Msc Data Science and Engineering

Group project guidelines

Academic Year 2023-2024

Politecnico di Torino
Department of Management and Production Engineering

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Department of Management and Production Engineering

Aims and objectives of the group project

A vast amount of data are generated in today's business environment, which enables

- support for decision-making at all levels, through information processing and insight generation
- content generation

The main question is: *How can data science be adopted in the business environment to generate insights and make impact at strategic and operational levels?* (Lu et al., 2020)

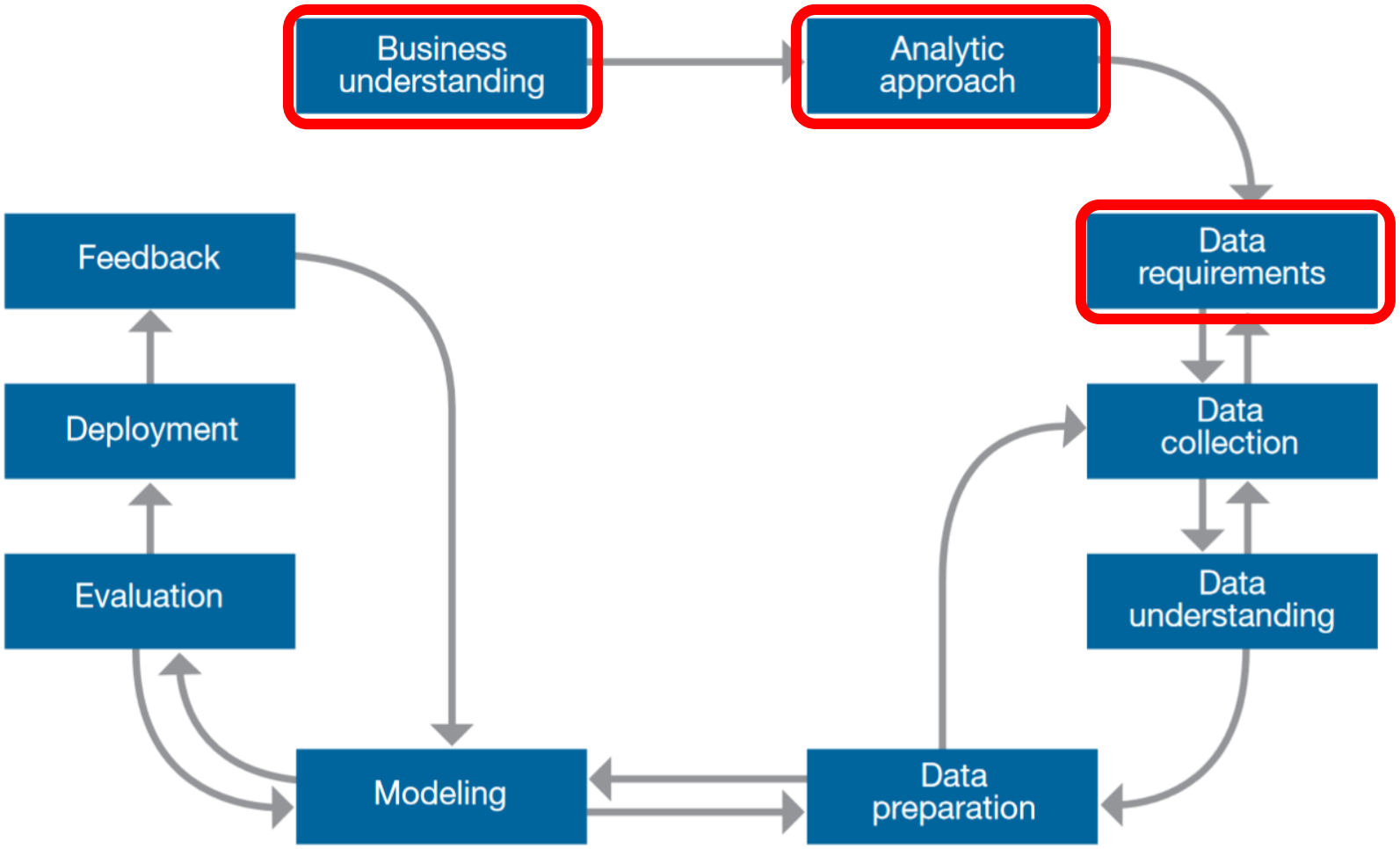
Each group will select and possibly interview a business company (subject to approval)

The objectives of the group project will be:

- Understanding the business: what are the operational problems and the strategic opportunities to address, why and how?

- Plan the application of a data-driven decision-making solution to
  - assist the managers in solving problems
  - create value within corporate processes

Methodology



Source: IBM, 2015

Business understanding

Representing / modeling
(via secondary research, interviews, workshops)

Redesigning
(via individual work, workshops)

RQ: What is the high-level strategy of the business?

TOOL: strategy board

RQ: What are the strategic-level foundations of the way the business works?

TOOL: business model canvas

RQ: What are the high-level processes that characterize the business?

TOOLS: value stream map, customer journey map…

RQ: What are the detailed processes?
TOOL: BPMN model

What is the current role of data ("as-is" perspective)?

How could we improve the business with data ("to-be" perspective)?

If we could redesign the business from scratch ("digital first") what would the business model and the VSM/CJ be?

What data science tools could be used?

