Study
"Unmanned Stores"

Executive summary

Relevance and scope

- Many large retailers in the world are currently testing or already have some unmanned stores in operation. In Europe, these are, for example, Albert Heijn, Auchan, Carrefour, various Coops, Edeka, Migros, Valora and Tegut.

- Most concepts have been developed in the last 1–2 years, whereas the pandemic has accelerated the trend to a "contact-avoiding" customer journey.

- According to the Market Research Institute's "Research and Markets", the global unmanned stores market is valued at USD ~67.5 million in 2019, growing by ~52% (CAGR) each year until it reaches USD ~1,640 million by 2027, with currently most of the stores being located in the Asia Pacific region.

- According to YouGov, slightly more than half of Germans (52%) can imagine shopping in an unmanned store.

- Despite the positive forecasts and the projected relevance, many trials are not rolled out slowly (e.g. Amazon Go) or not quite as projected (e.g. Wundermart) or even discontinued (e.g. Irispay, Eat Box or Smartmart).

- Hesitation and failures might be due to little insight on which business models of unmanned stores are most likely to be accepted by consumers.

Executive summary

Definition

- **Unmanned store** are defined as an accessible retail outlet, with no regular staff present, in which consumers have to check in and potentially check out in self-service.

Understanding and boundaries

- Unmanned stores allow an **unmanned customer journey;** the provider journey, including replenishment, is not unmanned.

- Unmanned versus **manned stores** should not be seen as a dichotomy; there is a variety intermediate stages (e.g. self check-out) between these two ends of the spectrum also allowing consumers to gradually adapt.

- The main difference between unmanned stores and **autonomous stores** is the absence of staff in the store.

- The main difference to **(walk-in) vending** is that products are freely accessible to consumers, usually requiring a check-in and check-out process on the part of the consumer to enter/exit the store.

Executive summary

Cluster and types of unmanned stores

- Three differentiated **clusters** emerge from the existing concepts, depending on the location, the provider and the delivery.

- Five **location types** of unmanned stores: 1) traffic hub locations, 2) high footfall locations, 3) community stores, 4) rural food deserts, and 5) seasonal stores.

- Three **provider types** of unmanned stores: 1) retailers launching/operating a new format, 2) technology providers launching/operating a test lab, and 3) hybrids and cooperations.

- Four **delivery clusters** of unmanned stores and related concepts: 1) fully unmanned, 2) unmanned check-in/check-out, 3) click and collect stations, and 4) walk-in vending.

- All presented unmanned store concepts fit into above three clusters, with the **most common** being:

  - community stores (location type),

  - retailers (provider type), and

 - unmanned check-in and check-out (delivery type)

Executive summary

Business models

- Based on existing formats and expert interviews, **seven dimensions of the unmanned store business model** were identified.

- All dimensions have two valences: 1) location (community setting vs anonymous), 2) construction (container vs fixed), 3) access to the store (app vs credit/debit card), 4) provider (retailer vs technology provider in collaboration with a retailer), 5) store size (small vs medium), 6) assortment (grocery vs to go focus), and 7) checkout process (self checkout vs fully automated).

- The **business model favoured by German consumers** is a store in a community setting such as at a university (location), that is in a fixed building (construction), with a slight insignificant preference for accessing the store via a provider app (access to the store), that is operated by either a retailer, or a retailer in collaboration with a technology provider (provider). The store is medium in size (size), preferably offering groceries and daily needs (assortment) and the check-out process is fully automated (check-out).

- The two criteria of **location** and **assortment** are particularly important to German consumers.

Executive summary

- The **trend** towards unmanned stores will be **growing** substantially, not only in Europe, but also in Germany.

- The **change** is going to be **gradual,** which has different dimensions:

  - Gradually, i.e. replacing manned service with technology

  - Gradually, i.e. part-time operating the store unmanned

  - Gradually, i.e. only a section of the store is unmanned

  - Gradually, i.e. enlarging vending to create a store-like environment

  - Gradually, i.e. introducing unmanned pick-up of pre-paid product baskets.

- In this change process, stores should not be seen as "manned" versus "unmanned", but as more or less manned.

- Currently we are in the phase of **competing technologies.**

- **Amazon Go** is further going to try to sell their **just walk-out technology** to other retailers such as to Hudson (US), which could lead to this technology becoming the standard technology and acceleration of acceptance.

Agenda

- **Relevance: Status quo and driving factors**
- Problems: Non-acceptance and failures
- Definition: Fully unmanned: realistic?
- Types of unmanned stores
  - Location types
  - Provider types
  - Delivery types
- Business models of unmanned stores
  - Dimensions of the business model
  - The optimal business model
  - Existing versus optimal business models
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  - Self check-out and misbehaviour and theft
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Relevance: Status quo and predictions

- **Status quo in Europe**: many large retailers are trialling unmanned concepts: e.g. Albert Heijn, Auchan, Carrefour, Coop, Lekkerland NL, Migros and Valora
- **Status quo in Germany**: E24 from Edeka with Deutsche Bahn, Tegut, Micro-Market as a joint venture with Livello (vending provider) and OHA foodservice and Herr Anton, as a trial from a technology provider

- Growth projections from **around the world**:
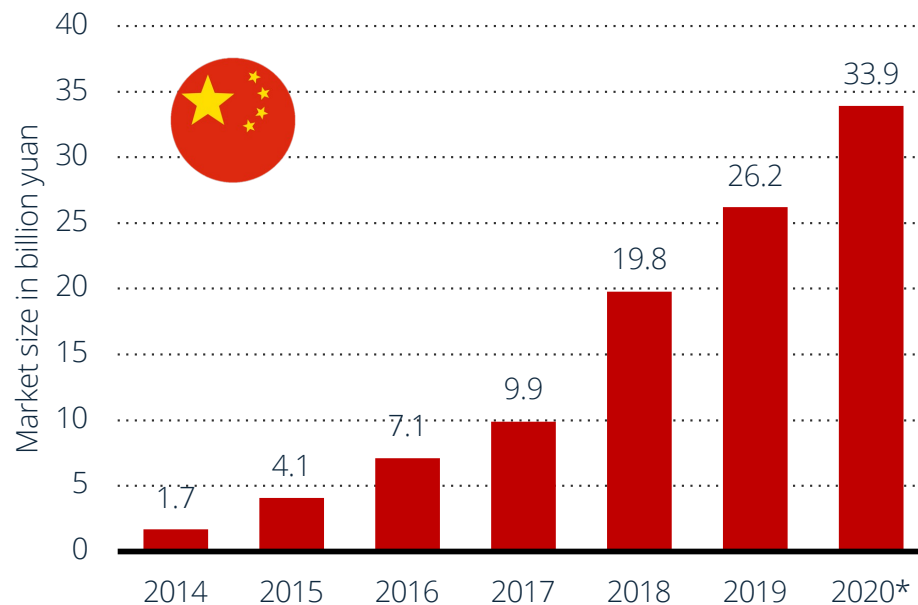
Note(s): China; 2014 to 2019, **source(s):** Forward Intelligence (Qianzhan); Eastmoney.com; Kantar; Statista ID 1149439

USD in million
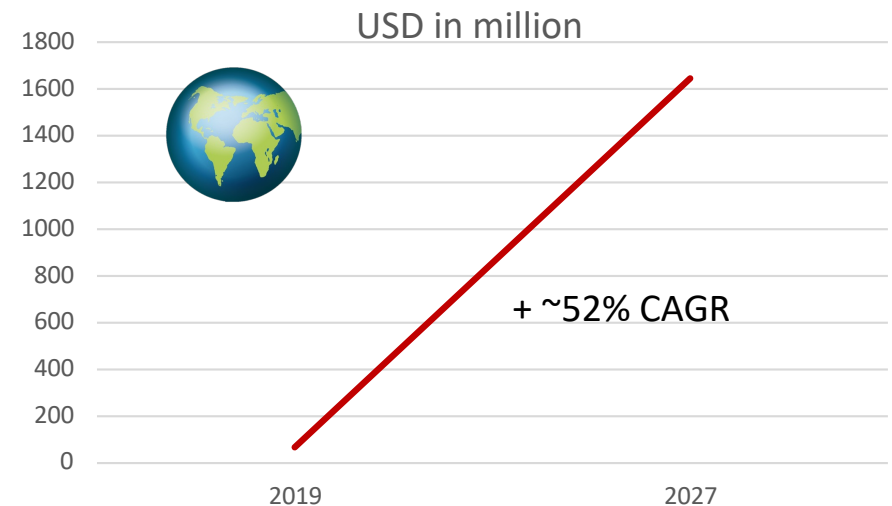
+ ~52% CAGR

According to "Research and Markets", the global unmanned stores market is valued at USD ~67.5 million in 2019 growing by ~52% (CAGR) each year until it reaches USD ~1,640 million by 2027.
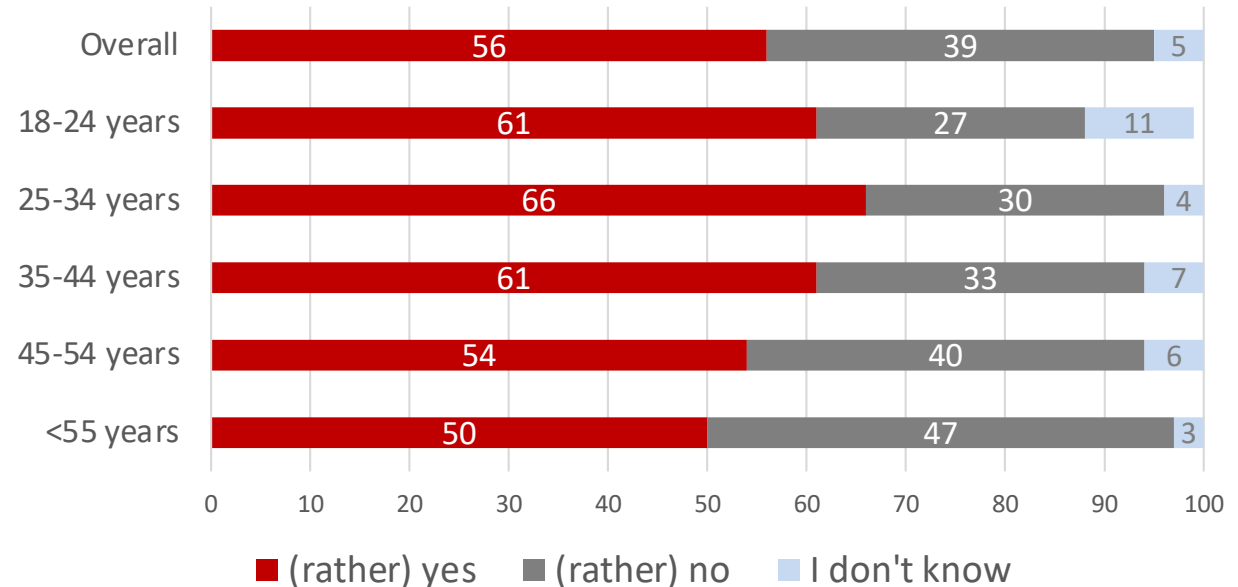
Relevance: Consumer perspective

Acceptance

- Queried directly during a very salient phase of the pandemic (end of 2020), about half of the Germans would consider shopping in unmanned grocery stores.

