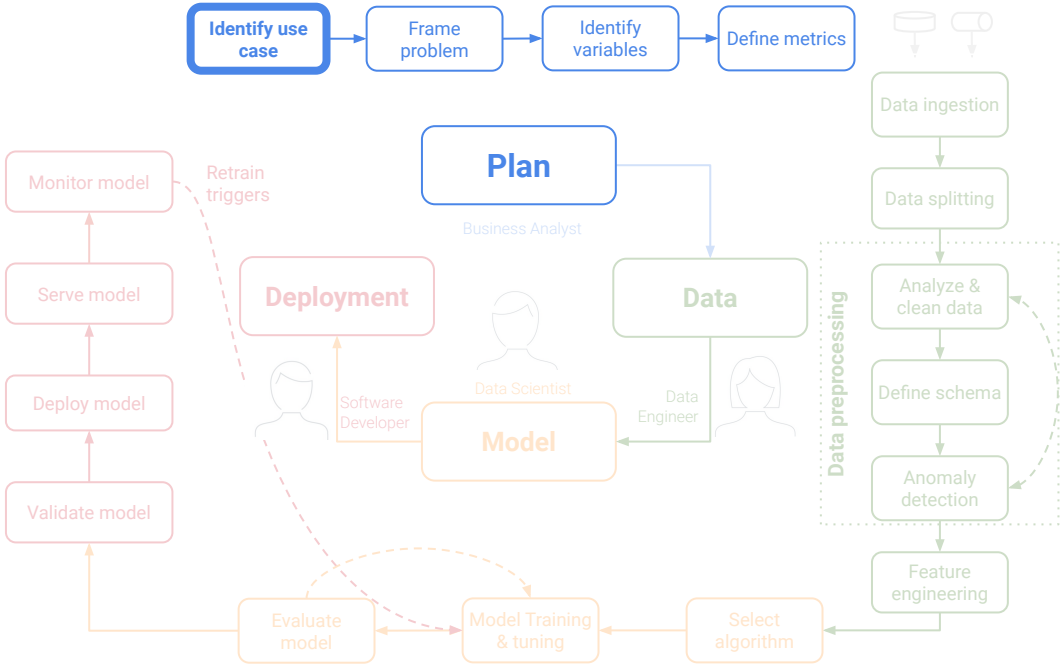
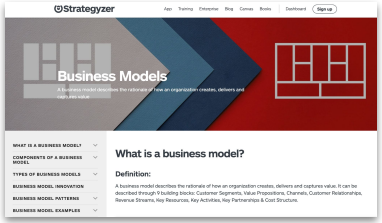


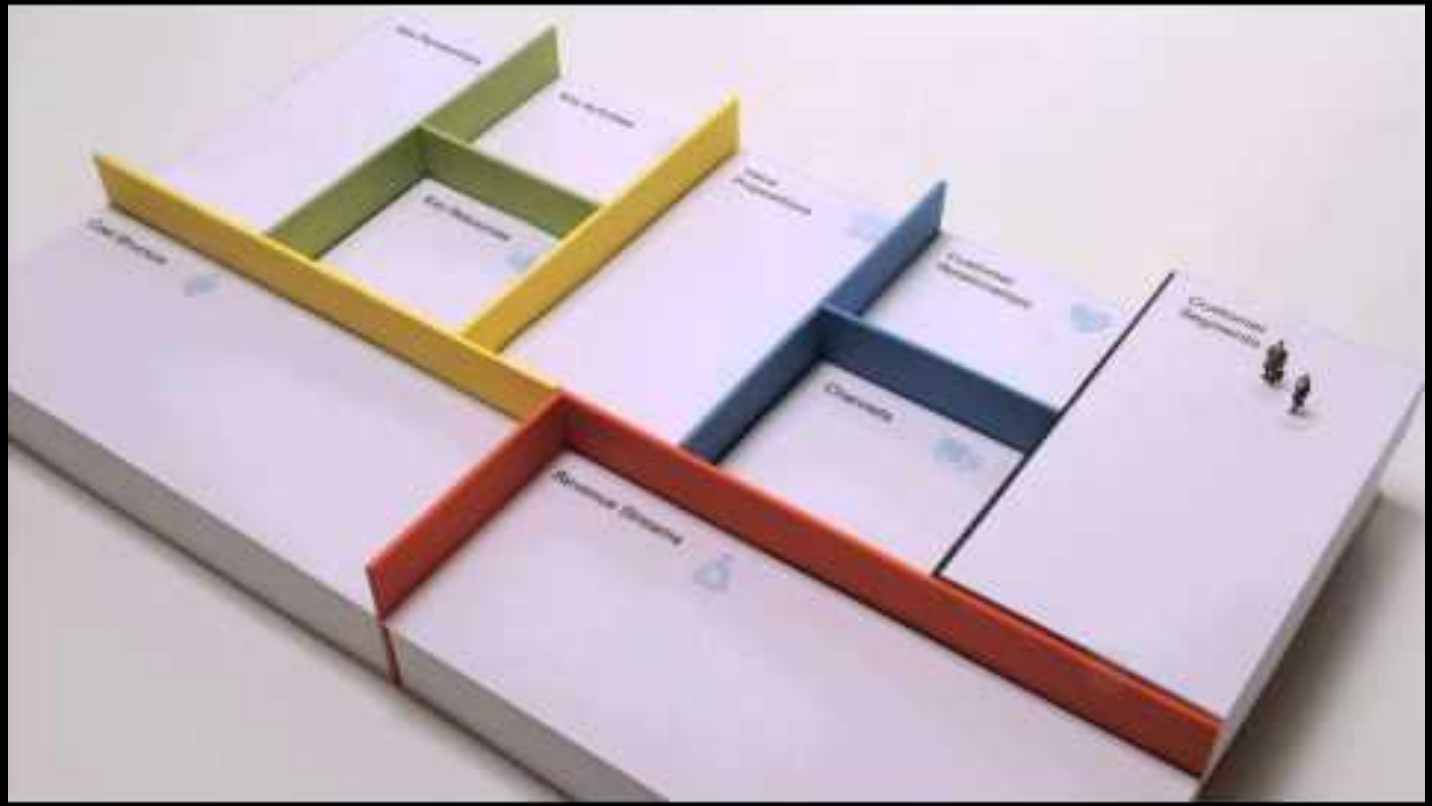
# Business Model Canvas

A business model describes the rationale of how an organization creates, delivers and captures value.

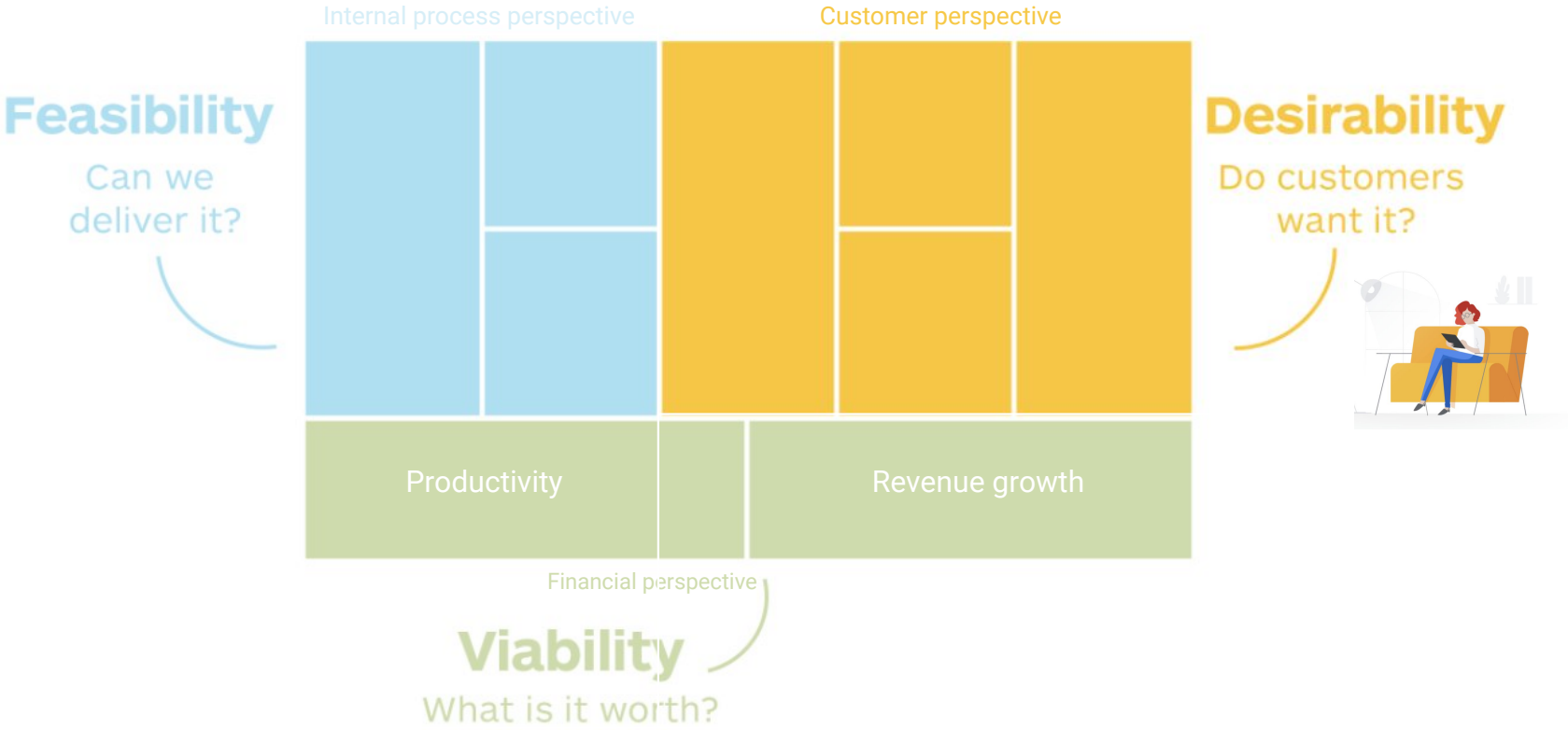



https://www.strategyzer.com/expertise/business-models

Gain insights about the essential building blocks of your business model to discover new growth opportunities



# How do we create, deliver and capture value?




Source: Osterwalder & Pigneur (2010)