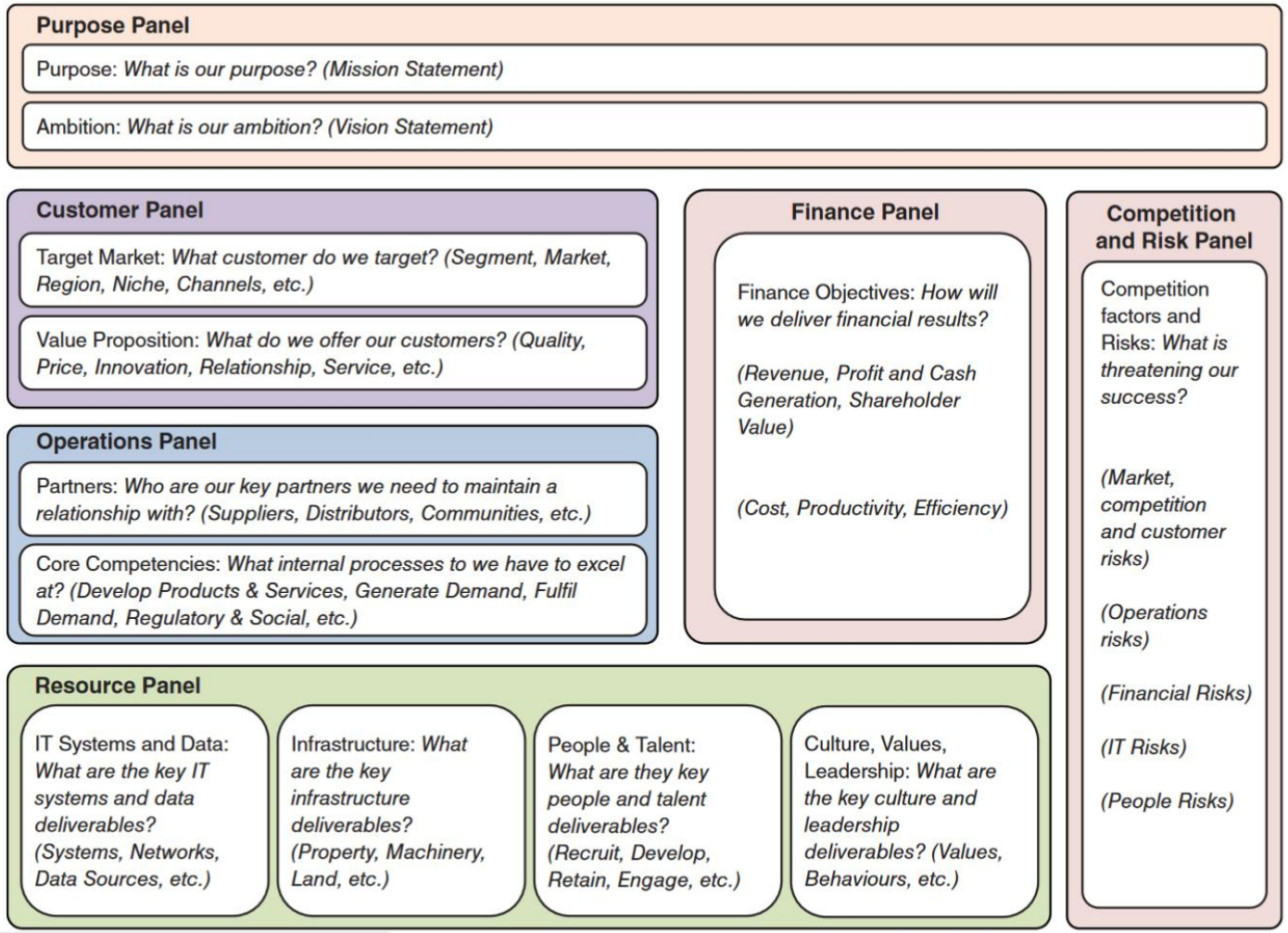
What are the technical /data requirements?

Phase 1 – Mid October – End of November

Phase 2 – December – Mid January

Tool 1 – The Smart Strategy board

Understanding the operational problems and the strategic opportunities



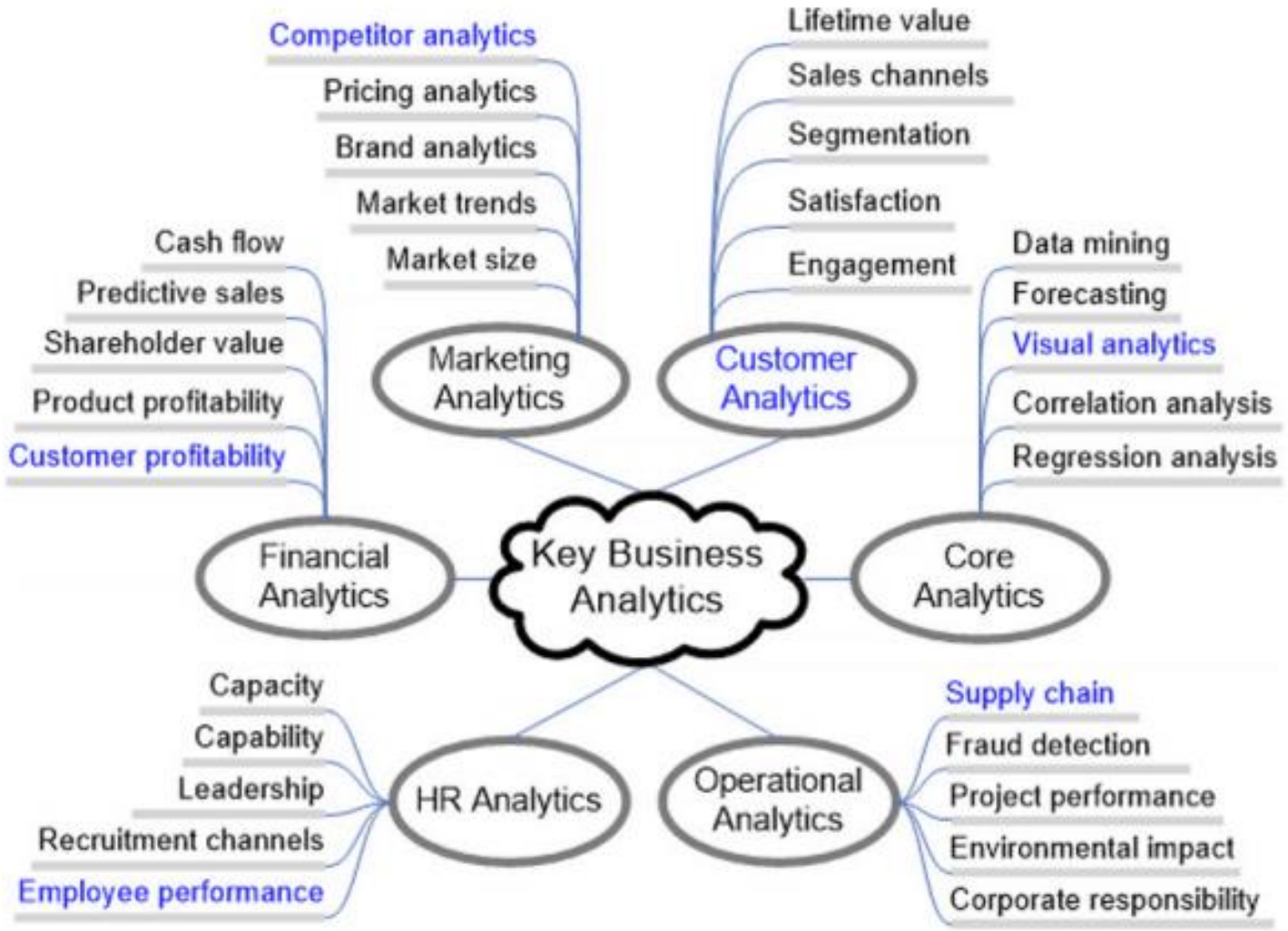
Source: Marr, 2015

PEST Analysis (or PESTLE if you add Legal + Environmental)			
Political	Economic	Social	Techno-logical