- Younger Germans have a higher acceptance rate.

- The highest acceptance is in the so-called enterprise phase of life* leading up to the age of 34 years in which multiple demands in life have to be met simultaneously.

Important aspects

- Queried for aspects that are important in the store, most aspects are important for the vast majority of the participants (over 87%).

- Amongst these, freshness, cleanliness and convenience of payment are important for over 95%.

Question: Could you generally imagine shopping in a grocery store without sales personnel?

	(rather) yes	(rather) no	I don't know
Overall	56	39	5
18-24 years	61	27	11
25-34 years	66	30	4
35-44 years	61	33	7
45-54 years	54	40	6
<55 years	50	47	3

■ (rather) yes   ■ (rather) no   ■ I don't know

Priorities for those that can imagine shopping in an unmanned store:
1. Freshness of merchandise (97%)
2. Cleanliness (96%)
3. Convenience payment (95%)
4. Size of assortment (89%)
5. Security and monitoring (87%)

Source: YouGov Deutschland, 2021, n=1136 Germans, queried in Nov/Dec.2020
*Armstrong (2008), The human odyssey, navigating the 12 stages of life.

Relevance: Driving factors

Retailers trialling unmanned stores and consumers choosing them is driven by the following main factors:

- Increasing **consumer expectations** with regard to a frictionless customer journey, opening hours, location, availability and more

- Increasing familiarity and **acceptance of technology** throughout all generations and globally

- The **pandemic** has accelerated technology acceptance and hesitation towards personal interactions

- Increasing difficulty in finding good store staff and high **staff costs,** whilst **technology costs** are (largely) decreasing

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Problem: Failures

- A number of retailers have in the past announced massive **expansion plans** for their unmanned store concepts, and for some these have **not materialised**.
- This might be due to the overall concept failing, or the **business model** in particular.

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Unmanned stores and related retail concepts

e.g. Selecta

e.g. Smart Mart

e.g. Herr Anton

e.g. avec box

Vending
space not accessible & individual product access restricted

Store
space accessible, unrestricted product access

Drive-through vending
store space not accessible, product access restricted

Walk-in vending
space accessible, product access restricted

Unmanned store
no regular staff in store & self check-in and -out

Pick-up lockers
space not accessible & pre-ordered

Staffed store
regular staff in store & no self check-in and –out needed

Autonomous store
regular staff in store & self check-in and check-out

e.g. Cleveron

e.g. Rewe To Go

e.g. Amazon Go

Unmanned stores and related retail concepts

Retail concept / criterion	Space accessible	Product access restricted	Pre-ordering necessary	Check-in necessary (identity)	Automated or self check-out (payment)	Regular staff on site
Vending machines	✗	✓	✗	✗	✓	✗
Walk-in vending	✓	✓	✗	✗	✓	✗
Drive-through vending	✗	✗	✗	✓	✓	✓ ✗
Pick-up lockers	✗	✓	✓	✗	✓	✗
Unmanned store	✓	✗	✗	✓	✓	✗
Autonomous store	✓	✗	✗	✓	✓	✓
Staffed store	✓	✗	✗	✗	✓ ✗	✓

▢ = highlighted areas of differences

Fully unmanned: Realistic?

Customer journey: unmanned

Unmanned

Self-service check-in
e.g. via app, QR code, credit card

No, or remote, in-store services, signage or video

Self-service or fully automated check-out via scan-pay-go, image & face recognition, etc.
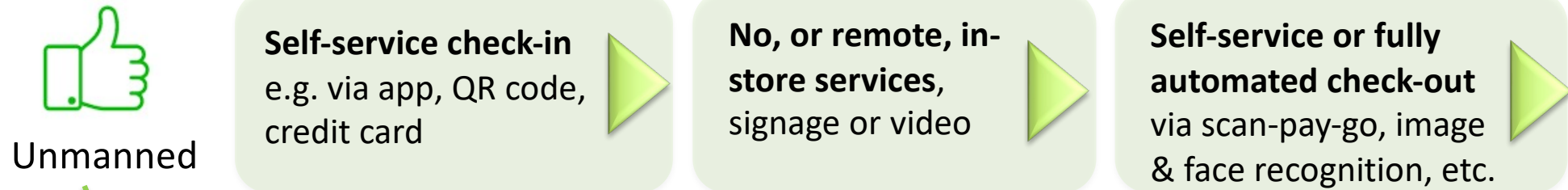
When thinking of an unmanned store, we should be thinking of a store that allows an unmanned customer journey.

Provider journey: no unmanned solution possible, existing

Not unmanned

Replenishment & Mgt. from a nearby **twin store**

Replenishment & Mgt. from **warehouse**

Replenishment & Mgt. from **manufacturers**

and never will be!

Fully unmanned = self check-out?

Unmanned check-in/check-out = Fully unmanned

Expert 13 (German): "… a term often used in German is **staff-less store** or shop without staff. Another term, which says nothing about the concept, is **self-checkout store** or self-service business. That's **not quite right** in my point of view, as this is already being done in combination with normal checkouts."

Expert 13 (German): „For me, unmanned does **not mean** that there's **never anyone there**. They just have a different role. It's primarily merchandising, but there's nobody left to [man the] check out or act as a contact person. That's the crucial difference."

Expert 11 (US): "Amazon Go…it's not autonomous; an autonomous store is something like BingoBox and China AiFi NanoStore…that's autonomous. Now, autonomous stores are going to need someone of course to restock the shelves and what not. But a lot of people are **mixing up stores that use this technology [self check-out]** with the concept of an **autonomous store**, and those are **two very different things**."

Unmanned = no staff? no customer service?

Fully
unmanned

? =

No
service
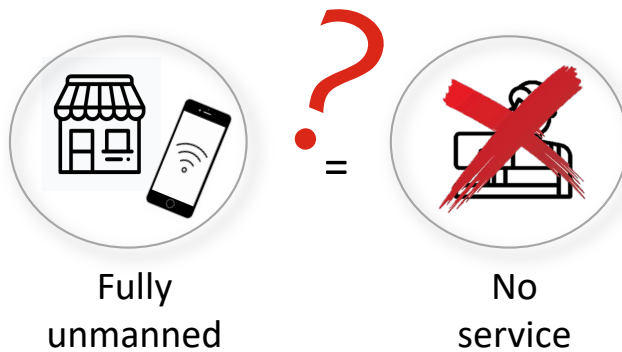
Expert 11 (US): "… I remember when **Amazon Go** started launching their stores…[a] retail guru who was lamenting the demise of customer service and saying Amazon Go represents a **soulless future,** and I had to kind of take a step back and wonder…it's clear you've never been there because Amazon Go is **full of employees**. In fact, they have some of the best customer service I've ever encountered in that type of a small format retail store.

But a lot of people make the mistake of thinking that just because you've eliminated the cash register, you don't need employees, and I think this comes back to a really old-fashioned, out of date concept of customer service. **No, the cash register is not where customer service happens.** The cash register is literally just getting a person out of the store, customer service doesn't happen when you're ready to leave…

…this technology [self check-out] doesn't exist solely to get rid of people. And, in fact, I would argue in many cases, it's not going to get rid of anybody. A lot of the reason why convenience stores especially have dirty restrooms or have dirty forecourts is because people are stuck behind a cash register and they don't have time to go clean the store. Smart retailers will just get rid of the cash register and **redeploy people to do customer service**, food service, cleaning, stocking the shelves, you know, the things that aren't getting done right now."