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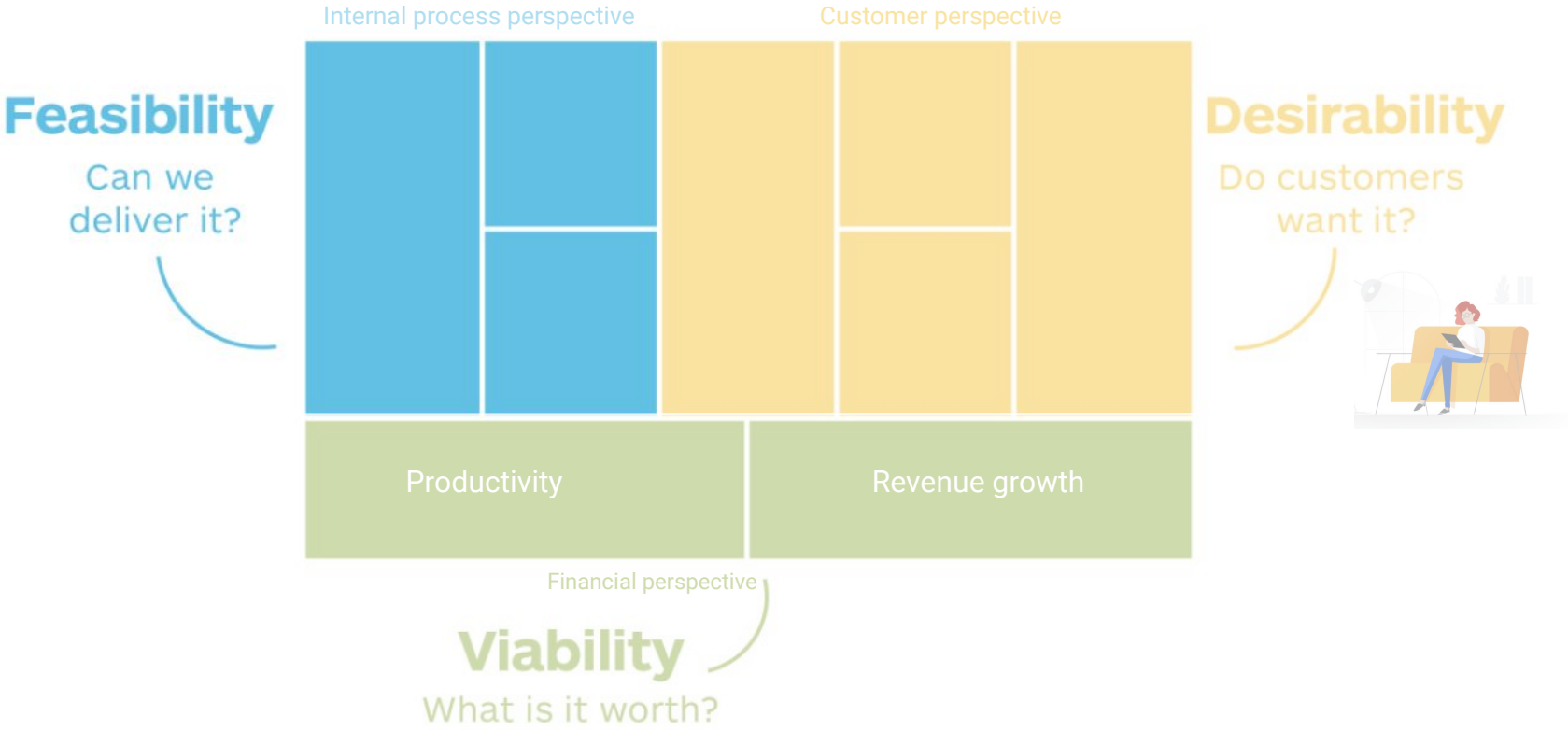


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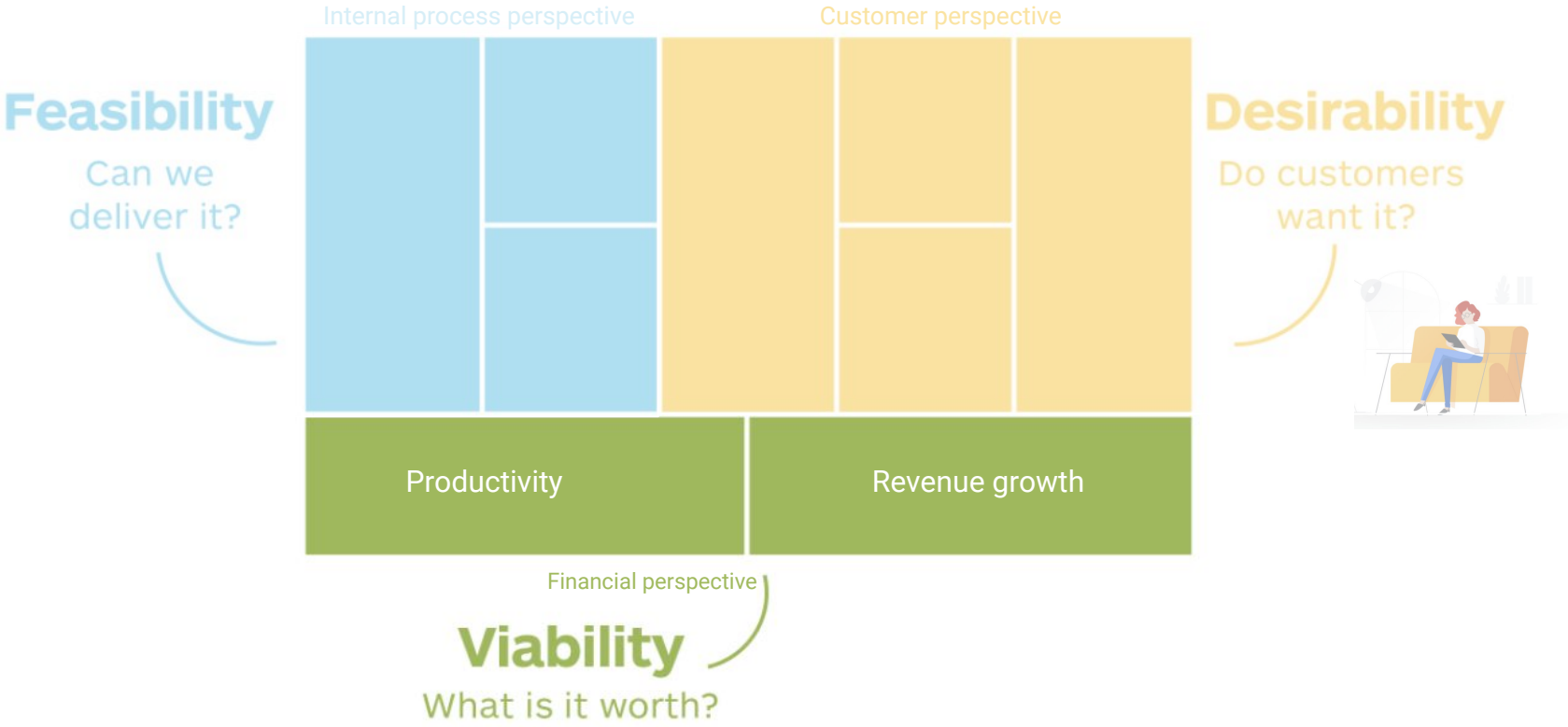


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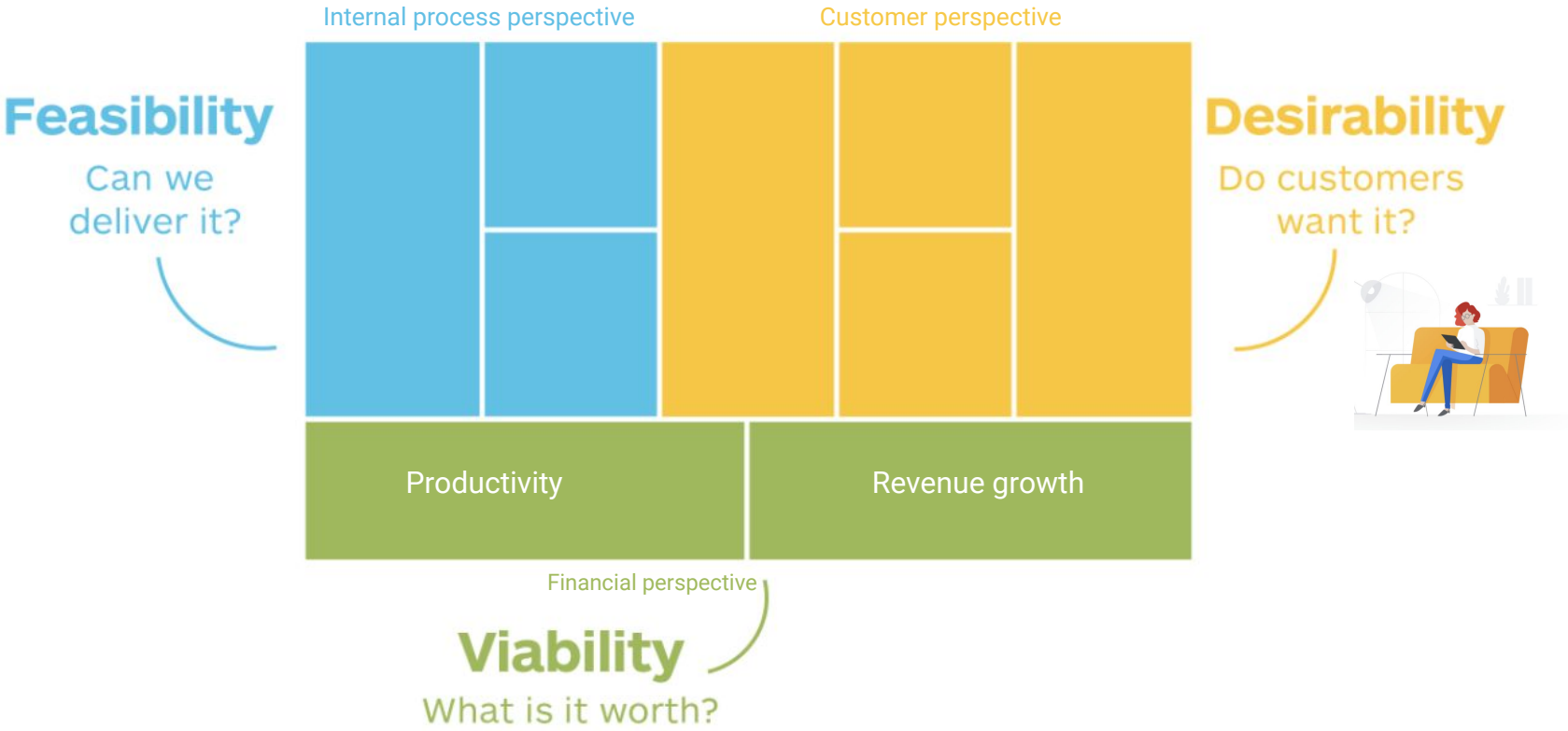


Source: Osterwalder & Pigneur (2010)

# Customer Segments

Key Partners

Key Activities

Key Resources

Value Proposition

Customer Relationships

Channels

**Customer Segments**

For whom are we creating value?

Who are our most important customers, clients, or users?

Cost Structure

Revenue Streams

Source: Osterwalder & Pigneur (2010)

# Value Proposition

Key Partners

Key Activities

Key Resources

**Value Proposition**

Which customer needs are we satisfying?

What bundles of products and services are we offering to each Customer Segment?

Customer Relationships

Channels

**Customer Segments**

Cost Structure

Revenue Streams

Source: Osterwalder & Pigneur (2010)

# Channels

Key Partners

Key Activities

Key Resources

Value Proposition

Customer Relationships

Customer Segments

**Channels**

How to reach and communicate with customers?

Where can they obtain our offerings?

Cost Structure

Revenue Streams

Source: Osterwalder & Pigneur (2010)

# Customer Relationships

Key Partners

Key Activities

Key Resources

Value Proposition

Customer Relationships

What type of relationship do we establish (personal/automated)?