SWOT Analysis	Helpful	Harmful
Internal	Strengths	Weaknesses
External	Opportunities	Threats

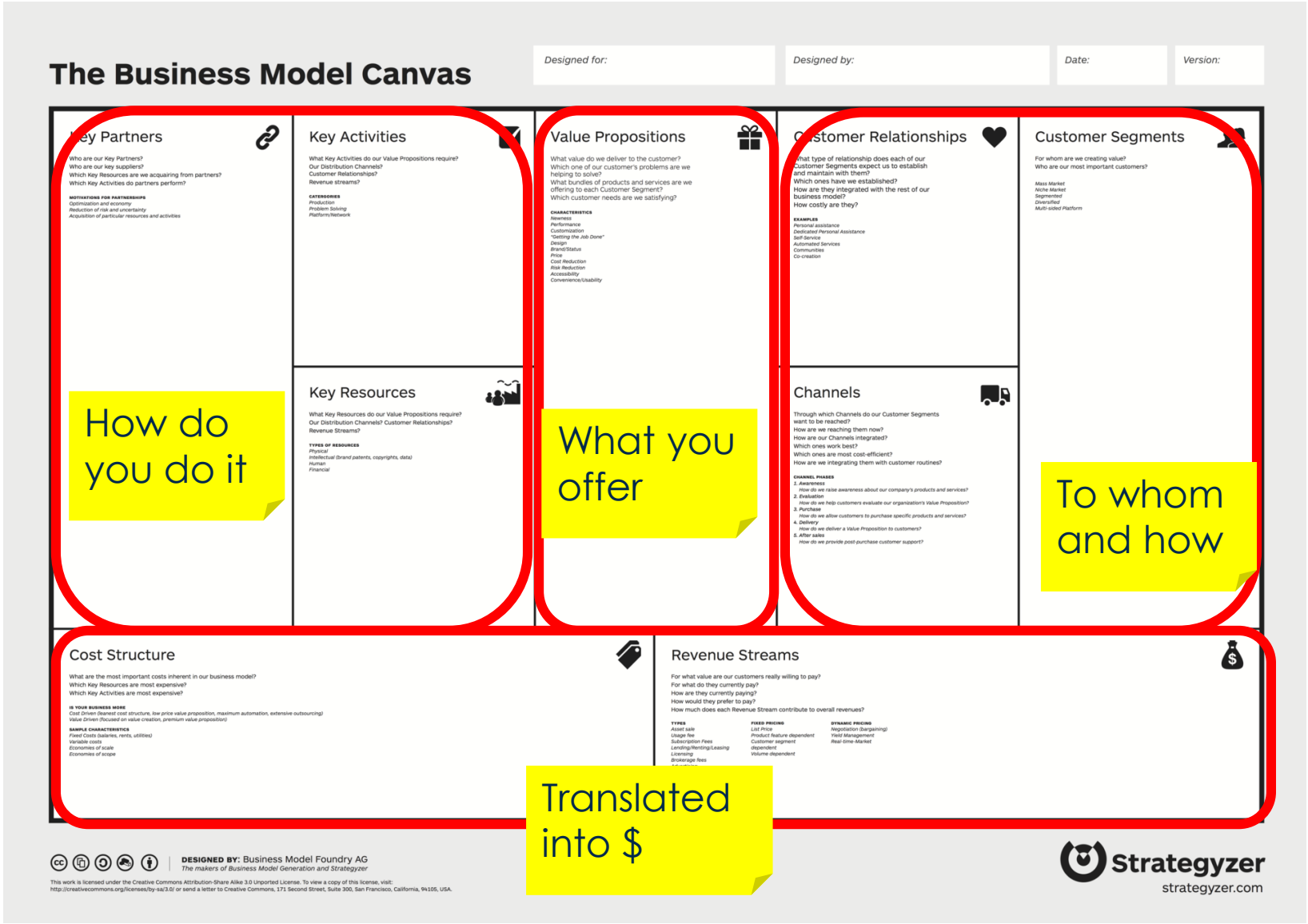
Tool 2 – Key business analytics domains

Understanding the operational problems and the strategic opportunities



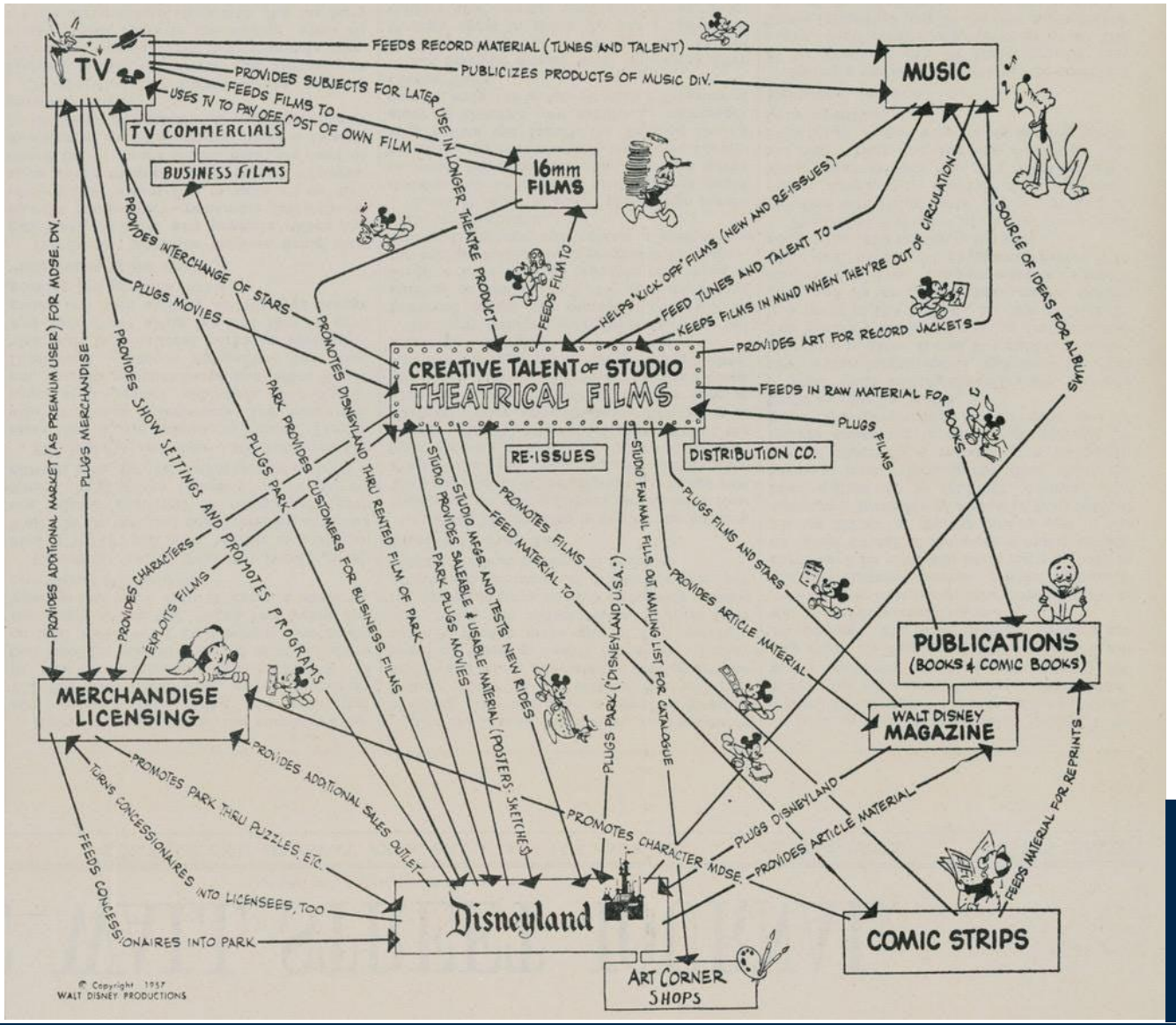
Source: Lu et al, 2020

Tool 3 – The Business Model canvas



Source: Osterwalder, 2005

Tool 3 – The Business Model canvas



An ancestor of business model representations (Disney, 1957)

The business model canvas

- Is there a sharp definition of who will be served (and who will not)?
- Is there a clear choice among B2C, B2B, B2B2C, etc.?
- What are the needs of these CSs (e.g., better, faster, cheaper)?
- Is there a roadmap from the beach-head to the mainstream market (innovators → early adopters → early majority)?
- What is the size of the market?
- What is their willingness-to-pay?
- Is the definition of CS based on a hunch, or did we actually speak to customers?

The business model canvas

- Is the VP defined in terms of the features or in terms of benefits?
- Is each VP well connected to each CS?
- Is the attractiveness of the VPs clear?

The business model canvas

- Do the Channels cover the entire lifecycle, from initial awareness to after-sales support?
- Are the Channels coherent with VPs and CSs?