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Different clusters of unmanned stores

Location clusters

Traffic hub locations

High footfall locations

Community stores

Rural food deserts
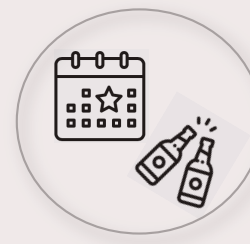
Seasonal stores

Provider clusters

New format for retailer
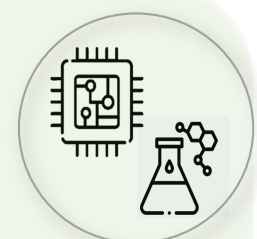
Test lab for tech provider

Hybrids & Cooperations

Delivery clusters

Fully unmanned

Unmanned check-in/-out

Click and collect stations

Walk in vending
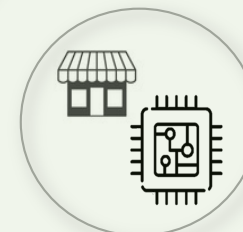
Different location types

Traffic hub locations	High footfall locations	Community stores	Rural food deserts	Seasonal stores

valora · ah

CLEVERON

NESTE

amazon go

★ PRET ★

wundermart

quick eats

Cheers

coop

HERR Anton

Local farmers & nordic id

coop
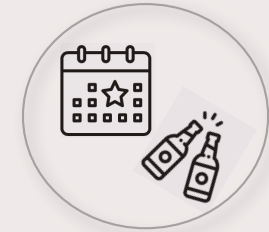
Example: Traffic hub location

"Albert Heijn Digital Store"
Ahold Delhaize launched an unmanned container-style store with AiFi at Schiphol Airport

Launch:
2019

Types	Location	Provider	Delivery

Location — Traffic hub locations

Provider — New format for retailer

Delivery — Fully unmanned

Retail Mix

Provider: Albert Heijn, Ahold Delhaize
Size & build: small container (14m2) using AiFi technology, semi-fixed
Location: Amsterdam Airport, Netherlands
Target group: not specified
Products: classical C-store assortment
Access to store: credit or debit card
Access to products: free
Checkout: automated, via image recognition, basket can be checked
Replenishment: unclear
Expansion plans: not clear, trial phase

Example: Traffic hub location

"AvecBox"
Launched by Swiss retailer Valora in 2019. Two of these container-style stores now open

Launch:
2019

Types

Location

Traffic hub locations

Community stores

Provider

New format for retailer

Delivery

Fully unmanned

Retail Mix

Provider: Valora
Size & build: container size, semi-fixed partly using AiFi technology
Location: 1st store at train station, was moved to University
Target group: not specified
Products: classical C-store assortment
Access to store: via app
Access to products: free
Checkout: self check-out and mobile payment
Replenishment: unclear
Expansion plans: unclear

Example: Traffic hub location

"Neste Easy Deli"
Neste launched a container-sized store in 2020, 2 are now in operation

Launch: 2020

Types

Location

Traffic hub locations
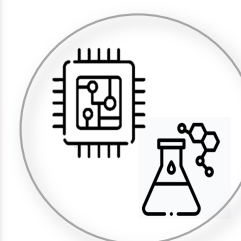
Provider

Test lab for tech provider

Delivery

Fully unmanned

Retail Mix

Provider: Neste, Finnish company providing sustainable solutions, amongst them energy
Size and build: container size, semi-fixed
Location: Finland, partly near gas stations, also providing robotic refuelling
Target group: gas station customers
Products: C-store assortment
Access to store: via app
Access to products: free
Checkout: RFID based self checkout of entire basket, payment via app with exit linked to payment
Replenishment: unclear
Expansion plans: currently 2 stores, more stores opening in petrol stations this year

Example: Traffic hub location

"Coop Norway"
Coop launched a pilot in 2019 which is unmanned from 23:00 to 07:00

Launch: **2019**

Types

Location — Traffic hub locations

Provider — New format for retailer

Delivery — Fully unmanned

Retail Mix

Provider: Coop Norway
Size & build: fixed location & normal store during daytime, unmanned option overnight
Location: Oslo, Norway
Target group: not specified
Products: full supermarket assortment
Access to store: via app
Access to products: free
Checkout: self-service checkout
Replenishment: during the day when the store is staffed
Expansion plans: unclear

Example: High footfall location

"JD.ID X-Mart"
JD launched an unmanned store powered by facial recognition in China

Launch: 2017

Types

Location

High footfall locations

Provider

New format for retailer

Delivery

Fully unmanned

Retail Mix

Provider: JD, large Chinese e-commerce retailer (Fortune 500)
Size and build: larger, first fixed store was 270m2
Location: China
Target group: not specified
Products: C-store assortment, larger focus on non-food compared to other unmanned stores, given the size
Access to store: via app and facial recognition
Access to products: free, but products are equipped with RFID chips
Checkout: automated via facial recognition
Replenishment: unclear, integrated in JD supply chain
Expansion plans: 20 stores as of 2018

Example: High footfall location

"BingoBox"
Launched in 2017, over 500 of these container stores are now open across Asia

Launch:
2017

Types

Location

High footfall locations
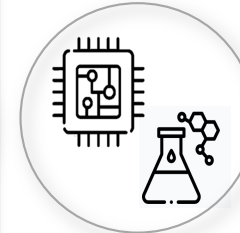
Provider

Test lab for tech provider

Delivery

Fully unmanned

Retail Mix

Provider: Bingo Fresh & Sun Art Retail Group

Size & build: two sizes 12.5m2 or 15.6m2, semi-fixed

Location: 500 mostly Asia and Australia

Target group: in China not specified, first trials of the European version for employees

Products: classical C-store assortment (around 500 to 800 SKUs)

Access to store: via app & facial recognition

Access to products: free

Checkout: via terminal and product scanning & facial recognition linked to payment on exit

Replenishment: unclear, but claimed in 2017 cuts of 80% of operating cost, more recently 15% less operating costs

Expansion plans: announced massive expansion (doubtful)

Example: Community store

"Teo"
First store near Tegut Headquarters, positioned with sustainable material

Launch: 2020

Types

Retail Mix

Location

Community stores

Provider

New format for retailer

Delivery

Fully unmanned

Provider: Tegut

Size & build: 50m^2, train wagon optic with green roof and wood fixtures, semi-fixed

Location: Fulda, Germany at Tegut Headquarters

Target group: employees

Products: grocery and fresh assortment (approximately 950)

Access to store: via app and QR code or credit/debit card

Access to products: free

Checkout: self-scanning, payment via debit/credit card

Replenishment: daily, through dedicated employees

Expansion plans: 10 Teos until the end of 2021, mid term more than 300 in Germany

Example: Community store

"Shop Box" from Lidl

Pilot store at the Lidl Headquarters on the campus of the local Lidl-sponsored university in Heilbronn

Launch: 2021

Types

Retail Mix

Location	Provider	Delivery
Community stores	New format for retailer	Fully unmanned

Provider: Lidl in cooperation with UST (AI provider) and Cloudpick

Size & build: semi-fixed, in combination with a click and collect station

Location: Heilbronn, Germany at Lidl-supported university

Target group: employees & students

Products: grocery and fresh assortment (currently 250-300)

Access to store: via app

Access to products: free

Checkout: fully automated payment by app

Replenishment: unclear (for Collect Box within 12 hours via nearby warehouse)

Expansion plans: unclear
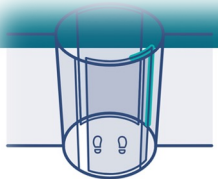
Example: Community store

"Cheers"
Launched by the retailer Cheers in Singapore in 2017 in a university campus

Launch: **2017**

Types

Location

Community stores

Provider

New format for retailer

Delivery

Fully unmanned

Retail Mix

Provider: Cheers local retailer in Singapore
Size & build: 40-60m2
Location: Singapore
Target group: located on a large university campus outside of city centre
Products: classical C-store assortment, partly with Asian hot food solutions & pizza
Access to store: via app
Access to products: free
Checkout: self-checkout via terminals
Opening hours: restricted 7.30am–7.30pm
Replenishment: auto-ordering, replenishment every morning before opening, run by the students
Expansion plans: unclear

Example: Community store

"QuickEats"

Launched in 2020 by tech company AWM in the lobby of a residential building

Launch: 2020

Types

Location

Community stores
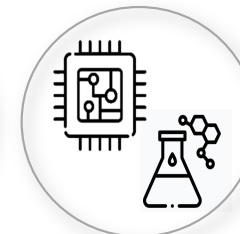
Provider

Test lab for tech provider

Delivery

Fully unmanned

Retail Mix

Provider: Aramark in cooperation with AWM Smart Shelves
Size and build: 10m2, fixed
Location: in large building complex in Santa Ana, California, US
Target group: residents of the building / block
Products: C-store assortment
Access to store: via app
Access to products: free
Opening hours: restricted to 7am to 10pm
Checkout: automated (via product detection)
Replenishment: unclear
Expansion plans: not clear

Example: Rural food deserts

"Coop Sweden"

Pilot phase of unmanned store in Gavle, 2 to be opened in autumn. Coupled with a click & collect solution

Launch: 2020

Types

Location

Rural food deserts

Provider

New format for retailer

Delivery

Fully unmanned

Click and collect stations

Retail Mix

Provider: Coop Sweden
Size: 30m2 depending on location in combination with pickup
Location: Gavle, Sweden
Target group: not specified
Products: supermarket assortment
Access to store: via app and QR code
Access to products: free
Checkout: self-service checkout, exit restricted linked to payment
Price level: normal
Replenishment: unclear
Expansion plans: have announced major investment in unmanned stores

Example: Rural food deserts

"Lifvs"

Currently 19 unmanned, digital supermarkets across Sweden, easily movable, if needed.

Launch: 2020

LIFVS
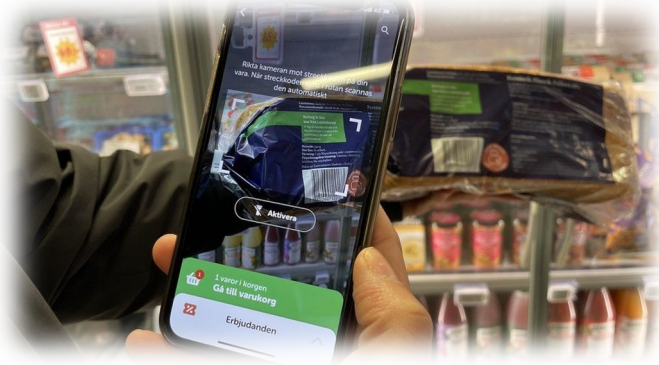
Types

Location

Rural food deserts

Provider

New format for retailer

Delivery

Fully unmanned

Retail Mix

Provider: Lifvs (start up from Sweden)
Size: 22m2
Location: across Sweden
Target group: rural population in villages
Products: supermarket assortment
Access to store: via bank card and provider app
Access to products: free
Checkout: self-service checkout
Price level: unknown
Replenishment: one store manager replenishes and manages four stores
Expansion plans: hundreds more over the next few years

Example: Rural food deserts

"Lähiapaja shop"
Container-type store run by local farmers in rural Finland

Launch: 2019

Types

Retail Mix

Location

Rural food deserts
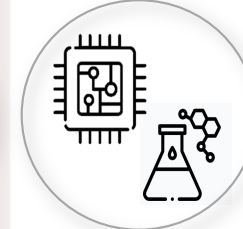
Provider

Test lab for tech provider

Delivery

Click and collect stations

Provider: local farmers in cooperation with Nordic ID (tech provider)
Size and build: container size, semi-fixed
Location: Finland
Target group: not specified, impulse and click & collect customers
Products: local artisan products and C-store assortment
Access to store: via app and code
Access to products: free
Checkout: self service terminal
Replenishment: unclear, likely by local farmers and retailer, depending on products
Expansion plans: unclear

Expert voices to clusters

Traffic hub locations

Expert 18 (US): "**Train station is a perfect place** for unmanned stores because you're in a hurry and you feel like you're in control, and the type of goods that they sell, especially with convenient foods and those types of things, ideal for those types of locations."