Channels

Customer Segments

Cost Structure

Revenue Streams

Source: Osterwalder & Pigneur (2010)

# Revenue Streams

Key Partners

Key Activities

Key Resources

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Customer Segments

Cost Structure

**Revenue Streams**

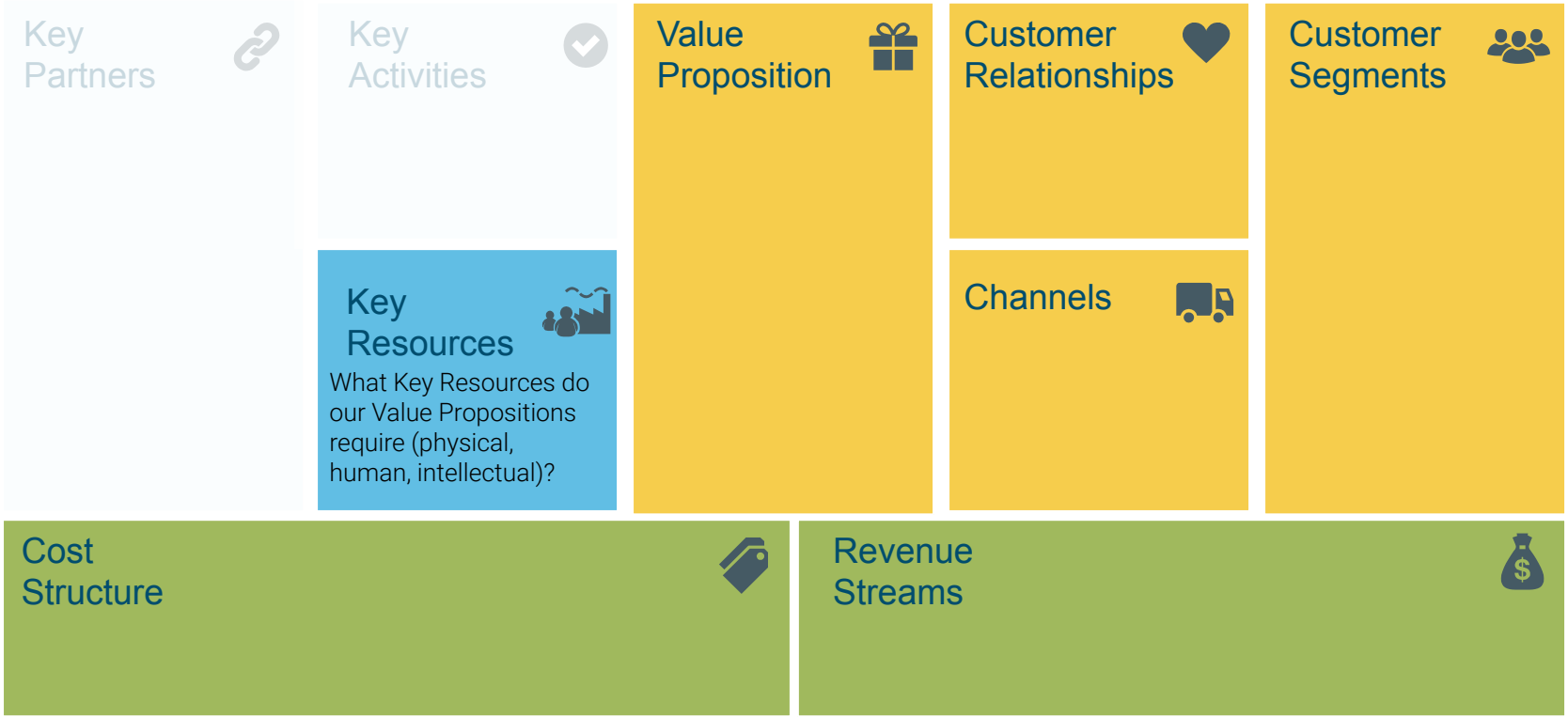
For what value are customers willing to pay?
How would they prefer to pay?
How much does each Revenue Stream contribute to overall revenues in terms of percentages of the total?

Source: Osterwalder & Pigneur (2010)

# Cost Structure


Source: Osterwalder & Pigneur (2010)

# Key Resources




Source: Osterwalder & Pigneur (2010)

# Key Activities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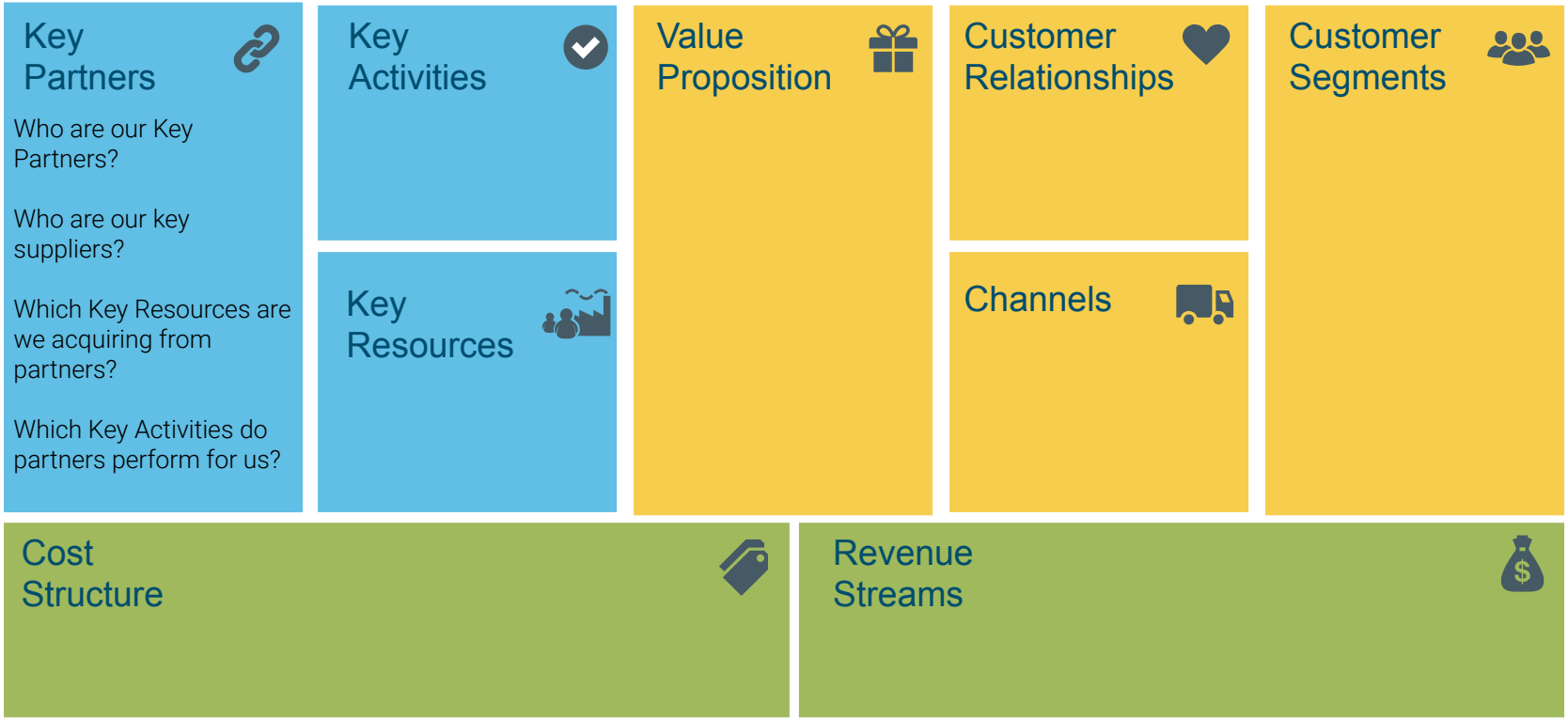
# Key Partners




Source: Osterwalder & Pigneur (2010)

# Business Model Canvas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Source: Osterwalder & Pigneur (2010)


Source: Strategyzer (2019)

# Some examples

# Key questions we will cover

Key Partners

Key Activities

Key Resources

## Value Proposition

Which customer needs are we satisfying?

What bundles of products and services are we offering to each Customer Segment?

## Customer Relationships

What type of relationship do we establish (personal/automated)?

## Channels

How to reach and communicate with customers?

Where can they obtain our offerings?

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## Revenue Streams

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How to optimize our value proposition?

How to build innovative and strong customer relationships?

How to unlock new market potential?

## Key Partners

## Key Activities

## Key Resources

## Value Proposition

**Products & Services**

- Concept testing and usability testing (A/B-testing)
- Offer optimization (conjoint analysis)

**Brand**

- Branding and attitudes research (Text mining, social network analysis)

## Customer Relationships

- Customer satisfaction and Loyalty (modeling)

## Channels

**Customer Experience & Behavior**

- Customer experience & behavior (Customer Decision Journey; modeling, association rule mining)

## Customer Segments

**Customer insights**

- Customer needs research (**Jobs to be Done**)
- Customer segmentation (**clustering**)

---

**Competitive research**

- Market and competitor analysis (**market analysis**, **web scraping**, **regression**, **classification**)

## Cost Structure

## Revenue Streams

Pricing and customer behavior research (conjoint analysis, modeling)

How to better capture value and boost margins?

Source: Osterwalder & Pigneur (2010)

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- Customer experience & behavior (**Customer decision journey, regression, classification association rule mining**)

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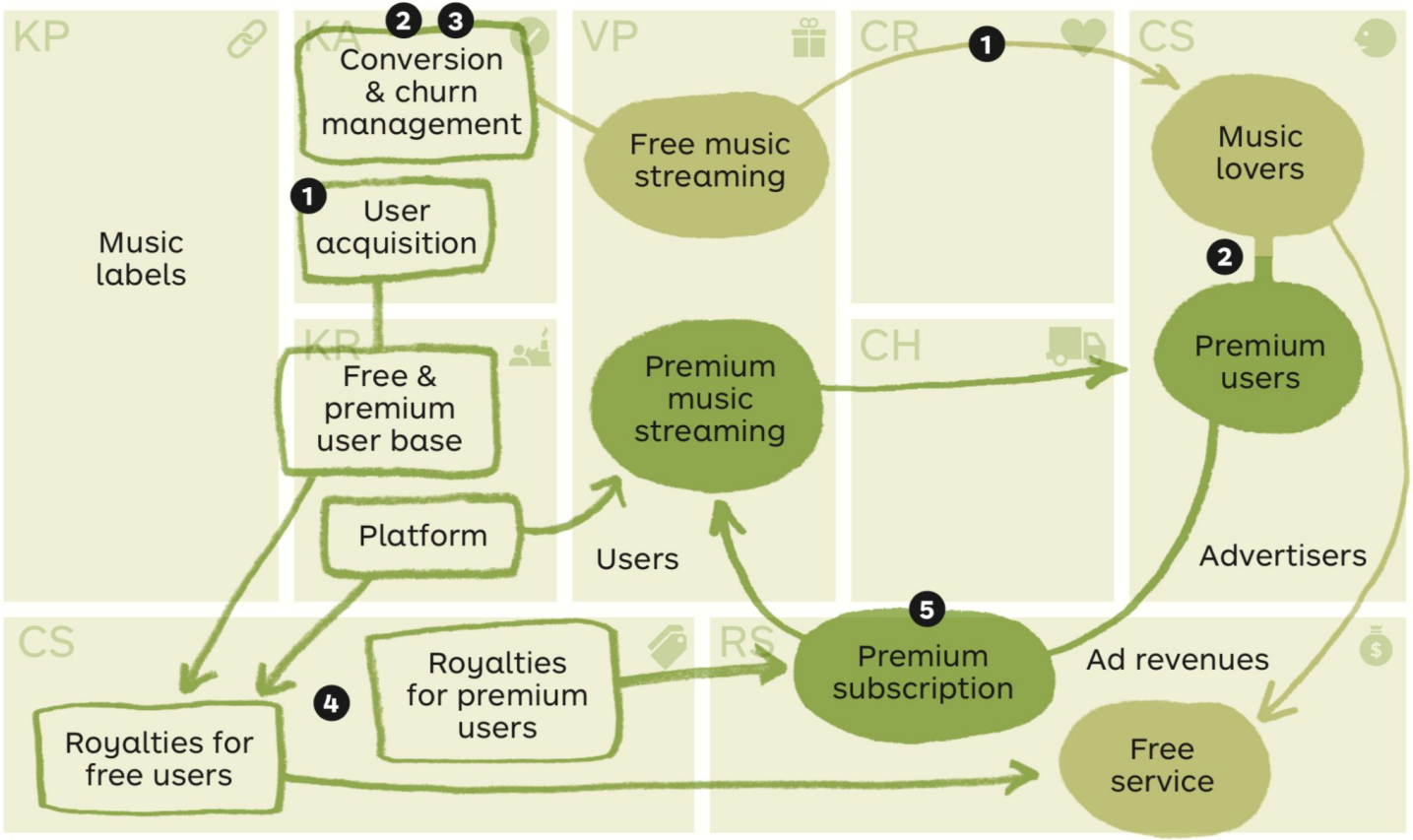
# How to identify valuable projects?