- Are the CRs able to fully engage CSs
- Are CRs complementary to the Channels?
- Are the CRs appropriate to VPs and CSs?

The business model canvas

- Are the KAs that are relevant to deliver the VPs all listed?
- Is there a clear distinction between core and non-core activities?

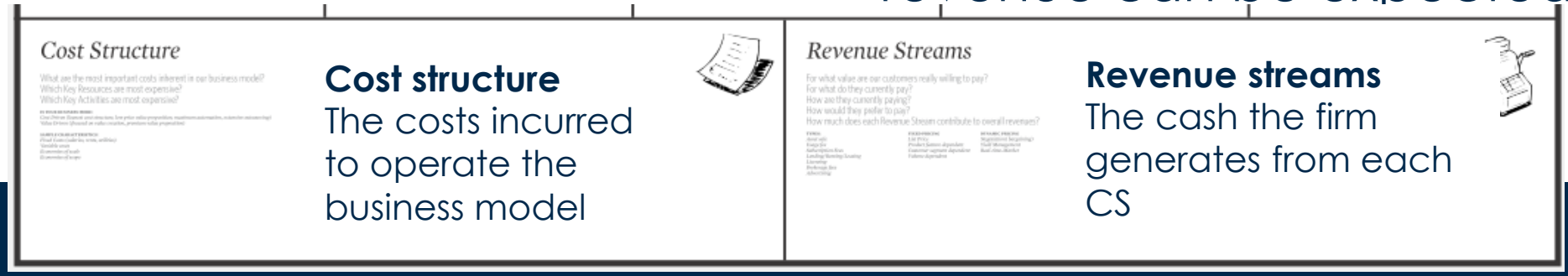
The business model canvas

- Are KRs and KPs coherent with the KAs?
- What type of KRs are they?
  - physical vs. intangible vs. human
  - fixed vs. current
  - generic vs. specific vs. co-specialized among themselves
- How should these KRs be acquired (buy, make, ally)?
- Are KPs adequate to ensure KRs and KAs?
- What type of relationships tie us to KPs?

The business model canvas

- What is the cost structure, divided among?
  - › Fixed costs
  - › Semi-fixed costs
  - › Variable costs
- Can you envisage?
  - › Economies of scale
  - › Economies of scope
  - › Economies of learning

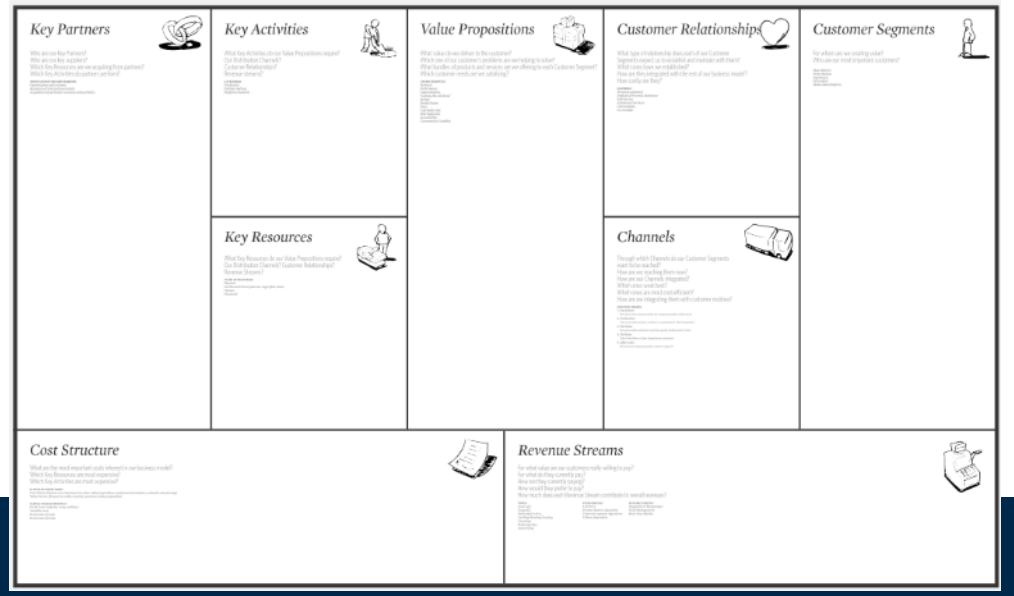
- What is the revenue model and how will it evolve?
  - › Transactions vs. recurring
  - › Fixed vs. subject to discounts
  - › Fixed vs. proportional to value transacted / generated (success fee)
  - › Sale vs. Rental vs. *aaS vs. Savings/Performance Contracting
  - › Static vs. dynamic pricing
- Given the size of CSs, what revenue can be expected?