Expert 11 (US): "Or you have, you know, pop it up in a **train station** in a mall or something."

Rural food deserts

Expert 9 (Europe): "…it's these kinds of stores when you put them inside a neighbourhood, it's also the **store of the neighbourhood**. So, the people who live there. Many of them are going to be very dedicated to want to say okay, but we would like to buy this, also could you change the assortment that you haven't got in the store. But I think also that **they're going to care about this store** a bit more than if you just put it in the centre of the square somewhere in the big city."
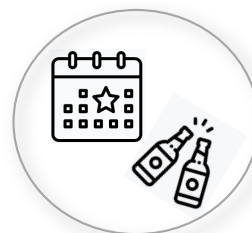
Seasonal stores

Expert 11 (US): "Let's say you had the **music festival**. You could pop up a shipping container full of convenience items and have someone just restock it every couple of hours or whatever."

Expert 9 (Europe): "On what time period they consider moving the store to a certain location: … [with the] wheel of the year that you could move it four times and still have a... so, like a week maybe from take down then it's rebuilt on another location."

Community stores

Expert 18 (US) asked about **ideal locations**: "To me, **universities**...to me, actually putting those types of store in places where people live, with the right profile of the population, has a tremendous advantage."

Expert 11 (US): "What they've done is they've dropped basically a **walk-in pantry** and cooler right there in the **apartment complex**. Scan your phone, walk in, grab and leave. It's so convenient. So those kinds of in-between places, whether it's an office lobby, an apartment complex, a really large gym, maybe even a train station or an airport. This kind of technology, it's just waiting to be deployed there. I mean it would really add a ton of convenience to people's lives."

Expert 11 (US): "I've talked to folks who work in some office buildings that have **Amazon Go in the bottom**. This is what he told me, he said he's just watched everybody adjust to it after it was added, and it started off being a novelty. But **over time they just treat it like a refrigerator**, they're in and out in like 30 seconds. They walk in, grab that one thing, leave and go back to the elevator. So, they just treat it like a refrigerator. It's just insanely convenient."

Different provider clusters

Provider clusters

New format for retailer
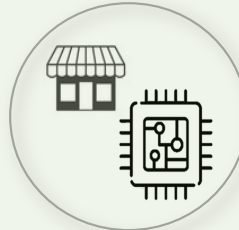
Hybrids & Cooperations
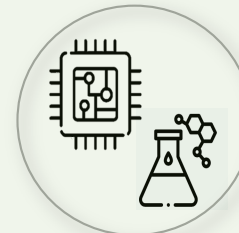
Test lab for tech provider

Local farmers & nordic id

Carrefour & Zaitt

amazon go

coop & CLEVERON

NESTE

AIFI

HERR Anton

quick eats

SmartMart

wundermart

Discontinued

wirecard   IRISPAY

Examples: New channel for retailer

7-Eleven Cashierless Store

"7-Eleven Cashierless Store"
Trialing an unmanned store in Texas, with checkout completely automated
Launch: 2020

Concept cluster

Location — Community stores
Provider — New format for retailer
Delivery — Fully unmanned

Retail Mix

Provider: 7-Eleven
Size & built: 65m2, fixed store
Location: Texas, US
Target group: employees only and premium customers (identified through (loyalty programme)
Products: Classical C-Store assortment
Access to store: via app
Access to products: free
Checkout: Automated
Replenishment: unclear
Expansion plans: yes, but unclear when an how

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Auchan Minute

"Auchan Minute"
Container sized unmanned store launched by Auchan in China in 2017 and then in France in 2019.
Launch: 2017

Concept cluster

Location — High footfall locations
Provider — New format for retailer
Delivery — Fully unmanned

Retail Mix

Provider: Auchan
Size & built: 18m2, semi-fixed (use Bingo Box technology)
Location: 1st store in China, as of 2020 also in France
Target group: in China not specified, first trials of the European version for employees,
Products: Classical C-Store assortment
Access to store: Via app (different in France)
Access to products: free
Checkout: Self checkout and mobile payment
Price level: about 20-30% lower than other co-stores (China)
Replenishment: unclear
Expansion plans: currently 750 stores across the China, expansion plans unclear

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AvecBox

"AvecBox"
Launched by a Swiss retailer Valora in 2019. 2 of these container-style stores now open.
Launch: 2019

Concept cluster

Location — Traffic hub locations / Community stores
Provider — New format for retailer
Delivery — Fully unmanned

Retail Mix

Provider: Valora
Size & built: container size, semi-fixed (use Aifi technology)
Location: 1st store at train station, was moved to University
Target group: not specified
Products: Classical C-Store assortment
Access to store: Via app
Access to products: free
Checkout: Self checkout and mobile payment
Replenishment: unclear
Expansion plans: unclear

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Albert Heijn Digital Store

"Albert Heijn Digital Store"
Ahold Delhaize launched an unmanned container-style store with Aifi at Schiphol airport
Launch: 2019

Concept cluster

Location — Traffic hub locations
Provider — New format for retailer
Delivery — Fully unmanned

Retail Mix

Provider: Albert Heijn, Ahold Delhaize
Size & built: small container (14m2), semi fixed
Location: Amsterdam Airport, Netherlands
Target group: not specified
Products: Classical C-Store assortment
Access to store: credit or debit card
Access to products: free
Checkout: Automated, via image recognition, basket can be checked
Replenishment: unclear
Expansion plans: not clear, trial phase

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Provider

New format for retailer

Carrefour Express

"Carrefour Express"
Launched by Carrefour as a walk-in vending machine. Original store now closed, now operational in Poland.
Launch: 2019

Concept cluster

Location — Traffic hub locations
Provider — New format for retailer
Delivery — Walk in vending / Click and collect stations

Retail Mix

Provider: Carrefour
Size & built: different trials container size up to 60m2, semi-fixed
Location: Brussels, Belgium
Target group: not specified
Products: Classical C-Store assortment, partly combined with click & collect
Access to store: free
Access to products: restricted, partly via screen or vending solution
Checkout: via vending machine
Replenishment: unclear
Expansion plans: unclear

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Amazon Go

"Amazon Go"
Launched by Amazon in 2016 featuring Just Walk Out technology with 26 of these stores now open
Launch: 2016

Concept cluster

Location — High footfall locations
Provider — New format for retailer
Delivery — Unmanned check-in/-o / Fully unmanned

Retail Mix

Provider: Amazon
Size & built: first 167m2, but have expanded to full supermarket size (1000m2)
Location: US,
Target group: first trials with employees, by now not specified
Products: Classical C-Store assortment
Access to store: Via app
Access to products: free
Service component: Special focus on service so usually many service people in the store
Checkout: Automated, via image recognition, basket can be checked
Replenishment: people in store at all times for replenishment and service purposes
Expansion plans: currently 26 locations, with expansion of 2000 stores across the US

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Pick me 24/7

"Pick me 24/7"
Migrolino launched a container type store next to a Tesla Supercharger Station
Launch: 2019

Concept cluster

Location — Traffic hub locations
Provider — New format for retailer
Delivery — Click and collect stations

Retail Mix

Provider: Migros
Size and built: container size, semi-fixed
Location: Dietikon (outskirts of Zürich), Switzerland, adjacent to a Tesla Supercharger station
Target group: Tesla drivers and beyond
Products: C-Store assortment and to-go items (430 SKUs)
Price level: similar to Migrolino
Access to store: no access
Access to products & checkout: vending solution
Replenishment: unclear, integrated in Migros supply chain
Expansion plans: unclear

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Coop Sweden

"Coop Sweden"
Pilot phase of unmanned store in Gavle, 2 to be opened autumn. Coupled with a click & collect solution
Launch: 2020

Concept cluster

Location — Rural food deserts
Provider — New format for retailer
Delivery — Fully unmanned / Click and collect stations

Retail Mix

Provider: Coop Sweden
Size: 30m2 depending on location in combination with pickup
Location: Gavle Sweden,
Target group: not specified
Products: supermarket assortment
Access to store: via app and QR code
Access to products: free
Checkout: self service checkout, exit restricted linked to payment
Price level: normal
Replenishment: unclear
Expansion plans: have announced major investment in unmanned stores

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Example: Hybrid & cooperation

"E24/7"

In cooperation with Deutsche Bahn at a train station

Launch: 2021

Types

Retail Mix

Location

Traffic hub locations
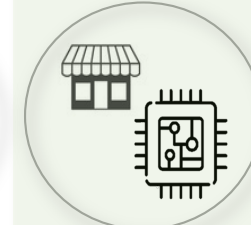
Provider

Hybrid & Cooperation

Delivery

Fully unmanned

Provider: Edeka in cooperation with Deutsche Bahn and Smark (tech provider)

Size & build: 60m2, containers, semi-fixed

Location: Renningen, Germany at train station

Target group: travellers and community

Products: C-store assortment (approximately 300 SKUs with planned 500)

Access to store: via app and QR code

Access to products: partly restricted, access through touchscreens, partly free accessible via self-service

Checkout: via debit/credit card or app, delivery after payment

Replenishment: via robots in the back of the store

Expansion plans: unclear

Specialty: combined with manned bakery next door

Example: Hybrid & cooperation

"EasyGo"
Container-style unmanned store launched as a startup.