# Examples




# Spotify

Source: Strategyzer (2019)

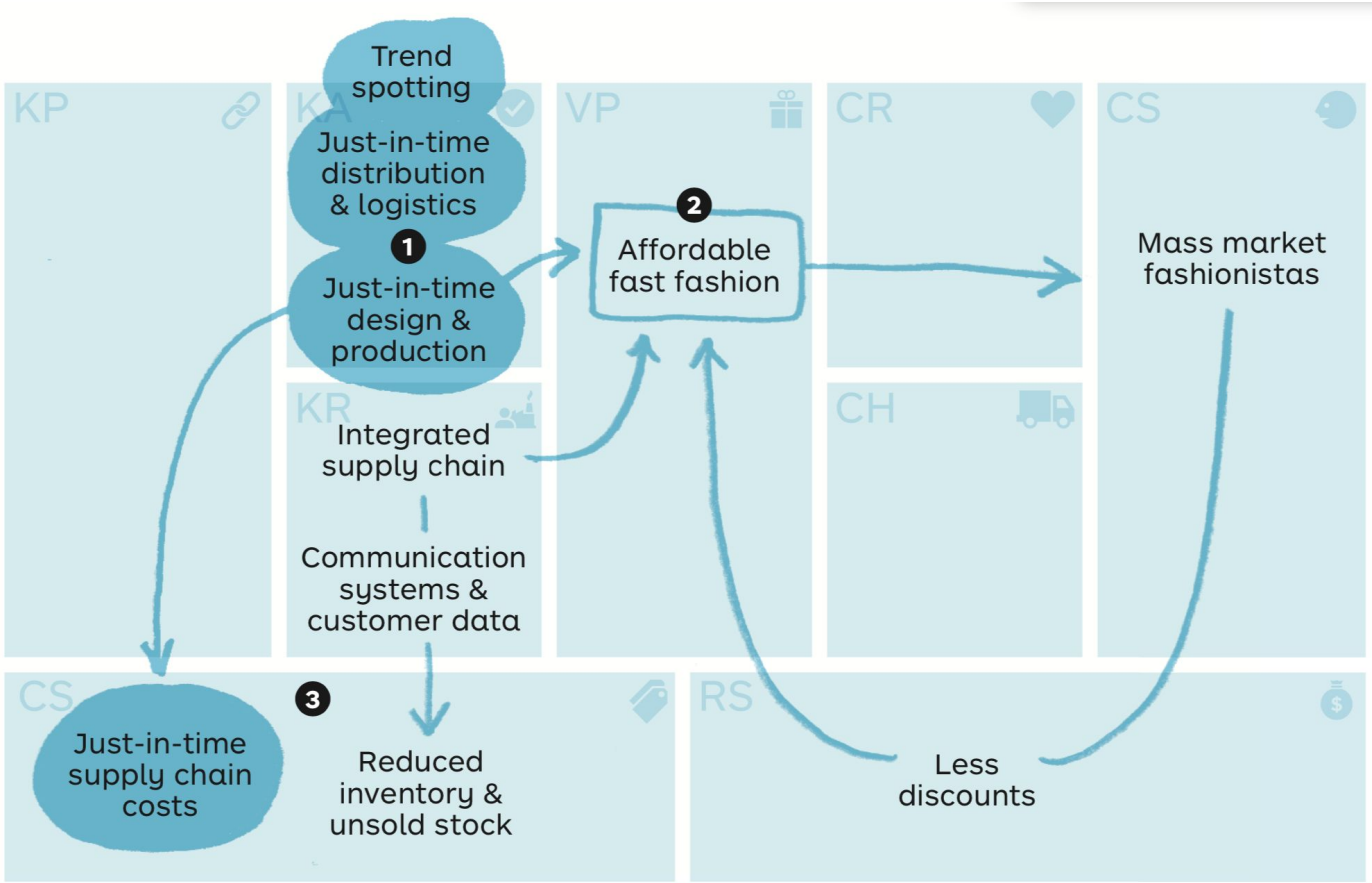
# How to select valuable projects?

Streaming provider or Ecommerce retailer looking to increase sales

- Better recommender system
- Better search
- Improve catalog data
- Price optimization

Questions

- What projects should we work on?
- What are the metrics for success?
- What are the resources (data, time, people) needed?




# Zara: Optimize activities for speed

Source: Strategyzer (2019)

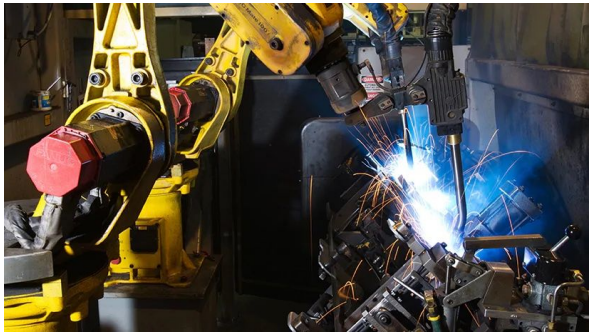
# Example

At 52 factories around the world, John Deere uses the Gas Metal Arc Welding (GMAW) process to weld mild- to high-strength steel to create machines and products.

In these factories, hundreds of robotic arms consume millions of weld wire pounds annually.

One common welding challenge felt across the industry is porosity, in which cavities in the weld metal are caused by trapped gas bubbles as the weld cools. The cavities weaken the weld strength.

Traditionally, GMAW defect detection has been a manual process requiring highly skilled technicians.



Source: John Deere (2021)

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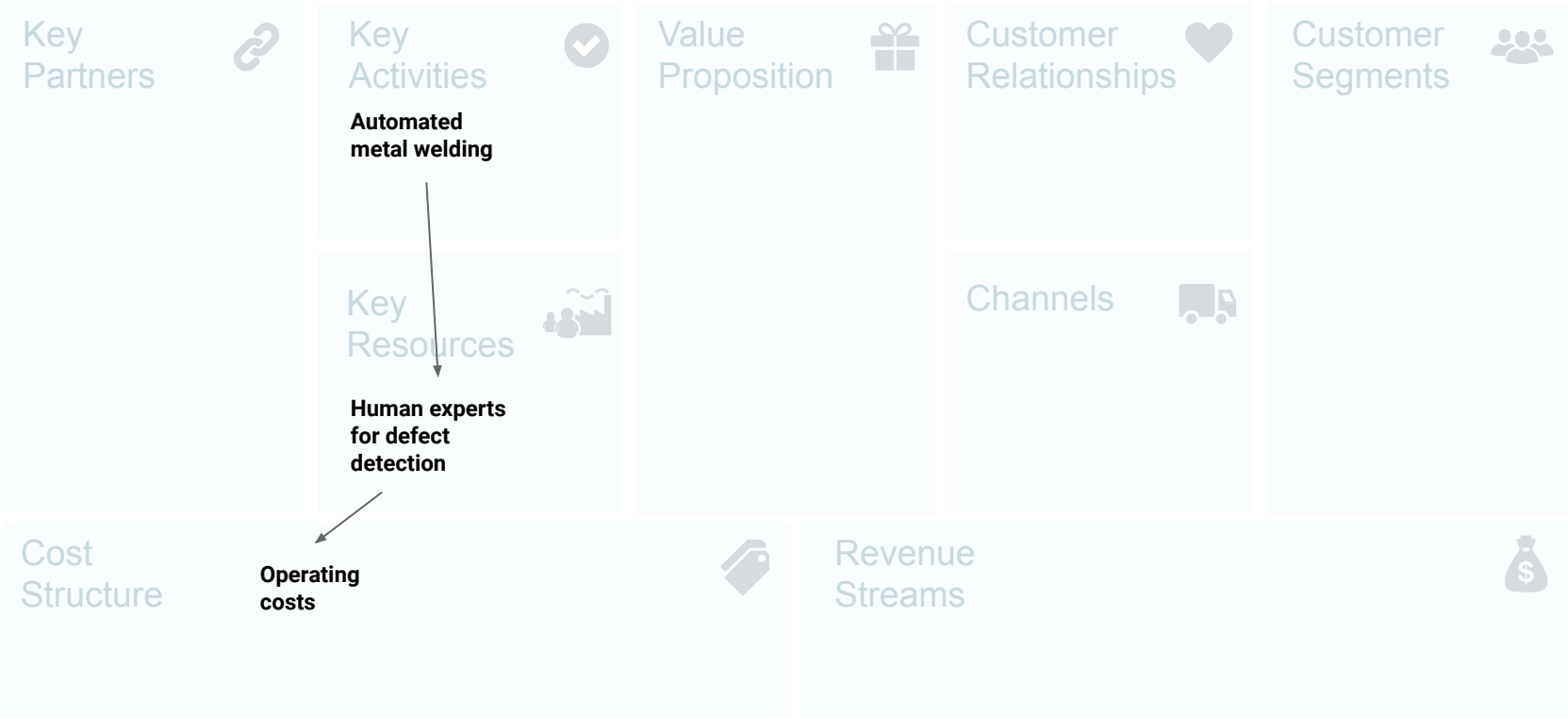


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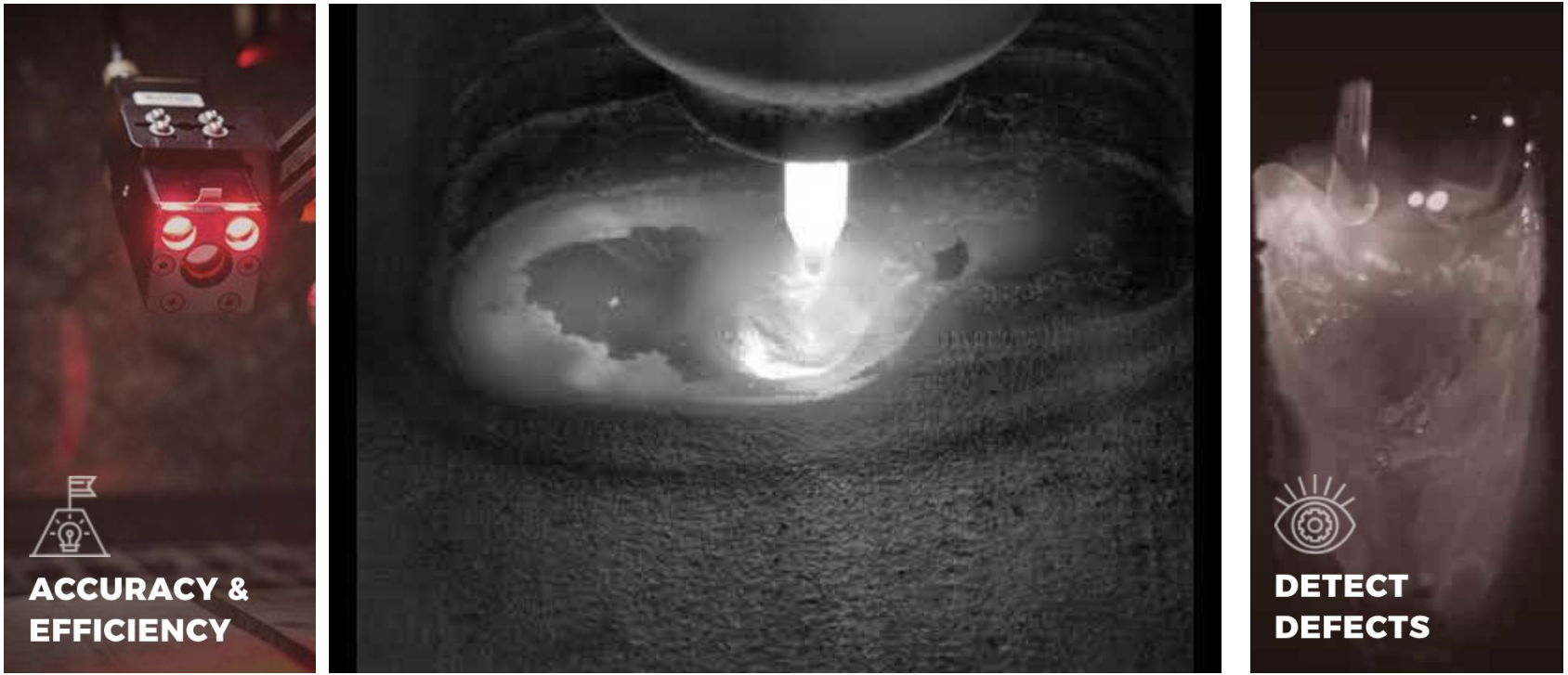
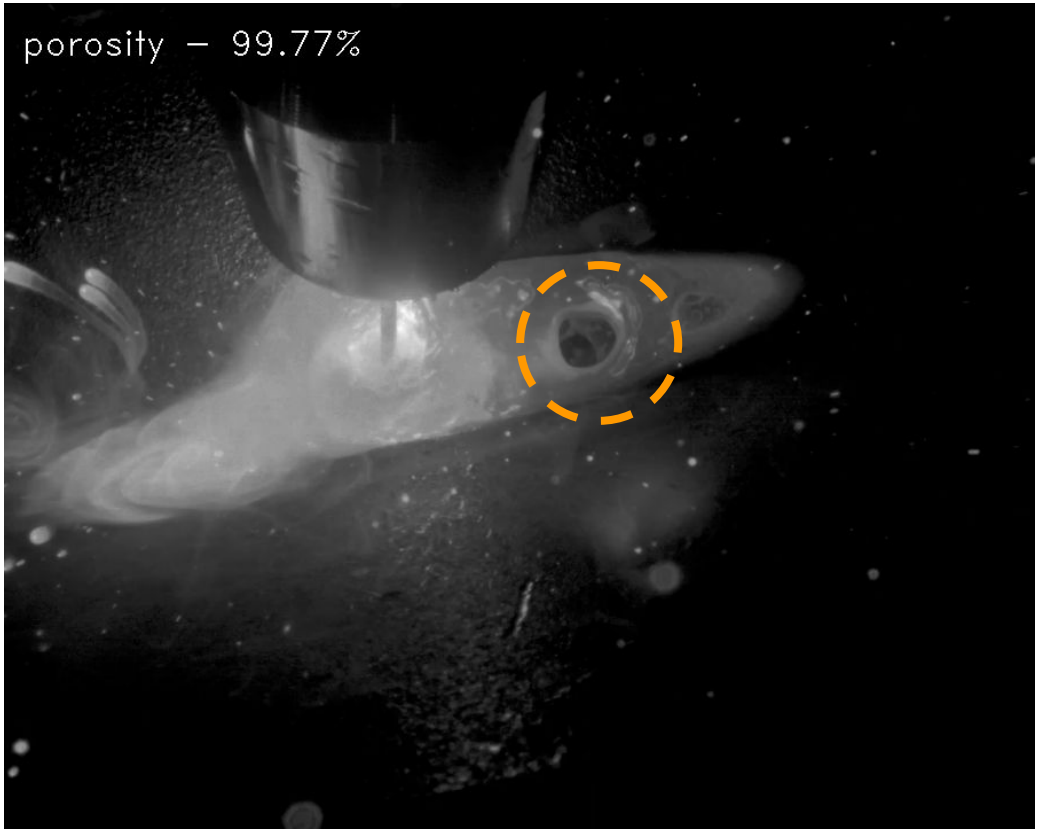