The business model canvas

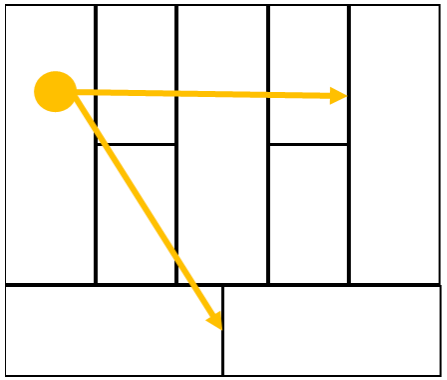
Try doing it! Pick one…

- Analyze the business model for your favorite restaurant
- Build a business model around your hobby
- Build a business model around the needs of 5 yr. old kids
- Build a business model around a cow you just inherited from your grandparent who lived in the countryside (or some other apparently useless asset)

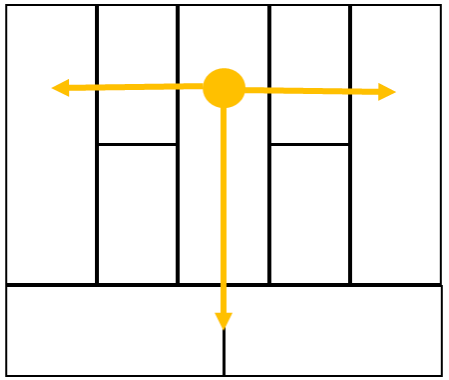


The business model canvas

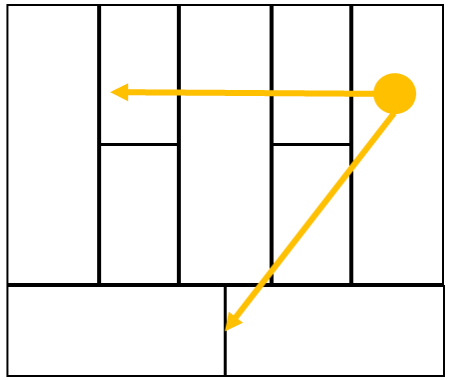
- Can we benchmark our canvas against competitors' ones?
- What are the possible future scenarios, and which business model would be most suitable in each?
- Can we "unbundle" the firm, focus on one of the three key processes (innovation, production, sales) and outsource the other ones?
- What is the core of the firm, around which we can pivot?



Resources and partners



A product / service / technology



Grip on a market

Key Partners

Who are our Key Partners?
Who are our key suppliers?
Which Key Resources are we acquairing from partners?
Which Key Activities do partners perform?

MOTIVATIONS FOR PARTNERSHIPS
Optimization and economy
Reduction of risk and uncertainty
Acquisition of particular resources and activities

What data could we give our partners to help them operate better?

What data could we require from partners to improve our operations?

Key Activities

What are our KPIs? Can we use data to improve the op. perf. of our processes (= less opex, more efficiency)?

Key Resources

Can we use data to improve the upkeeping of our resources, human and material?

Value Propositions

What value do we deliver to the customer?
Which one of our customer's problems are we helping to solve?
What bundles of products and services are we offering to each Customer Segment?
Which customer needs are we satisfying?

CHARACTERISTICS
Newness
Performance
Customization
"Getting the Job Done"
Design
Brand/Status
Price
Cost Reduction
Risk Reduction
Accessibility
Convenience/Usability

Can we use data to improve the value of the VPs?

Customer Relationships

How can we make sure that CRs support a full collection of data on CSs?

How can we improve the operational performance of CRs through data?

Channels

Through which Channels do our Customer Segments

What data can we collect on our CSs through the Cs?

How can we improve the operational performance of Cs through data?

Customer Segments

For whom are we creating value?
Who are our most important customers?

Mass Market
Niche Market
Segmented
Diversified
Multi-sided Platform

What data could we have on our current and prospective CSs?

What data would come from our processes and what from other sources?

Cost Structure

What are the most important costs inherent
Which Key Resources are most expensive?
Which Key Activities are most expensive?

IS YOUR BUSINESS MORE
Cost Driven (leanest cost structure, low price value pr
Value Driven (focused on value creation, premium val

SAMPLE CHARACTERISTICS
Fixed Costs (salaries, rents, utilities)
Variable costs
Economies of scale
Economies of scope

What would be the impact of the above on fixed and variable costs?

The "using data" perspective
For simplicity, the questions are aimed at "to be".
One should develop both "as is" and "to be" versions

What would be the impact of the above on revenue streams?

, 2005

Tool 4 - Value Stream Mapping

- High-level modeling of business processes often use the Value Stream Mapping modeling approach
- 1998, Value Stream Mapping is proposed by Rother and Shook as a communication and documentation tool for continuous improvement.
- VSM as a way to "*learn how to see*" the flow of **value**, and the origins of **waste**
- VSM has become an essential tool in the context of Lean Management both for **changing** and **designing** systems
- VSM can be used both in manufacturing environments and services ("transactional" activities)
- VSM as an "intuitive but deep" approach to process mapping → allows greater participation by employees involved

Value Stream Mapping

5 Lean principles

- Define value
- Map value stream
- Create flow
- Establish pull
- Pursuit perfection

Value is "what the customer is willing to buy"
Of the right quality
At the right time
At the right price
Non-value is "what the customer would not be willing to pay for"
Can be necessary
…or it can be un-necessary

7 wastes (WIMTODO)