Launch: 2017

Types

Location

Traffic hub locations

High footfall locations
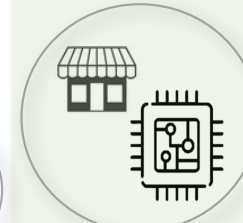
Provider

Hybrid & Cooperation

Delivery

Fully unmanned

Retail Mix

Provider: Four Seas Group, Caterer and Retailer from Hong Kong

Size & build: container size, semi-fixed

Location: China

Target group: not specified

Products: C-store assortment

Access to store: via app and QR code and facial recognition

Access to products: free, but equipped with RFID chips

Checkout: RFID detection of basket, payment through WeChat Wallet, exit restricted linked to payment

Replenishment: unclear

Expansion plans: unlikely, few new since 2018

Example: Hybrid & cooperation

"Livello Markt, Smart Store, Micro-Markt"
In cooperation with OHA regional food provider

Launch: 2021

Types

Location
Community stores
High footfall locations
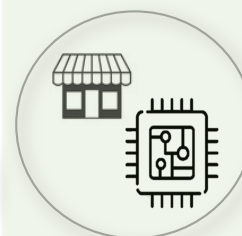
Provider
Hybrid & Cooperation

Delivery
Fully unmanned

Retail Mix

Provider: Livello
Size & build: 18m2, semi-fixed
Location: Immenstadt, Germany
Target group: not specified
Products: C-store assortment and regional food to go products (approximately 300 SKUs)
Access to store: via app
Access to products: freely accessible
Checkout: fully automatic through automatic detection of products
Replenishment: unclear
Expansion plans: unclear

Example: Test lab for tech provider

"AiFi NanoStore"
Concept unmanned container-style store to be opened in the US.

Launch: concept store

Types

Location
Traffic hub locations
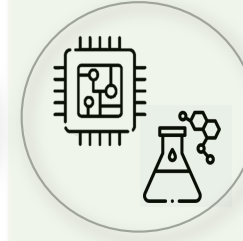
Provider
Test lab for tech provider

Delivery
Fully unmanned

Retail Mix

Provider: AiFi, artificial intelligence company

Size & build: various, from small container size to larger sizes

Location: concept store in the US, but partnered with various retailers such as Albert Heijn, Carrefour, Valora, Loop

Loop forecourt store: 1,500 SKUs on 140m2 (1,500sft) adjacent to a Shell Station

Products: classical C-store assortment or customised to retail partners' preferences

Replenishment: unclear, dependent on retailer

Expansion plans: 330 by 2021

Example: Test lab for tech provider

"Zaitt"
This startup retailer launched this unmanned store in partnership with Carrefour in São Paulo

Launch: 2019

Types	Location	Provider	Delivery
	High footfall locations	Test lab for tech provider	Fully unmanned
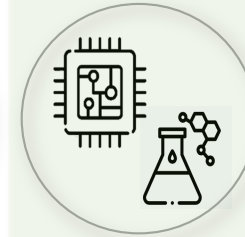
Retail Mix

Provider: Zaitt in cooperation with Carrefour
Size and build: small supermarket, fixed
Location: Vitória and São Paulo, Brazil
Target group: not specified
Products: C-store assortment
Access to store: facial recognition, app
Access to products: free
Checkout: first store operated scan pay go, second store with facial recognition and RFID tagged products and exit is linked to payment
Replenishment: industry and retail suppliers are in charge, integrated in Carrefour supply chain
Expansion plans: not clear

Different delivery clusters

Delivery clusters

Fully unmanned	Unmanned check-in/-out	Click and collect stations	Walk in vending

Auchan · ah · valora · JD.COM · SmartMart · wundermart · quick eats · 7-ELEVEN

Most others

amazon go · PRET

co-op

HERR Anton

Example: Fully unmanned

"7-Eleven Signature Store"
Launch: 2017

Launched in 2017, 3 now in operation, automated store powered by "Handpay"

Types

Location
Community stores

High footfall locations

Provider
New format for retailer

Delivery
Fully unmanned

Retail Mix

Provider: 7-Eleven
Size & build: C-store size, fixed
Location: Seoul, South Korea
Target group: first only for employees, now open to everyone
Products: classical C-store assortment
Access to store: Handpay (later discontinued)
Access to products: free
Checkout: automated
Replenishment: unclear
Expansion plans: 3 stores as of 2020, expansion unknown, opened one on high-street in response to COVID, but (it seems) without Handpay

Example: Fully unmanned

"7-Eleven X Store"
Launched in Taiwan in 2018 by 7-Eleven, 2 of these stores now running

Launch: 2018

Concept cluster	Location	Provider	Delivery

Community stores

High footfall locations

New format for retailer

Fully unmanned

Retail Mix

Provider: initially owned by a local retailer President Chain Store Corporation, bought by 7-Eleven

Size & build: 26m2, fixed store

Location: Taipei, Taiwan

Target group: first employees only at headquarters, later not targeted

Products: classical C-store assortment

Access to store: facial recognition

Access to products: free

Zones: store operates two zones with human service during the day and a fully unmanned restricted area for overnight

Checkout: fully automated

Replenishment: night staff for replenishment

Expansion plans: unclear

Example: Fully unmanned

"7-Eleven Cashierless Store"

Launch: 2020

Trialling an unmanned store in Texas, with checkout completely automated

Types

Location

Community stores

Provider

New format for retailer

Delivery

Fully unmanned

Retail Mix

Provider: 7-Eleven
Size & build : 65m2, fixed store
Location: Texas, US
Target group: employees only and premium customers (identified through (loyalty programme)
Products: classical C-store assortment
Access to store: via app
Access to products: free
Checkout: fully automated
Replenishment: unclear
Expansion plans: yes, but unclear when and how

Example: Fully unmanned

"Wundermart"
Launched in 2016, now 30 retail stores in operation across Europe

Launch: 2016

Types	Location	Provider	Delivery
	Community stores	Test lab for tech provider	Fully unmanned
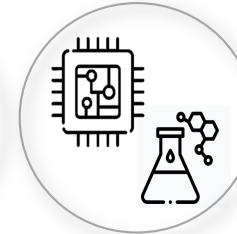
Retail Mix

Provider: Positioned as technology provider, not as retailer, party operated by independent retailers
Size & build: various, fixed
Location: Netherlands
Target group: not specified
Products: usually C-store assortment
Access to store: not restricted
Access to products: free
Checkout: self-checkout via scan pay go,
Replenishment: unclear, suppliers on their platform
Expansion plans: aiming for 1,000 stores by 2022

Example: Fully unmanned

"Zaitt"
This startup retailer launched this unmanned store in partnership with Carrefour in São Paulo

Launch: 2019

Types

Location

High footfall locations
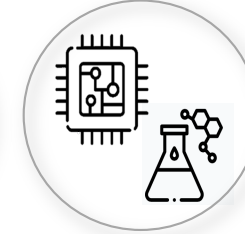
Provider

Test lab for tech provider

Delivery

Fully unmanned

Retail Mix

Provider: Zaitt in cooperation with Carrefour
Size & build: small supermarket, fixed
Location: Vitória and São Paulo, Brazil
Target group: not specified
Products: C-store assortment
Access to store: facial recognition, app
Access to products: free
Checkout: first store operated scan pay go, second store with facial recognition and RFID tagged products and exit is linked to payment
Replenishment: industry and retail suppliers are in charge, integrated in Carrefour supply chain
Expansion plans: not clear

Example: Unmanned check-in/-out

"Amazon Go"
Launched by Amazon in 2016 featuring Just Walk Out technology with 26 of these stores now open

Launch: **2016**

Types

Location

High footfall locations

Provider

New format for retailer

Delivery

Unmanned check-in/-out

Fully unmanned

Retail Mix

Provider: Amazon

Size & build: first 167m2, but have expanded to full supermarket size (1,000m2)

Location: various in the US, focus on Seattle

Target group: first trials with employees, by now not specified

Products: classical C-store assortment

Access to store: via app

Access to products: free

Service component: special focus on service so usually many service people in the store

Checkout: automated, via image recognition, basket can be checked

Replenishment: people in store at all times for replenishment and service purposes

Expansion plans: currently 26 locations, with expansion of 2,000 stores across the US

Example: Unmanned check-in/-out

"Pret A Manger"
Pret are trialling an unmanned feature within a regular store

Launch: 2019

Types	Location	Provider	Delivery
	High footfall locations	New format for retailer	Unmanned check-in/-out

Retail Mix

Provider: Pret a Manger
Size & build: fixed food service outlet
Location: London
Target group: not specified
Products: foodservice assortment and freshly prepared coffee (with human barista)
Access to store: free
Access to products: free, except for the barista coffee that needs to be ordered
Checkout: self-checkout
Replenishment: unclear
Expansion plans: not clear

Example: Click and collect

"Cleveron 501"

Launched by Cleveron, a locker-type click and collect solution. Currently still in the test phase

Launch: 2020

Types

Location

Community stores

Provider

New format for retailer

Delivery

Click and collect stations

Retail Mix

Provider: Coop Estland (using the technology of Cleveron)

Size & build: container size, semi-fixed

Location: Tallin, Estland

Target group: commuters driving out of town

Products: full assortment due to click & collect

Access to store: no access

Access to products: mobile phone code for locker

Checkout: no checkout, prepaid

Replenishment: integrated into Coop delivery fleet

Expansion plans: unclear, but likely yes to replace home deliveries

Example: Click and collect

"Pick me 24/7"

Migrolino launched a container-type store next to a Tesla Supercharger Station

Launch: 2019

Types	Location	Provider	**Delivery**
	Traffic hub locations	New format for retailer	**Click and collect stations**
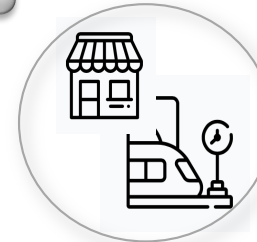
Retail Mix

Provider: Migros
Size & build: container size, semi-fixed
Location: Dietikon (outskirts of Zürich), Switzerland, adjacent to a Tesla Supercharger station
Target group: Tesla drivers and beyond
Products: C-store assortment and to-go items (430 SKUs)
Price level: similar to Migrolino
Access to store: no access
Access to products & checkout: vending solution
Replenishment: unclear, integrated in Migros supply chain
Expansion plans: unclear

Example: Walk-in vending & click and collect

"Carrefour Express"
Launched by Carrefour as a walk-in vending machine. Original store now closed, now operational in Poland.