MeltTools
Focused Welding Solutions

# Visualizing welding in-process

Source: MeltTools

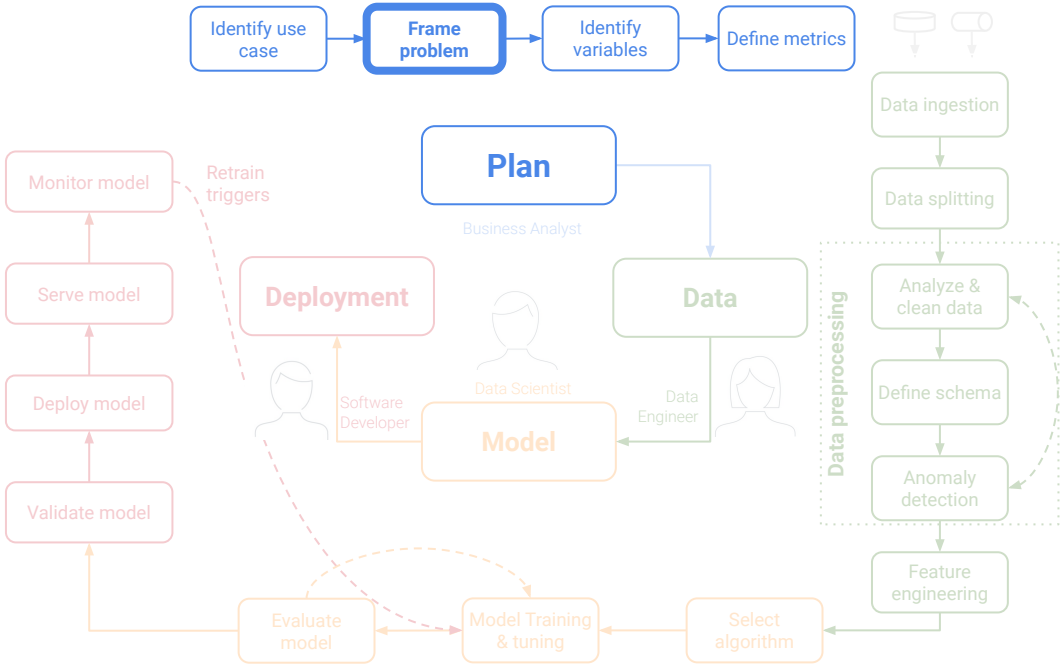



# Porosity weld recognition model

Source: OpenVino (2021)

# Data Science Lifecycle

**Plan** | Data | Model | Deployment



Provide a statement of what is to be learned and how decisions should be made

# Initial problem definition

1) **Specify the use case and target population (or target process)**

   We are investigating < … >

2) **Provide a question and unit of measurement**

   Because we want to find out < … >

3) **Motivate the question and provide a business objective**

   In order to decide < … >

Example: JOHN DEERE

Image: Freepik.com

1) We are investigating

   <the detection of defects in real time>

   <in our automated manufacturing welding process>

2) Because we want to find out

   <if AI is able to spot defects as they occur>

   <with a precision of at least 95% (detection of defects)>

3) In order to decide

   <if we should replace human experts>

   <which would lead to a cost reduction of 20% (xxx.xxx $) >

Source: Booth et al. (2003)

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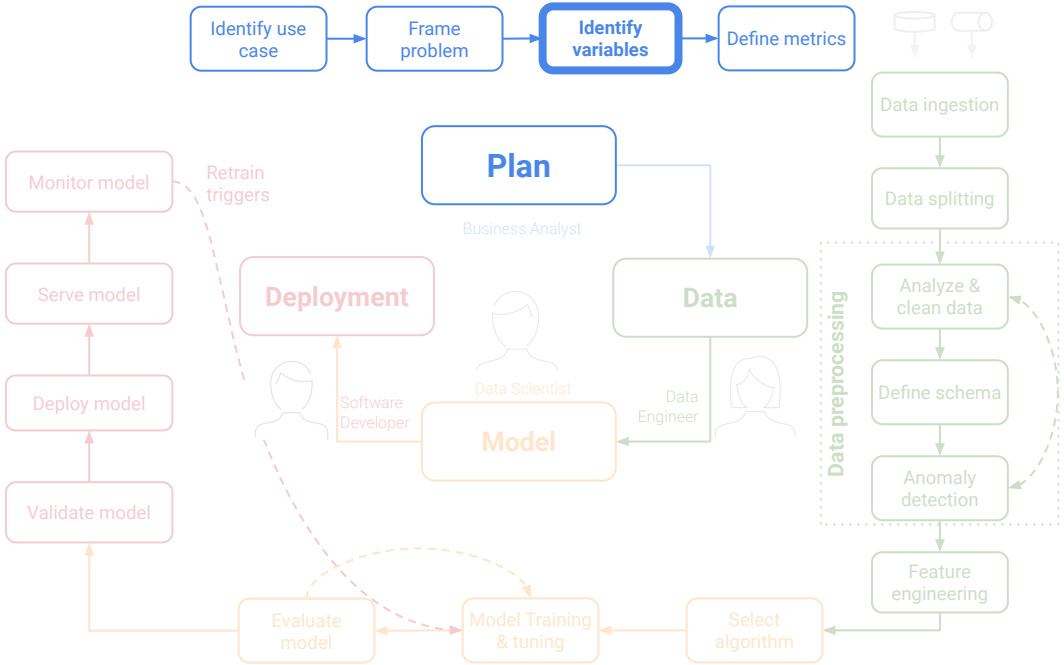


# 4 Major **types** of data science projects

Features



| | **Structured data:** Variables | **Unstructured data:** Labels |
|---|---|---|
| Small data (n <= 10,000) | Type A | Type C |
| Big data (n > 10,000) | Type B | Type D |
| | Feature engineering | Humans label data / Data augmentation |

A "**feature**" refers to the entire column in the dataset

Feature = **Variable**

| Transaction_id | in_foreign_country | size_compared_to_avg_transaction | fraud? |
|---|---|---|---|
| 7485 | False | 0.8x | False |
| 46854 | True | 21.2x | True |
| 3521 | True | 1.1x | False |

A "**feature value**" refers to a single value of a feature column

# If we have **unstructured data**, we need to identify relevant **labels**

Computer vision

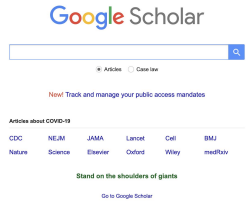
Natural language processing

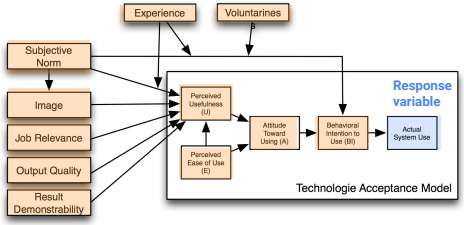
Audio processing

Source: AWS (2021)

# For **structured data** problems, we need to identify potentially relevant **variables**

- **Goal**: show the primary variable of interest (response variable) and possible factors (explanatory variables)
    - explanatory variable →might affect → response variable
- Speak to **domain experts**
- Do **literature research** (e.g., using google scholar) to identify possible relationships between variables
- In business use cases you can also use a **strategy map**

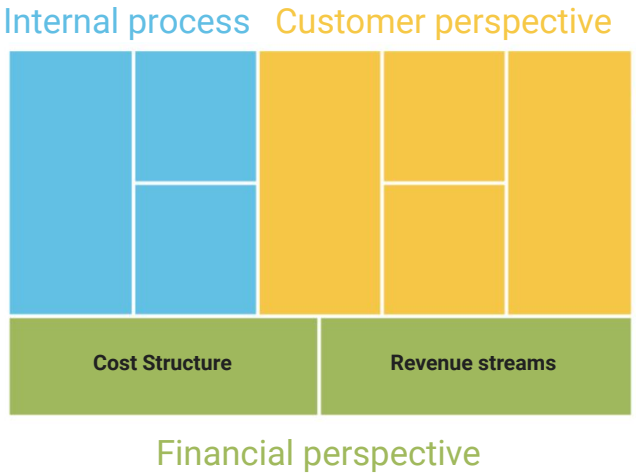



Venkatesh & Davis (2000)

# Strategy Mapping

# From BMC to Strategy Map

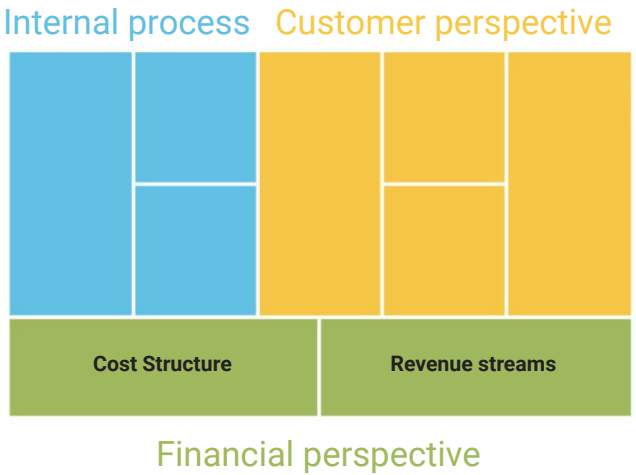






Source: Osterwalder & Pigneur (2010)