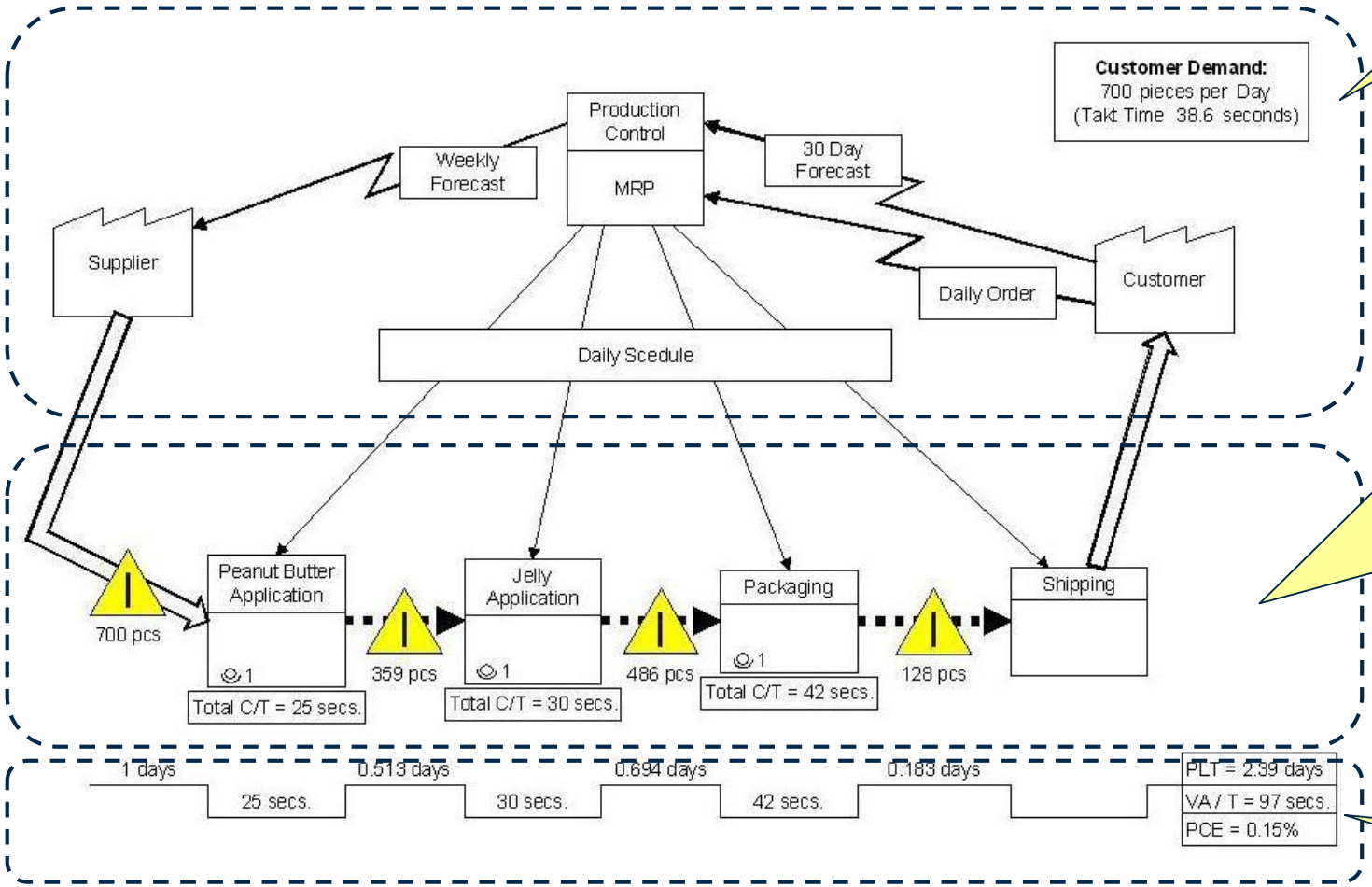
- Waiting
- Inventory
- Motion
- Transportation
- Over processing
- Defects
- Over production

The VSM process

- A VSM exercise entails five phases
  - Preparation
    - definition of the “product family” to be analyzed,
    - Identification of customer and supplier
    - appointment of the team
  - Drafting a “Current state” map (or As-Is)
  - Drafting a “Future state” map (or To-Be)
  - Creating an implementation plan
  - Executing it

Main elements of a VSM

- The map is based on three sections



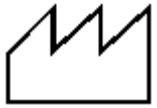
Communication or information and control flow
Formal and informal

Process flow
The main flow
Always left to right
Can include subtasks (i.e. auxiliary processes feeding the primary one)
Can include alternative processes

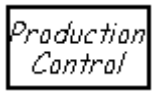
Analysis of timelines and travel distance

Main elements of a VSM

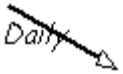
- Communication flow



Supplier (on the left-hand side) or Customer (on the right-hand side)



Department or person engaged in production control activities



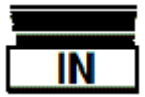
Manual flow of information. Notes indicate media, frequency, etc.

Electronic flow of information. Notes indicate media, frequency, etc.

MRP/ERP. Planning system based on MRP principles

Go see. Gathering of information by visual means. Notes indicate actor, frequency

Verbal information. Information flow based on verbal communication. Notes indicate actor, frequency



Purchase orders coming from the outside

Main elements of a VSM

- Communication flow (case of Kanban-based systems)

Production Kanban. It tells a process to make a given number of parts

Withdrawal Kanban. It tells a material handler to pick up a given number of parts from a storage point

Signal Kanban. It is originated by an inventory level reaching a reorder point, and tells an upstream process to produce a batch

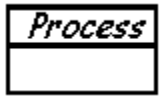
Kanban board (where physical Kanban cards are placed)

Sequenced pull. It represents the signal given to a subassembly process to produce a given type and quantity of a product

Load leveling. Kanbans are batched in order to level the production volume and mix

Main elements of a VSM

- Process flow



Dedicated process. A process element that is 1:1 to the product family. It can incorporate subprocesses that the analyst does not want to model in detail

Shared process. A process element that is shared by multiple product families

Data box. Provides details on other elements. In the case of processes, it can include information on cycle time CT, setup (or changeover) time CO, uptime/availability A%, defect rate D

Production cell. Represents a collection of generally heterogeneous processes that is dedicated to the product family

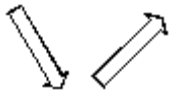
Inventory. A location where materials are formally stored. Data reports on inventory level or waiting time

Queue. A location where materials are informally stored as a queue. Data reports on inventory level or waiting time