Launch: 2019

Types

Location

Traffic hub locations

Provider

New format for retailer

Delivery

Walk in vending

Click and collect stations

Retail Mix

Provider: Carrefour

Size & build: different trials container size up to 60m2, semi-fixed

Location: Brussels, Belgium, later Poland next to a click and collect station

Target group: not specified

Products: classical C-store assortment, partly combined with click & collect

Access to store: free

Access to products: restricted, partly via screen or vending solution

Checkout: via vending machine

Replenishment: unclear

Expansion plans: unclear

Example: Walk-in vending

"Herr Anton"
Launched in 2020 by a German technology company producing vending machines

Launch: 2020

Types

Location

Rural food deserts
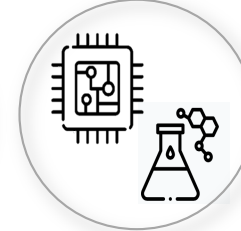
Provider

Test lab for tech provider

Delivery

Walk in vending

Retail Mix

Provider: German manufacturer of vending machines

Size & build: semi-fixed and (small) container size (approx. 15m2)

Location: North Germany rural area

Access to store: free

Access to products: restricted

Products: for unmanned store, mostly brands, for vending mostly from local suppliers and farmers

Replenishment: partly done by suppliers themselves

Expansion plans: Four more stores announced in 2020

Example: Drive-through vending

"SmartMart"

Fully automated drive-through vending solution launched by SmartMart in 2017

Launch: 2017
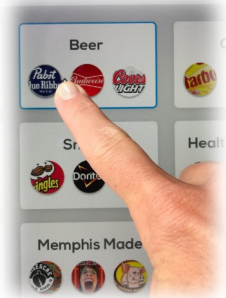
Types	Location	Provider	Delivery
	Traffic hub locations	New format for retailer	Drive in vending

Retail Mix

Provider: Smart Mart
Size & build: fixed, drive-through solution
Location: US
Target group: not specified
Products: supermarket assortment (2,800 SKUs)
Access to store: no access needed, drive-by ordering and delivery solution
Access to products: via screen
Checkout: prepayment via credit card
Replenishment: unclear
Claims: to reduce overhead by 70% and increases returns by factor 2.5 (not updated since 2013)
Expansion plans: not clear, press releases not updated since 2017

Agenda

- **Relevance: Status quo and driving factors**
- Problems: Non-acceptance and failures
- Definition: Fully unmanned: Realistic?
- Types of unmanned stores
  - Location types
  - Provider types
  - Delivery types
- **Business models of unmanned stores**
  - Dimensions of the business model
  - The optimal business model
  - Existing versus optimal business models
- Operational aspects
  - Target groups
  - Cost considerations & rollout
  - Self checkout & misbehaviour and theft
  - Product visibility
  - Store access
- Prediction of future development
- Appendix

Overview: Research approach

Given the variety of options for unmanned stores, the overall goal is:

1) To get a sense of the **overall perception**
2) To identify the **optimal business model** for the German market and identify potential **barriers** and **driving factors** of acceptance of German customers

Step 1: **Overall perception** of the unmanned stores

Step 2a: Identify the **relevant dimensions** of the unmanned store **business model** and their valence
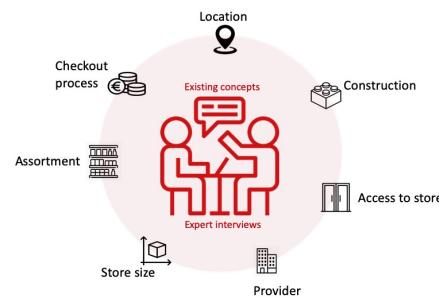
Step 2b: **Test** which valence of the dimensions has the **highest acceptance** by German consumers

- Across all different business models of unmanned stores, the majority of participants in Germany were either indifferent or positive towards unamend stores
- Across all categories, more participants evaluated having a good experience than participants saying they would patronise the store

Percentage of evaluations

Projected experience: (rather) negative: 22%
Projected store patronage: (rather) not: 34%

Projected experience: indifferent: 38%
Projected store patronage: (rather) yes: 32%

Projected experience: (rather) positive: 38%
Projected store patronage: (rather) yes: 34%

Experience: Extremely bad
Patronage: Under no circumstances

Experience: Extremely good
Patronage: In any event

■ Experience ■ Patronage

Sample: based on 2990 evaluations, see method section

COMPETENCE CENTER
for on-the-go Consumption

Positive perception of unmanned stores

- Technology openness and curiosity

- Acceptance conditional to similar prices and assortments

- Perceived as more convenient generally

- No personal contact needed, in particular during the pandemic

Negative perception of unmanned stores

- Personal interaction with staff in manned stores is appreciated

- Lack of control in exceptional situations (e.g. technical difficulty)

- Importance of data protection, fear of data usage violation of privacy, uneasiness of video observation

- Fear that technology will lead to job losses

- Product quality might be compromised

- Store might not be secure

From reviewing **existing concepts** and conducting **expert interviews, seven** relevant **dimensions** of unmanned store business models were identified

Location

Checkout process

Construction

Existing concepts

Assortment

Access to store

Expert interviews

Store size

Provider

Location as dimension of the business model: **Experts**

Location

Option A: Community type stores, in rural areas, offices, apartment complexes or universities.

Option B: Anonymous environments at high frequency traffic hubs like train stations or airports.

Exemplary quotes from the expert interviews:

- "Technology, staff and rental costs. This business case is worthwhile in mini-supermarkets in **rural regions."** *(Expert 1, German)*
- "Especially in **rural areas**... we absolutely need new ideas and concepts." *(Expert 10, German)*
- "They're going to see that the **smaller towns** are a better placement for unmanned stores than in the big cities." *(Expert 8, Europe)*
- "You put them inside a neighbourhood it's also the store of the neighbourhood." *(Expert 9, Europe)*
- "High traffic, talk about universities for instance." *(Expert 7, Europe/Asia)*
- [best location] ... "the whole sort of **college campus type environment."** *(Expert 4, UK)*
- "Best locations ... a **housing estate."** *(Expert 2 (UK)*
- "They've dropped a walk-in pantry and cooler right there in the **apartment complex**. ... those kinds of **in-between places**, whether it's an office lobby, an apartment complex, a really large gym." *(Expert 11, US)*
- "Shops are particularly suitable as an **in-house solution** ... as a large company ... several thousand employees ... at one location." *(Expert 10, German)*
- "In **hotel lobbies, office buildings, residential buildings or hospitals** or something." *(Expert 13, German)*

Exemplary quotes from the expert interviews:

- "... you can put this thing **anywhere,** including in **public places**. At the train station, at a partly-closed gas station 24/7." *(Expert 1, German)*
- **"Travel locations**, maybe hotel accommodations as well could be part of that and where you have those **short-term spikes** in demand." *(Expert 12, UK)*
- "I think they would also be having them in places like **train stations and airports."** *(Expert 14, Europe)*
- **"High traffic locations** like what Amazon is doing." *(Expert 16, Europe)*
- **"Train station is a perfect place** for unmanned stores because you're in a hurry and you feel like you're in control, and the type of goods that they sell, especially with convenient foods and those types of things ideal for those types of locations." (Expert 18, US)
- "They're generally set in fairly **urban dense areas** where people are walking in and walking out." *(Expert 17, US)*
- "Often there are **local entry and exit roads** where you can stop if you have good parking and can then shop there 24 hours a day". *(Expert 20, Germany)*
- "I'm surprised we haven't seen these kinds of formats being used in **forecourts**, especially sort of maybe during sort of middle of the night to early morning." *(Expert 3, UK)*

Location as dimension of the business model: **Consumers**

Location

Option A: Community type stores, in rural areas, offices, apartment complexes or universities.

Option B: Anonymous environments at high frequency traffic hubs like train stations or airports.

Examples:
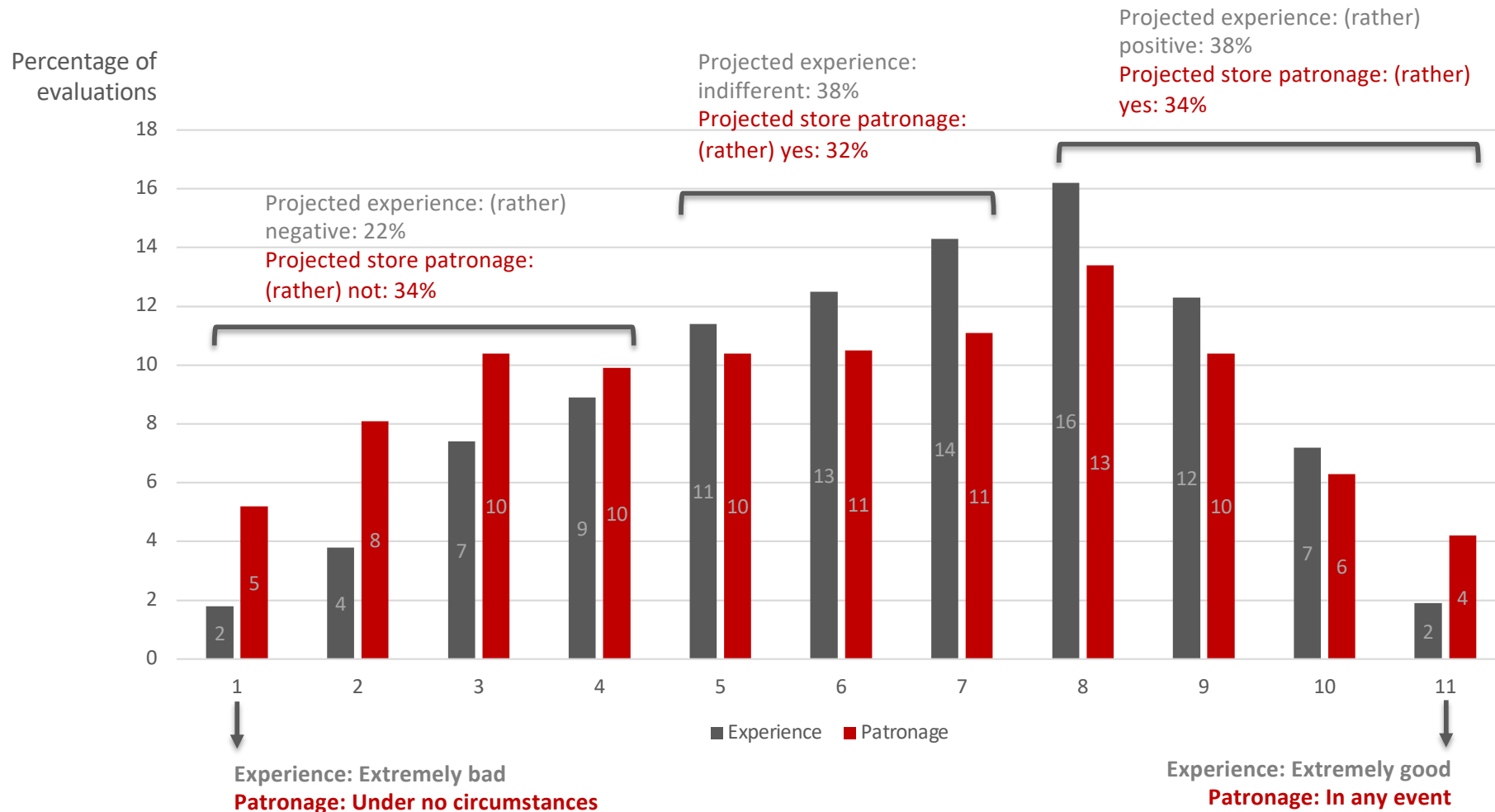
Quick Eats in an apartment complex in the US