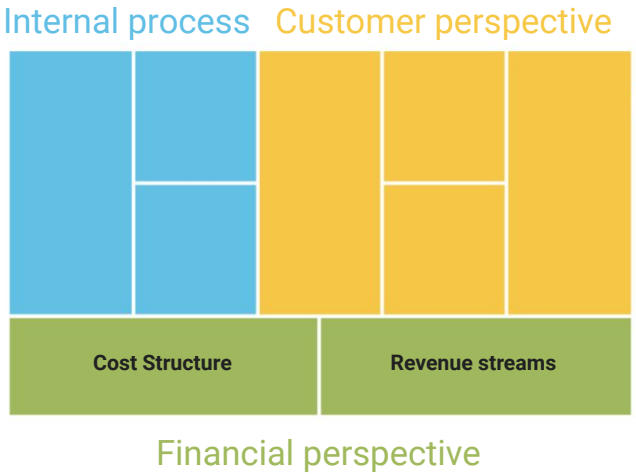
# Financial perspective





Source: Osterwalder & Pigneur (2010)

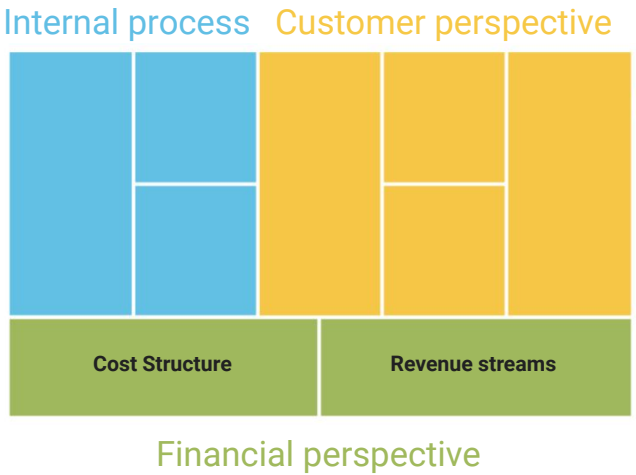
# Customer perspective is our focus





Source: Osterwalder & Pigneur (2010)

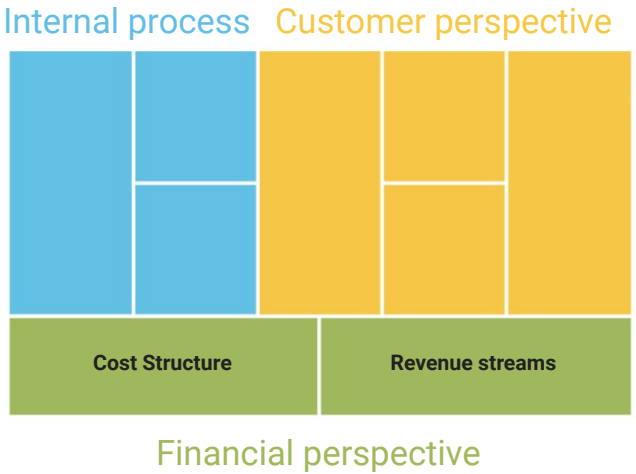
# Internal processes

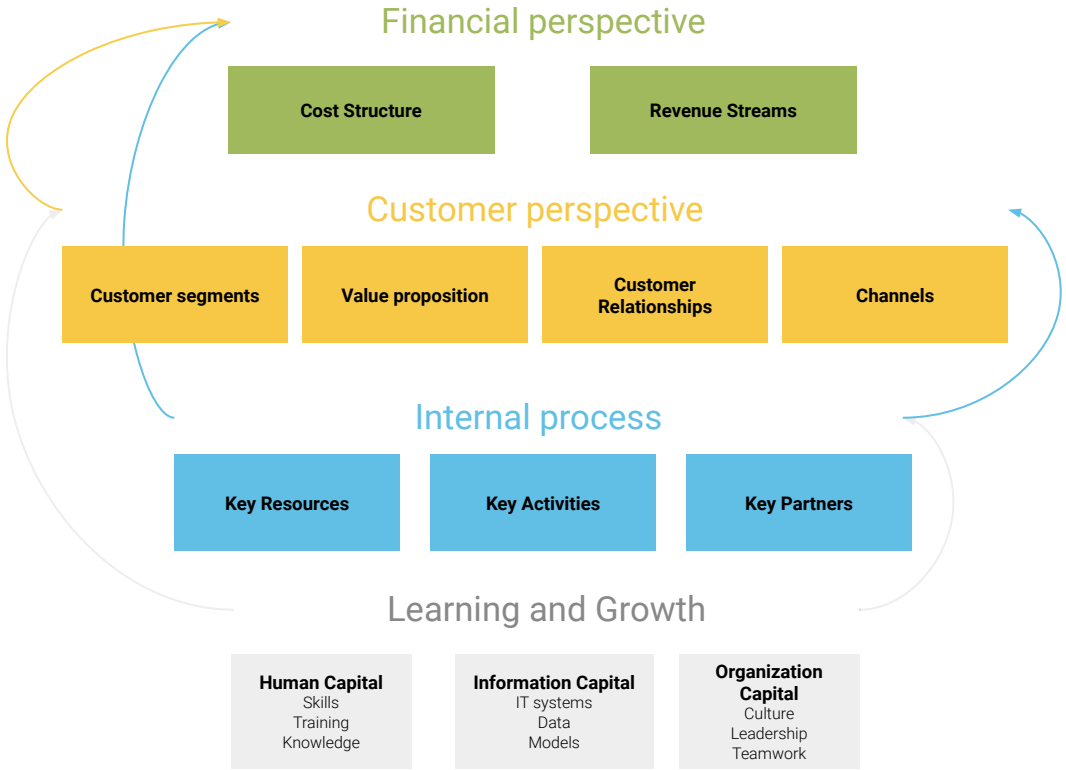




Source: Osterwalder & Pigneur (2010)

# Learning and growth is the basis

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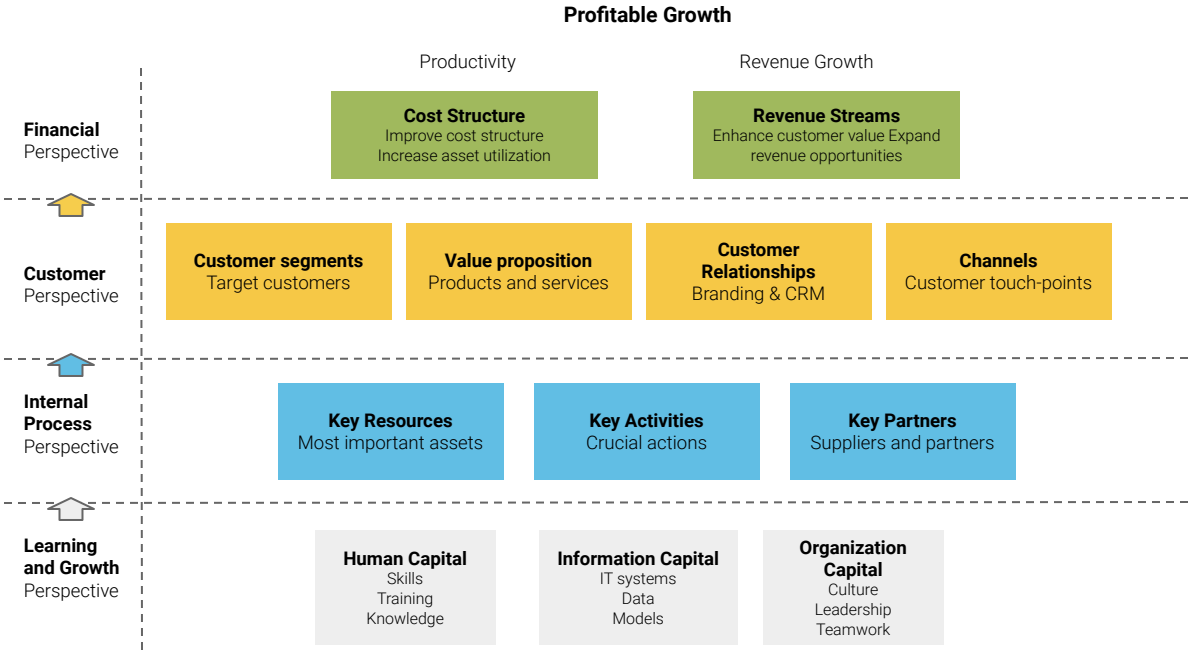
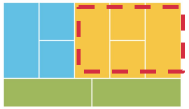
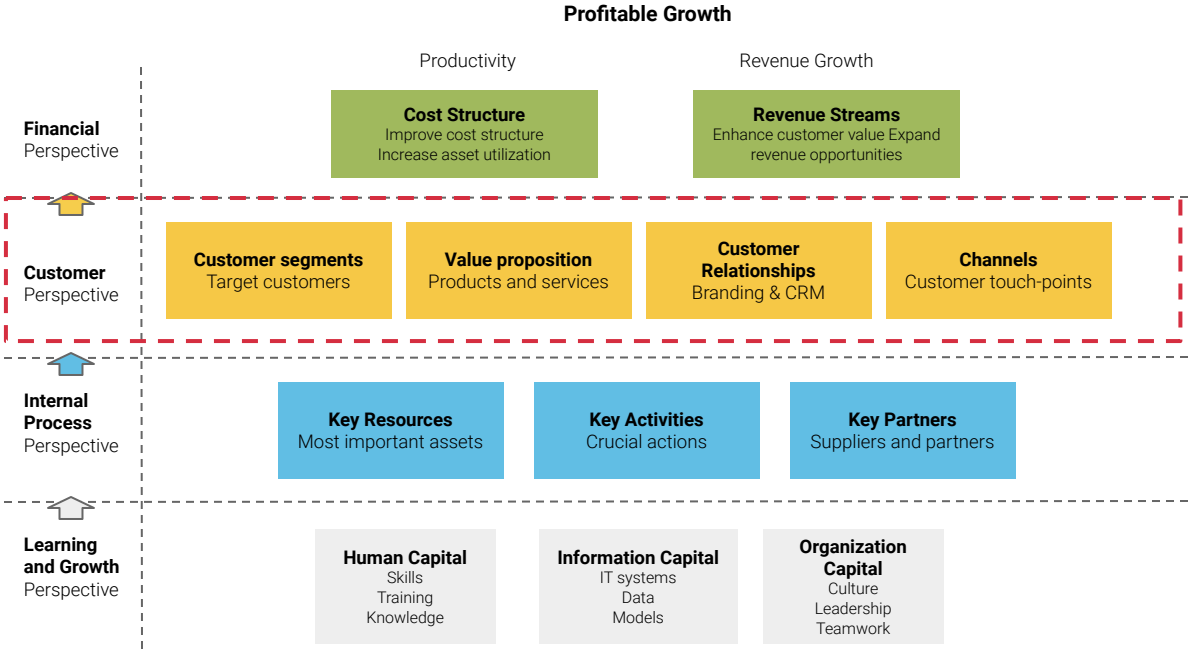



# Strategy Map

Source: Adapted from Kaplan, R. S. & Norton, D. P. (2004). Measuring the Strategic Readiness of Intangible Assets. Harvard Business Review, February

# Example






## Customer perspective

Source: Adapted from Kaplan, R. S. & Norton, D. P. (2004). Measuring the Strategic Readiness of Intangible Assets. Harvard Business Review, February

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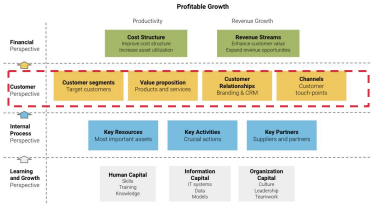


| | | Measurement | Target | Analytics Initiative |
|---|---|---|---|---|
| **Financial** Perspective | Profitability | Operating income | 20% increase | |
| | Revenue Growth | Same store growth | 12% increase | |
| **Customer** Perspective | Brand image; Shopping experience | Customer loyalty: ever active, # units | 60%; 2 units | **Customer loyalty** |
| | | Brand image perception | Increase by 10% each year | **Advertising optimization** |
| **Internal Process** Perspective | "A"-class factories; Line plan mana-gement | Merchandise from "A" factories | 70% by year 3 | Optimize integrated supply chain |
| | | Items in stock | 85% | |
| **Learning and Growth** Perspective | Factory relationship skills; Merchandise/ Buying/ Planning Systems | % of strategic skills available | Year 1 (50%) Year 2 (75%) Year 3 (90%) | Strategic AI skills plan |
| | | Strategic sytems vs. plan | | |

## Customer perspective

Source: Adapted from Quelle: Kaplan, R. S. & Norton, D. P. (2001). The Strategy Focused Organisation. Harvard Business School Publishing Corporation.