Terminator. Used when parts can be defective and are either scrapped or sent back to process X for rework

Main elements of a VSM

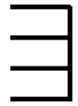
- Process flow



Shipments. Represents arrival of raw materials from supplier and shipments of finished goods to customer

Push. A part is pushed from an upstream process to a downstream one when the former is ready for it (and without considering the needs of the latter)

Pull. A part is moved from an upstream process to a downstream one when the latter calls for it



Supermarket. An intermediate inventory that decouples upstream and downstream processes. The latter go and pick goods, and the former replenish it

Material pull. Represents «pull» from a supermarket

FIFO lane. A limited capacity buffer connecting processes. When full it creates blocking

Safety stock. Represents stock whose aim is to protect against unforeseen events

Operator. Represents an operator or a group of operators in charge of activities

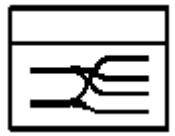
Main elements of a VSM

- Process flow

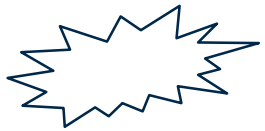
External shipment. Icons represent the modality for the shipment. Data may include frequencies

Expedited. Represents deliveries that are always or usually expedited

Milk run. Represents a vehicle that makes a pickup and delivery round at a given time without necessarily requiring a full load. A fixed route is often used



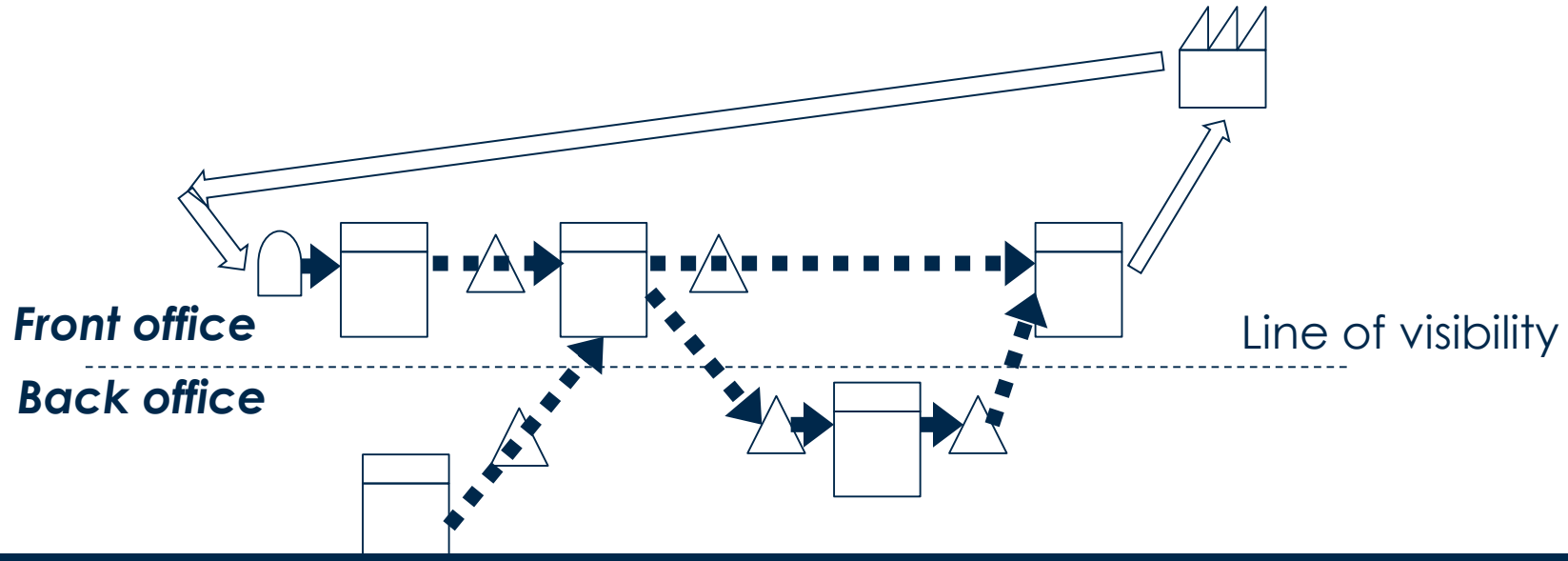
Cross docking. A cross docking operation where goods are shifted from inbound to outbound trucks with minimal storage



Kaizen burst. Represents proposals for improvements

The case of services

- The customer is both customer and supplier (and part)
- VSM as a “customer journey” map (maybe as “agent journey” map too)
- It is recommended to distinguish between
  - Front-office process flow (experienced by customer), with "touchpoints"
  - Back-office process flow (not experienced by customer)
  - Ancillary process flow (not experienced by customers)