LIFVS shops in villages in Sweden

Cheers at a university campus in Singapore

Auchan Minute

Amazon Go

Albert Heijn at Amsterdam Airport

Preference:
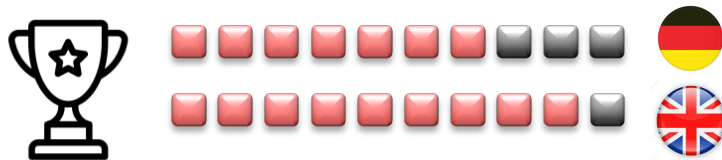
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🟥🟥🟥🟥🟥🟥🟥🟥🟥⬛ 🇬🇧

Interpretation: The side on which the preferences are written represents the choice for Option A versus B, the squares generally represent the strength of the preference from 1 = very low, to 10=very high, whereas the red squares represent the strength in particular, i.e. 7/10 in importance for German customers, 9/10 for UK customers.

Construction as a dimension of the business model: **Experts**

Construction

Option A: Container & semi-movable ← → **Option B:** Fixed, brick & mortar store

Exemplary quotes from the expert interviews:

- "If you still [want] to distinguish between built-in shops and what there is now, ... these are **kind of containers** that you can put somewhere else, but which are also unmanned." *(Expert 13, German)*
- "Then actually that kind of **container box-style store**, whether it's manned or unmanned kind, can really help meet that extra demand in a relatively cost-efficient way." *(Expert 12, UK)*
- "Where the **effort for a permanent store is too great** and where you then simply put a container." *(Expert 13, German)*
- "Most of the boxes that I visited are basically **shipping containers.**" *(Expert 15, UK)*
- "It's a unique category where it's a **modular shipping container-size stores.**" *(Expert 19, US/Asia)*
- "There are also those who sell **things from overseas containers.** We said we would take one-way containers and convert them so that they work." *(Expert 20, German)*
- "The container size ones are **removable** ... it's because it's movable that they could place it in a **pop festival or rock concert outdoors.**" *(Expert 7, Europe/Asia)*
- "You can have a seasonal store, it's also movable for us." *(Expert 9, Europe)*

Exemplary quotes from the expert interviews:

- "If you still [want] to distinguish between **built-in shops** and what there is now, ... these are kind of containers that you can put somewhere else, but which are also unmanned." *(Expert 13, German)*
- "...such as Carrefour or Loop ... for example. They already have shops. And we are basically **retrofitting their existing shops** to turn that into autonomous store." *(Expert 19, US/Asia)*
- "You use an existing store and you only take the technology of an unmanned store and add that to it as an existing store." *(Expert 7, Europe/Asia)*
- "During the middle of this project where we said that yeah, we're going to build an unstaffed store, we also came to the conclusion that you can take a regular store and make it unstaffed." *(Expert 9, Europe)*
- "Amazon Go approach where it's not a container as such. It's **your standard convenience store.**" *(Expert 3, UK)*
- "Those JDX stores in a fixed location. They can only be bigger, have more SKUs, have more variety." *(Expert 7, Europe/Asia)*
- "If you have a small room in your apartment building, that could also be a store." *(Expert 8, Europe)*

Construction as a dimension of the business model: **Consumers**

COMPETENCE CENTER
for on-the-go Consumption

Option A: Container & semi-movable ← **Construction** → **Option B:** Fixed, brick & mortar store

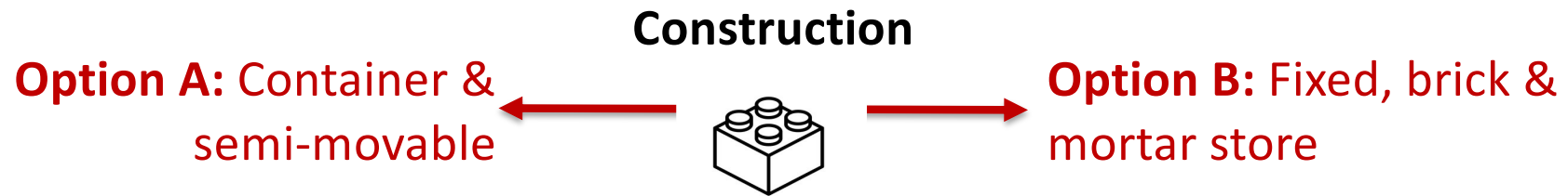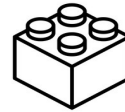**Examples:**
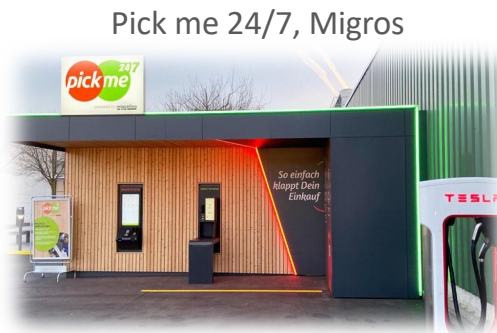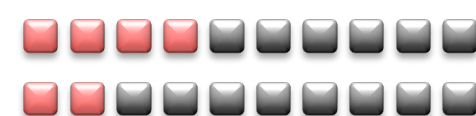
Avec Box, Valora

Pick me 24/7, Migros

E24/7

Wundermart

Zaitt

Preference:

🇩🇪

🇬🇧

Interpretation: The side on which the preferences are written represents the choice for Option A versus B, the squares generally represent the strength of the preference from 1 = very low, to 10=very high, whereas the red squares represent the strength in particular, i.e. 4/10 in importance for German customers, 2/10 for UK customers.

Store access as a dimension of the business model: **Experts**

Access

Main option A: Provider app ← | → **Main option B: Debit or credit card**

Exemplary quotes from the expert interviews:

- "You just have to **scan your phone to open the door** … if you have to download 20 different apps for 20 different retailers and you have to enter a form of payment for each one. If you have to do all of that, that starts to be really frustrating… I think a **retailer is going to want to have you on their app** and everything, … but they're going to have to figure out like, how do you let people in if they don't have an app … I think that's one of the big problems right now. Do you move towards some sort of universal app that can be used at all of these?" *(Expert 11, US)*

- "Why would a consumer want to **download a retailer's app**. Am I going to have five retailer apps for the five retailers I go to?" *(Expert 17, US)*

- "If you **first have to download** an app and the checkout process is relatively complicated, people don't do that. They don't suddenly download an app or something for every single shop." *(Expert 13, German)*

- "So how the Amazon one works is you need to have the **special app** for Amazon Go. And then when you open up the app, a **QR code appears**. And you use that to scan into the store." *(Expert 14, Europe)*

- "When I got there the **biggest barrier** was if you haven't downloaded the **app."** *(Expert 15, UK)*

Exemplary quotes from the expert interviews:

- "One thing that was interesting I saw with AiFi's NanoBox. You can scan a **QR code** from an app, but you can also just **swipe a credit card** and access a store that way." *(Expert 11, US)*

- "Or you do it with a **credit card, debit card** or whatever ... If you want go into such a shop and have to identify yourself with an credit or ID card, then you've actually already solved that, because then you can scan the age and then you may or may not buy alcohol and cigarettes. Then somehow you need a door with an access control. You have them today at every Sparkasse where you have an EC terminal [cash machine] in there." *(Expert 13, German)*

- "…or like Albert Heijn, you use your **debit card**, that'd mean different ways to get into there to identify." (Expert 18, US)

- "[talking about the Albert Heijn store] … what they have is you check in with your **bank card."** *(Expert 7, Europe/Asia)*

- "It [AiFi store] does require you to use **either app or a credit card** or something to ID yourself." *(Expert 19, US)*

- "[Taking about unmanned stores more generally] …scan your card at the entrance, it lets you in." *(Expert 2, UK)*

Store access as a dimension of the business model: **Consumers**

Main option A: Provider app ← **Access to store** → **Main option B: Debit or credit card**
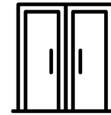
7-Eleven cashierless store

Examples:

Amazon go

Zaitt

Auchan Minute in France

Albert Heijn

Preference:

*weakly significant

🇩🇪

🇬🇧

Interpretation: The side on which the preferences are written represents the choice for Option A versus B, the squares generally represent the strength of the preference from 1 = very low, to 10=very high, whereas the red squares represent the strength in particular, i.e. 1/10 in importance for German customers, 2/10 for UK customers.