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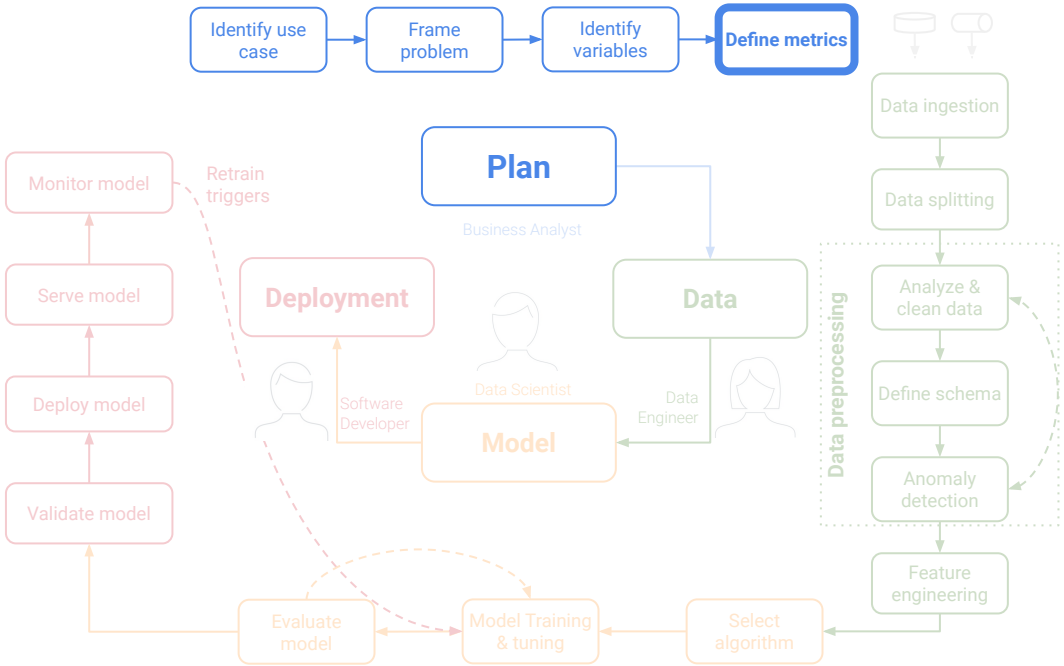

# Some initial thoughts

**Heuristic**

Think about a scenario where you need to deliver the product tomorrow, and you can’t use AI. What heuristics would you use? What would you do?

If we didn't use ML, we would < … >

**The Oracle Test**

Assume you always had the correct answer. What would you be willing to spend for this perfect information from a model?

If we could obtain perfect information, we would be willing to spend < … >

Source: Google Developers (2020)

# Model **problem** definition

1) **Specify the task of your model**

   We want the model to < … >

2) **Provide an ideal outcome (independent of the model itself)**

   Our ideal outcome is <...>

3) **Motivate the question and provide a business context**

   In order to <>

Example: JOHN DEERE

Image: Freepik.com

1) Specify the task of your model
   We want the model to
   < detect bad welds (defective joints) in real time>

2) Provide an ideal outcome (independent of the model itself)
   Our ideal outcome is to
   < be able to replace a bad weld immediately without human >

3) Motivate the question and provide a business context
   In order to
   < replace human experts and reduce manufacturing downtime and costs by 20% >

Source: Google Developers (2020)

# Define **success metrics** (anticipated outcomes)

1) **Success metrics**

   Our success metrics are < … >

2) **Key results (KR) for the success metrics:**

   Our key results (KR) for the success metrics are < ... >

3) **Model failure**

   Our model is deemed a failure if < … >

Example JOHN DEERE

Image: Freepik.com

1) Success metrics
   Our success metrics are
   < reduced operating costs & reduced downtime >

2) Key results (KR) for the success metrics:
   Our key results (KR) for the success metrics are
   < 20% less labor costs and a reduction of downtime by 10% >

3) Model failure
   Our model is deemed a failure if
   < we only reduce operating costs by 15% or have a downtime reduction of 5% >

Source: Google Developers (2020)

# How to select between multiple initiatives?

# Prioritization of initiatives

**Customer perspective**

1. Customer segments initiative
2. Value proposition initiative
3. Channels initiative
4. Customer relationship initiative

**Internal process**

5. Key activities initiative
6. Key resources initiative
7. Key partners initiative




Source: McKinsey & Company (2018)

# Look for initiatives with high impact

**Customer perspective**

1. Customer segments initiative
2. Value proposition initiative
3. Channels initiative
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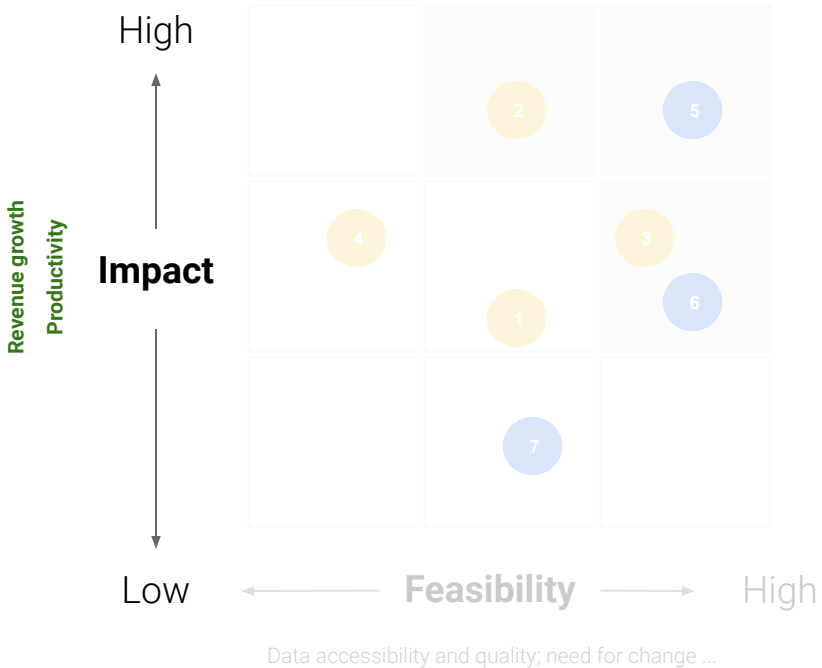
**Internal process**

5. Key activities initiative
6. Key resources initiative
7. Key partners initiative




Source: McKinsey & Company (2018)

# Which also have a high feasibility

**Customer perspective**

1. Customer segments initiative
2. Value proposition initiative
3. Channels initiative
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**Internal process**

5. Key activities initiative
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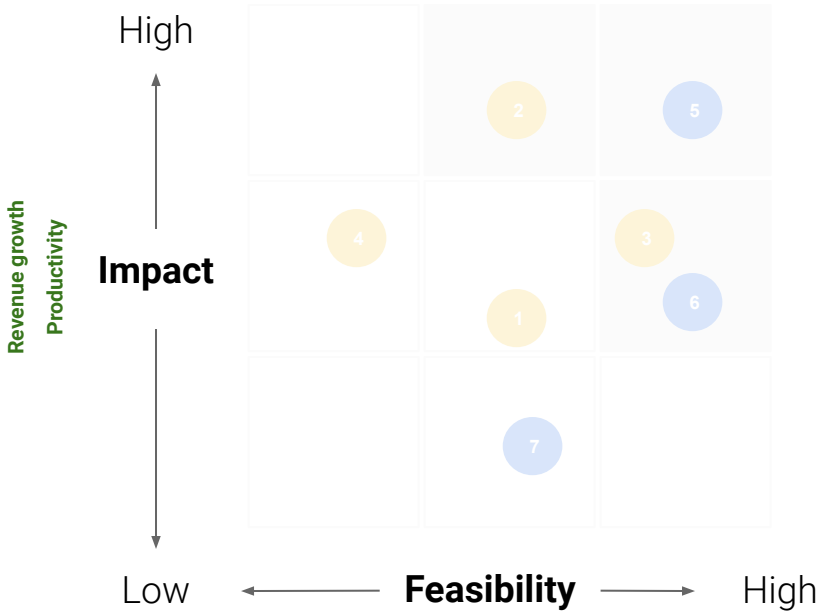


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# Prioritization of initiatives