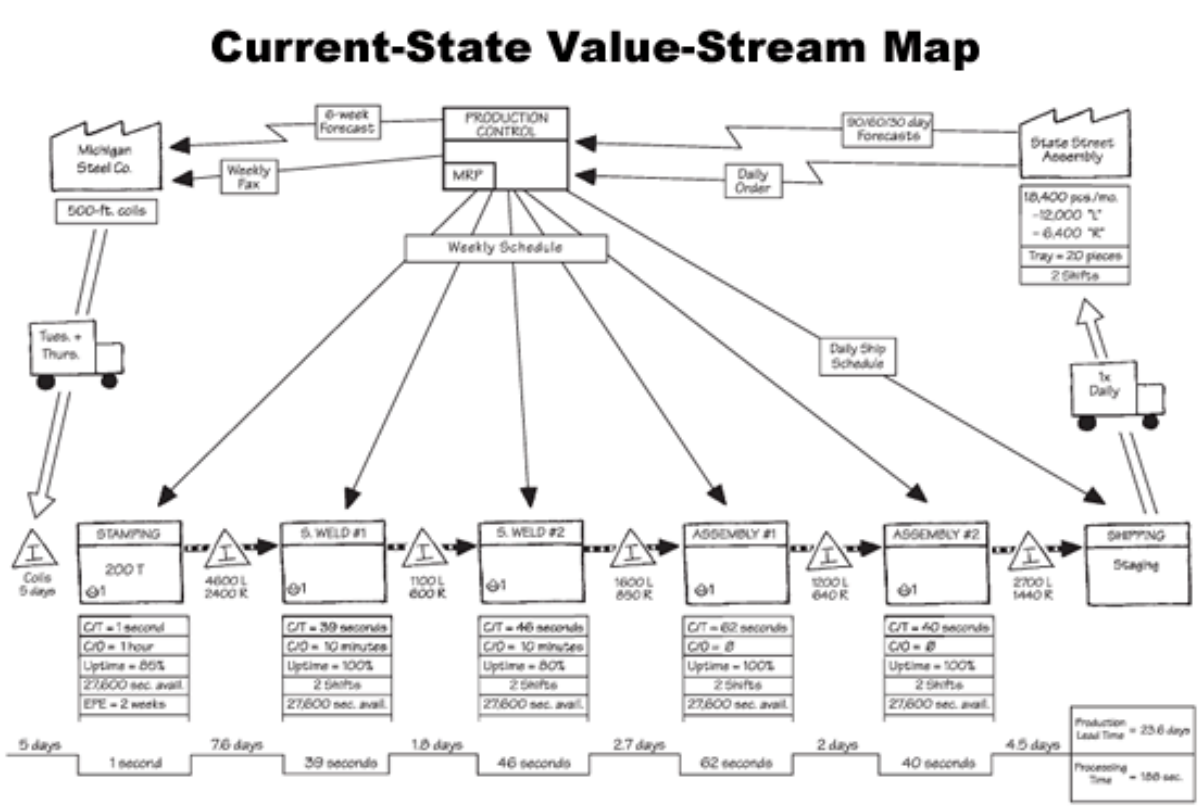
The case of services

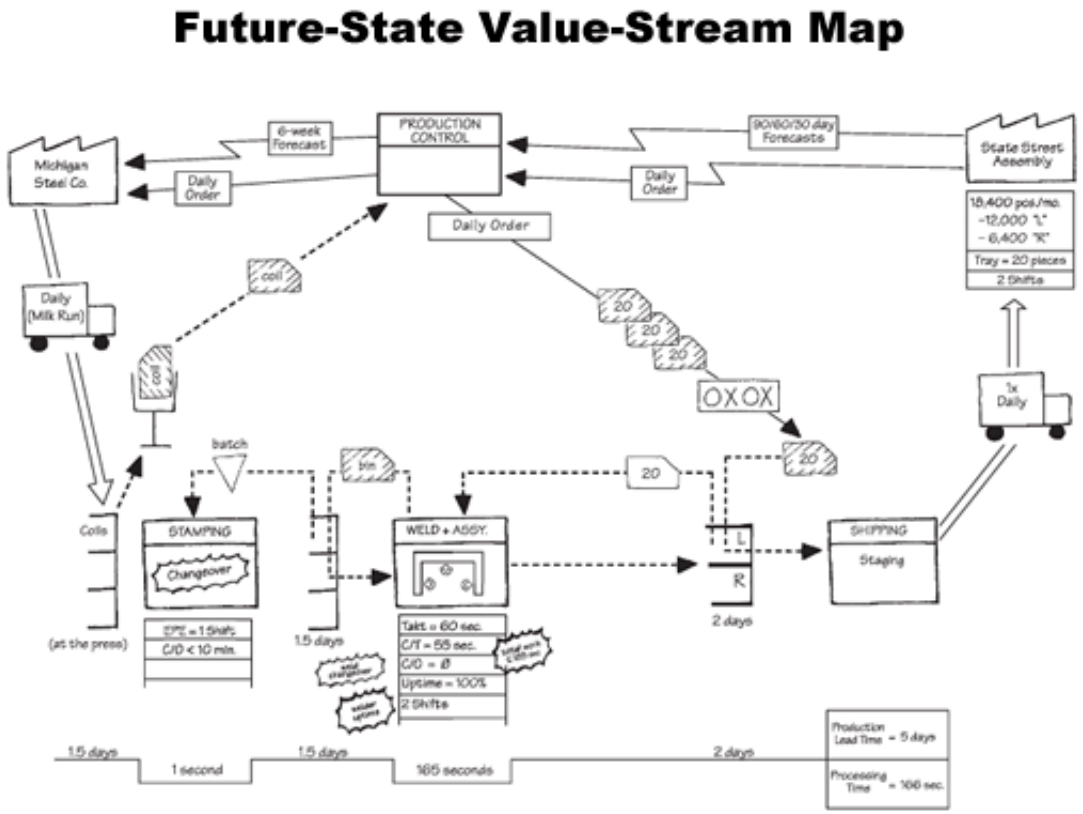
- VA activities have to do with customer experience that is positively perceived (satisfaction, emotion, etc.)
- Activities as ***contacts*** between customer and company (mediated by products, people, buildings, etc.)
- Waiting as NVA activity ***and*** as lack of contact
- Activities in the customer journey can be analyzed by recording
  - Positive vs. negative emotions
  - Distance traveled
- Activities in the customer journey can also be analyzed according to elements such as
  - WHERE and WHEN should I go?
  - WHAT should I do and how?
  - WHO should I ask?
  - WHY is this happening?

Can be done by thinking of median customers

Best done by considering customers with some degree of impairment

An example of value streams maps





Source: www. lean.org

Readings

Foundational Methodology for Data Science. IBM Analytics White paper, 2015

Lu, J., Cairns, L., & Smith, L. (2021). Data science in the business environment: customer analytics case studies in SMEs. **Journal of Modelling in Management**, 16(2):689-613 doi/10.1108/JM2-11-2019-0274

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Osterwalder, A., & Pigneur, Y. (2010). *Business model generation: a handbook for visionaries, game changers, and challengers* (Vol. 1). John Wiley & Sons.

Martin, K. & Osterling, M. (2013) Value stream mapping: how to visualize work and align leadership for organizational transformation. Mc Graw Hill

"10 Easy Steps to Complete a Value Stream Map" Six Sigma DSI Blog https://sixsigmadsi.com/value-stream-map/ (last access, 2022 Oct 13)

Timeline and important deadlines

25/10/2023 - Project work #1: planning the route

24/11/2023 - Project work #2 - Heading out – Discussion and feedback on project works (groups presentation, max 3 groups)

7/12/2023, 3pm – MID-TERM DEADLINE - PROJECT WORK SUBMISSION
(Phase 1: Representing/Modeling the business «AS IS»)

15/12/2023 - Project work #3 - **Prepare for the landing** – In-class discussion and feedback on project works (specific aspects)

22/12/2023 Project work #4 - **Prepare for the landing** – In-class discussion and feedback on project works (specific aspects)

15/01/2023, 3pm – FINAL DEADLINE - PROJECT WORK FINAL SUBMISSION
Phase 1 (Representing/Modeling the business «AS IS») + Phase 2 (Redesigning the business «TO BE»)