**Customer perspective**

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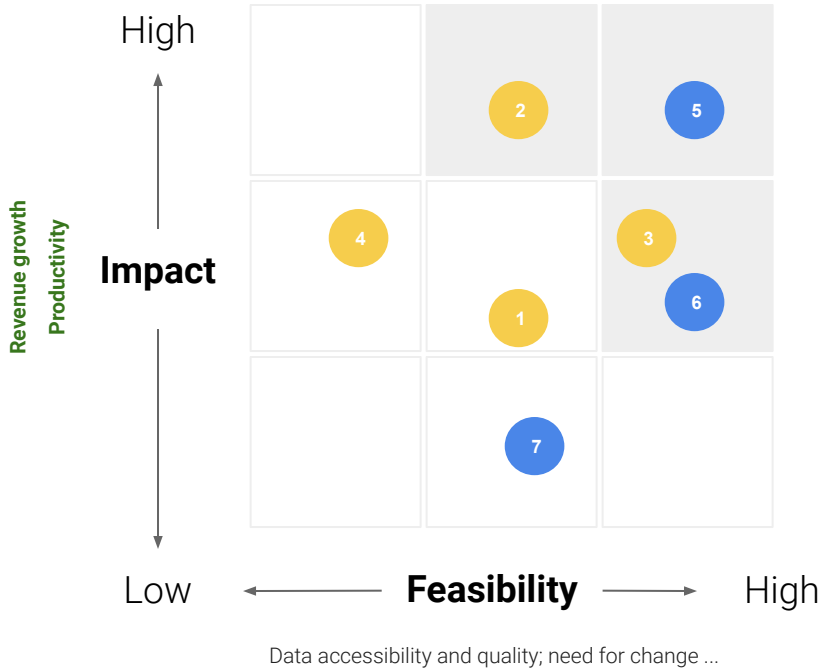
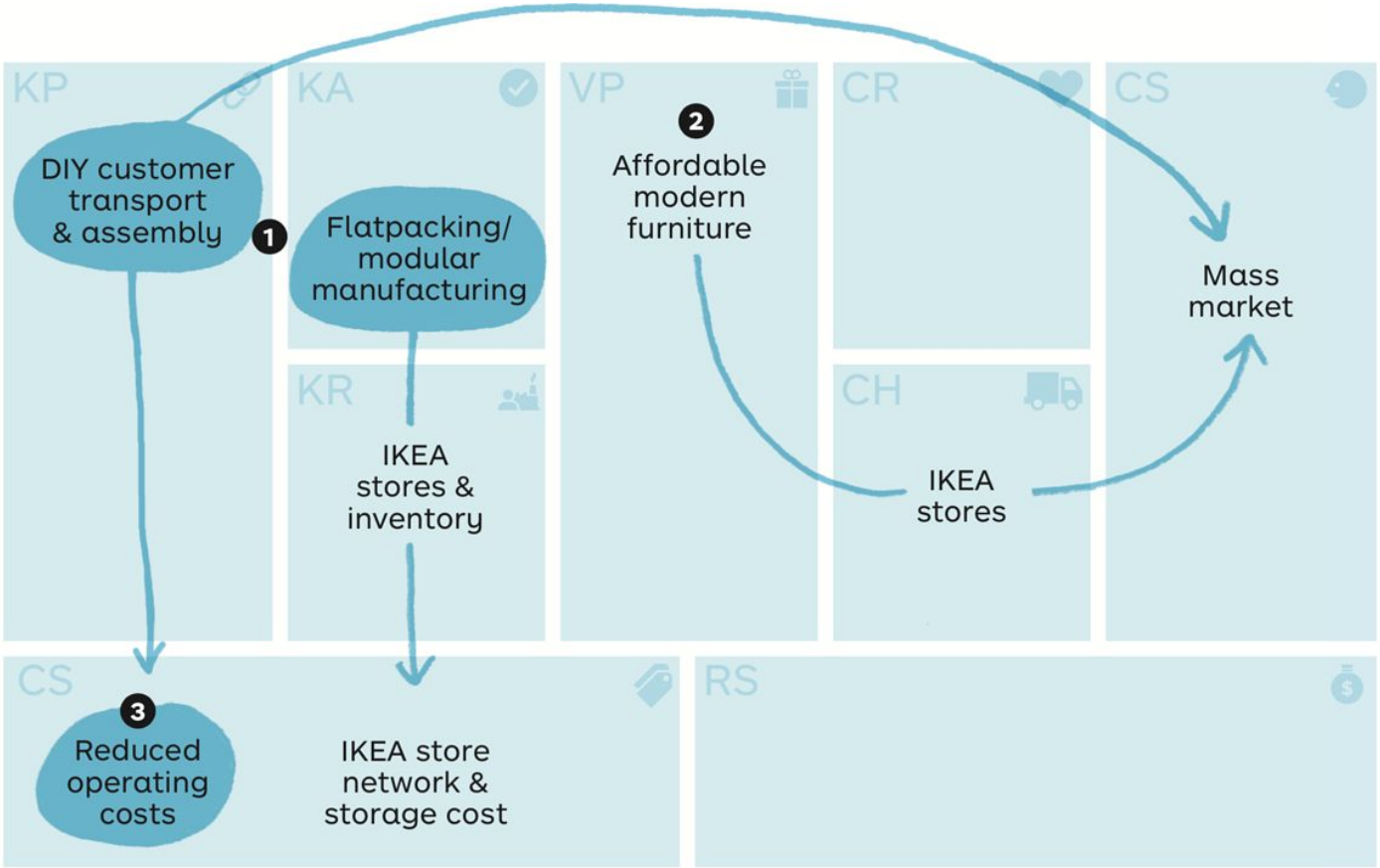



Source: McKinsey & Company (2018)

# Backup



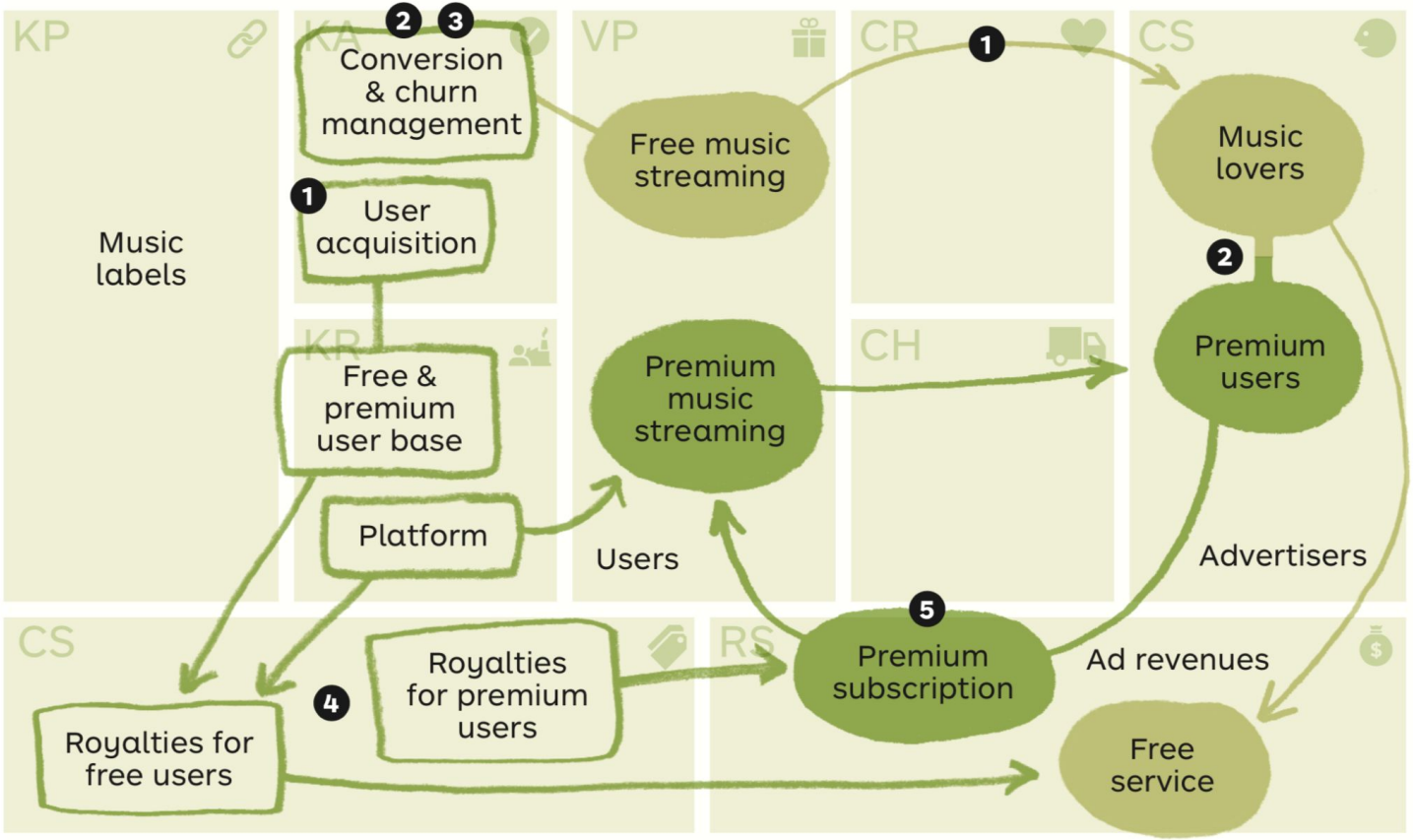

**Customer insight:**

*"I actually don't need furniture that will last a lifetime.*

*But I need modern,* ***affordable*** *furniture* ***right now*** *so I can stop sitting, eating and sleeping on the floor of this apartment."*

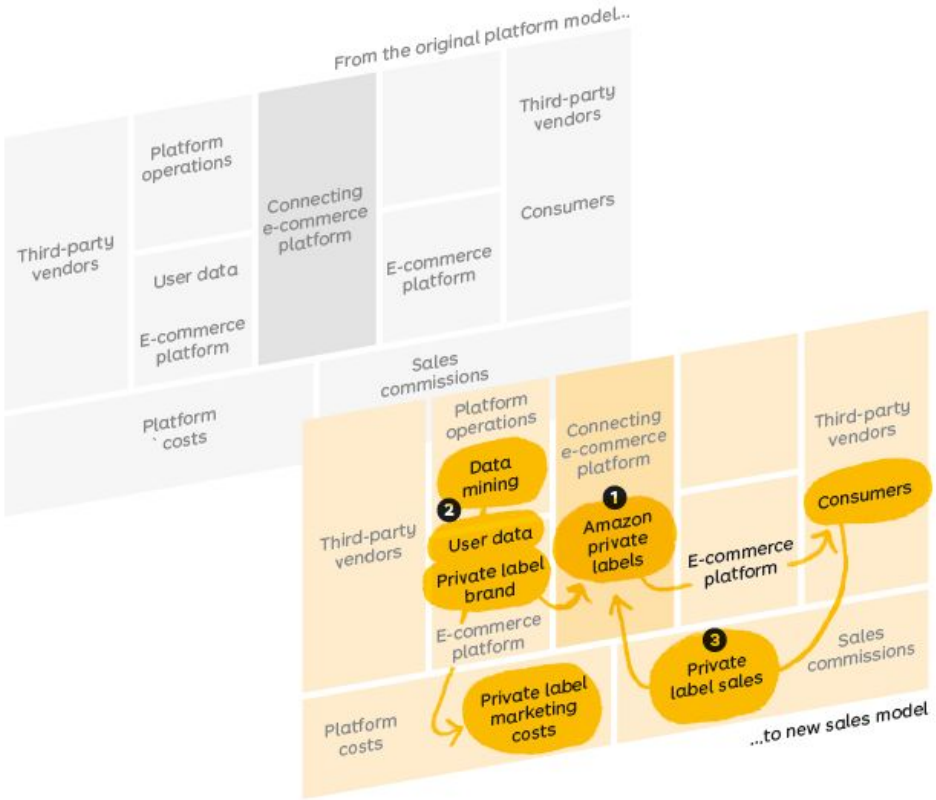
# Ikea: integrate customer in value chain

Source: Strategyzer (2019)




# Spotify

Source: Strategyzer (2019)




# Amazon private labels

# The IoT Business Model Builder (Bosch IoT Lab & Bosch Software Innovations GmbH)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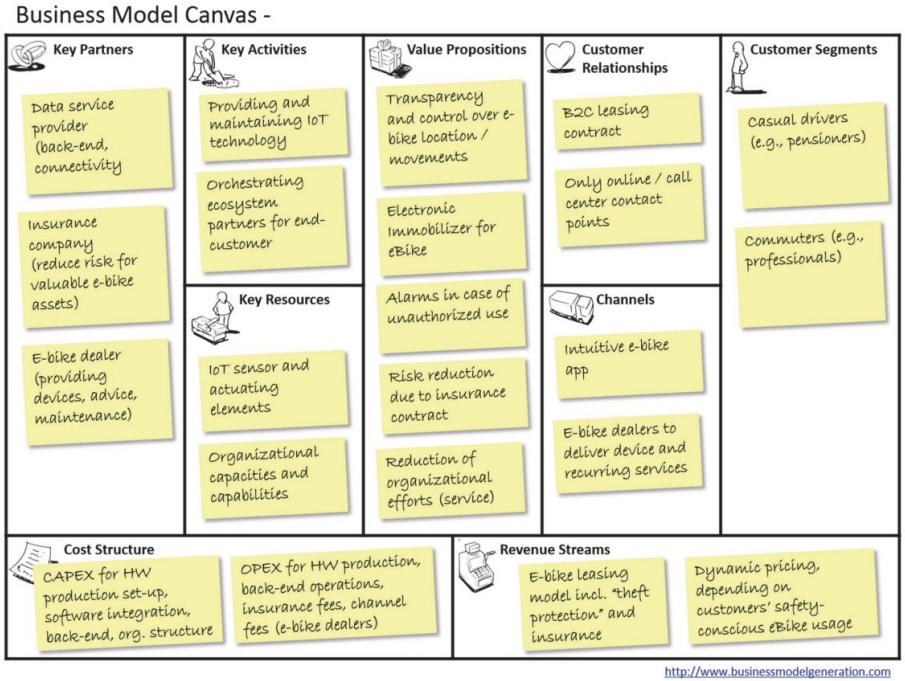


**Figure 12: Osterwalder canvas for the node "full service provider" from the e-bike example (adapted from Osterwalder & Pigneur, 2010)**

# Model output

1) **Model output**

   The output from the model will be < … >

2) **Output format**

   The output is defined as:

3) **Using the output**

   The output from the ML model will be made < … >

   The outcome will be used for < … >