Consumer voices: Ambivalent perception of app

Support & hesitation towards unmanned stores

- More secure methods requested than credit/debit card
- App is preferable; fear of sharing data of credit/debit card
- App requires even more data
- Fear of becoming too transparent
- Fear of lacking access in the population

Open comments from German participants:

- "Would that work in any way **without tapping my card**? E.g. with PayPal? Or even cash?" (Male, 46, lives with family, urban)
- "I find it easier to use the **app** because I would not like to check in with an debit card". (Female, 47, lives with family, suburban)
- "I think the concept is very good, but I would prefer to enter the shop if I **didn't have to show a debit card** or scan in to get into the shop at all. I found the idea with the app very good." (Female, 23, lives with family, suburban)
- "I am well aware of the need to regulate how consumers enter and exit the business in such businesses (and have paid). I assume that (as in any other business) there are cameras everywhere. One is used to that. Now, however, I am giving additional data by using my debit - or **worse in terms of data protection law**, via app to get into a shop. Depending on who has access to this data, I find that questionable. [...] That sounds very German [...] but I don't want to be a transparent customer.." (Female, 33, lives with family, rural)
- "If I had to identify myself at the entrance of an unmanned store with a **debit card**, **I would not enter it** and otherwise, if I had to register via the app, I would not be able to enter it either because I do not have a smartphone." (Female, 59, lives alone, rural)
- "I more or less **rejected "app" businesses**, because not only I but also many other older people do without expensive smartphones. Debit card would be acceptable to me. (...) These deals would be an additional but never the only solution for me." (Female, 64, lives alone, suburban)

Sample: n=299 German participants, open comments at the end of the survey

Provider as dimension of the business model: **Experts**
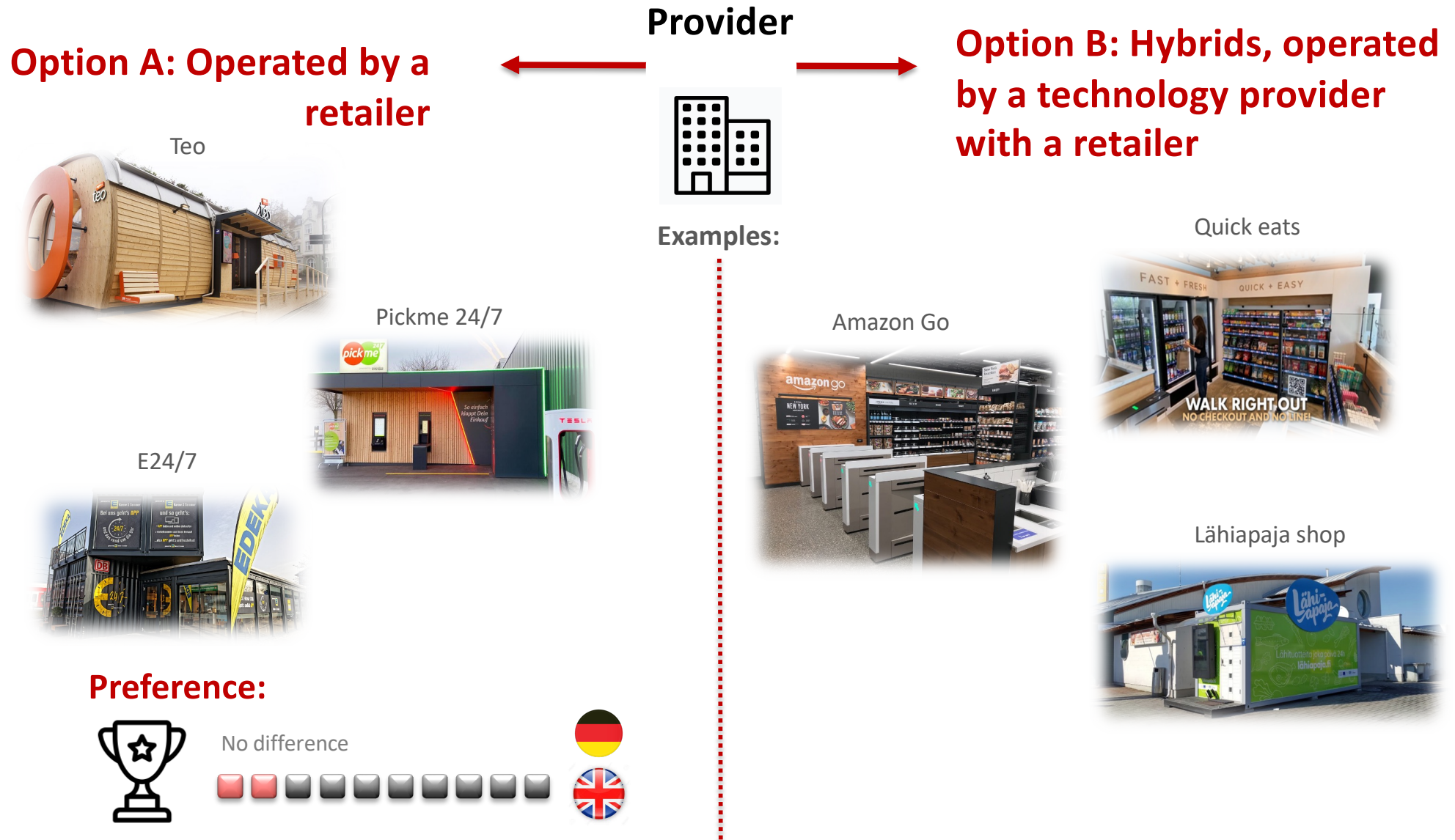
Provider

Option A: Retailer ← → **Option B: Hybrids, e.g. technology providers or them in cooperation with food retailers**

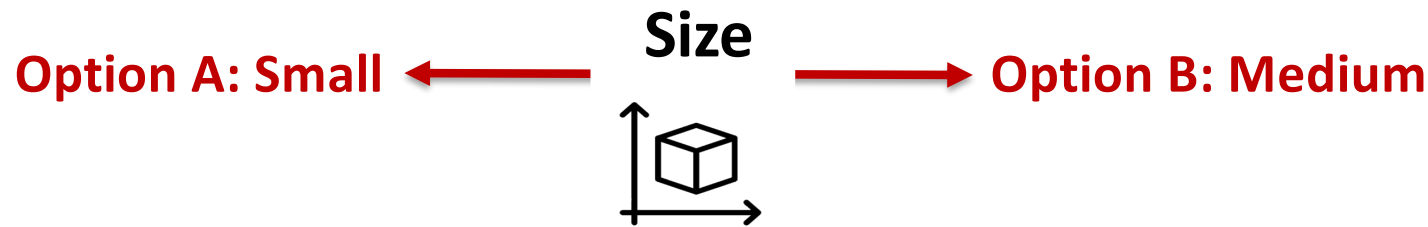**Exemplary quotes from the expert interviews:**

- "The **Avec Box from Valora** is a good **example.**" *(Expert 10, German)*
- "The ones I've come across have been more around … the **experimentation** from **retailers** within Europe." *(Expert 12, UK)*
- "7-Eleven developed their own [unmanned store]. They actually have it open in their headquarters and they're now using it as a test lab." *(Expert 18, US)*
- "The other thing right now is **a lot of it is PR**. How do you **position yourself as a leading edge retailer** to offset what some of the Amazons and Alibabas and those kinds of companies are doing." *(Expert 18, US)*
- "[talking about retailer brands] … people have an **affinity with that brand** with the brand of store they're going in." (Expert 2, UK)
- "Will we see a retailer trying these unmanned stores plus click and collect plus maybe even sort of using it as a launch pad for drone deliveries?" *(Expert 3, UK)*
- "I don't know if I'm comfortable going to an **XYZ company or XYZ store** and getting out my credit card or buying from this – officially; or as opposed to someone like an Amazon that's trusted, or a **Target** or a **Walmart.**" *(Expert 5, US)*
- "**Tesco and Lidl,** and all the big, really **big convenience stores** will go more with the unmanned stores in the future as well." *(Expert 8, Europe)*

Exemplary quotes from the expert interviews:

- "**Amazon**, I never believed it was going to have ten million, ten thousand, [even] ten of those [Amazon Go] stores. So, it's a technology experiment of course it is for a tech company." *(Expert 16, Europe)*
- "It depends on who's operating the store. If you take a company like an **Amazon**, it has a lot of brand equity, brand recognition, a lot of brand loyalty, I think folks are more open to try it." *(Expert 5, US)*
- "That's another reason why I think **Amazon** could be quite dominant because people in many European countries already know Amazon as a brand, and they already trust it, and they also trust the technology." *(Expert 14, Europe)*
- "For **Amazon** it's just a laboratory, where you as customer are the free lab visitor." *(Expert 1, German)*
- "[talking about Amazon] … they basically want to sell their proprietary technology." *(Expert 3, UK)*
- "I find the **JDX stores** the most impressive because they're completely driven by technology, you check in through facial recognition." *(Expert 7, Europe/Asia)*
- "I would imagine that **Amazon** would be quite a major player just because they've got deep enough pockets to subsidise the rollout of stores if they want to." *(Expert 14, Europe)*
- "This is where **Amazon Go** has a phenomenal lead. So, they've actually defined a new category of retail." *(Expert 17, US)*

Provider as dimension of the business model: **Consumers**

COMPETENCE CENTER
for on-the-go Consumption

Provider

Option A: Operated by a retailer

Teo

Pickme 24/7

E24/7

Option B: Hybrids, operated by a technology provider with a retailer

Examples:

Quick eats

Amazon Go

Lähiapaja shop

Preference:

No difference 🇩🇪

🇬🇧

Interpretation: The side on which the preferences are written represents the choice for Option A versus B, the squares generally represent the strength of the preference from 1 = very low, to 10=very high, whereas the red squares represent the strength in particular, i.e., not difference for German customers, 2/10 for UK customers.
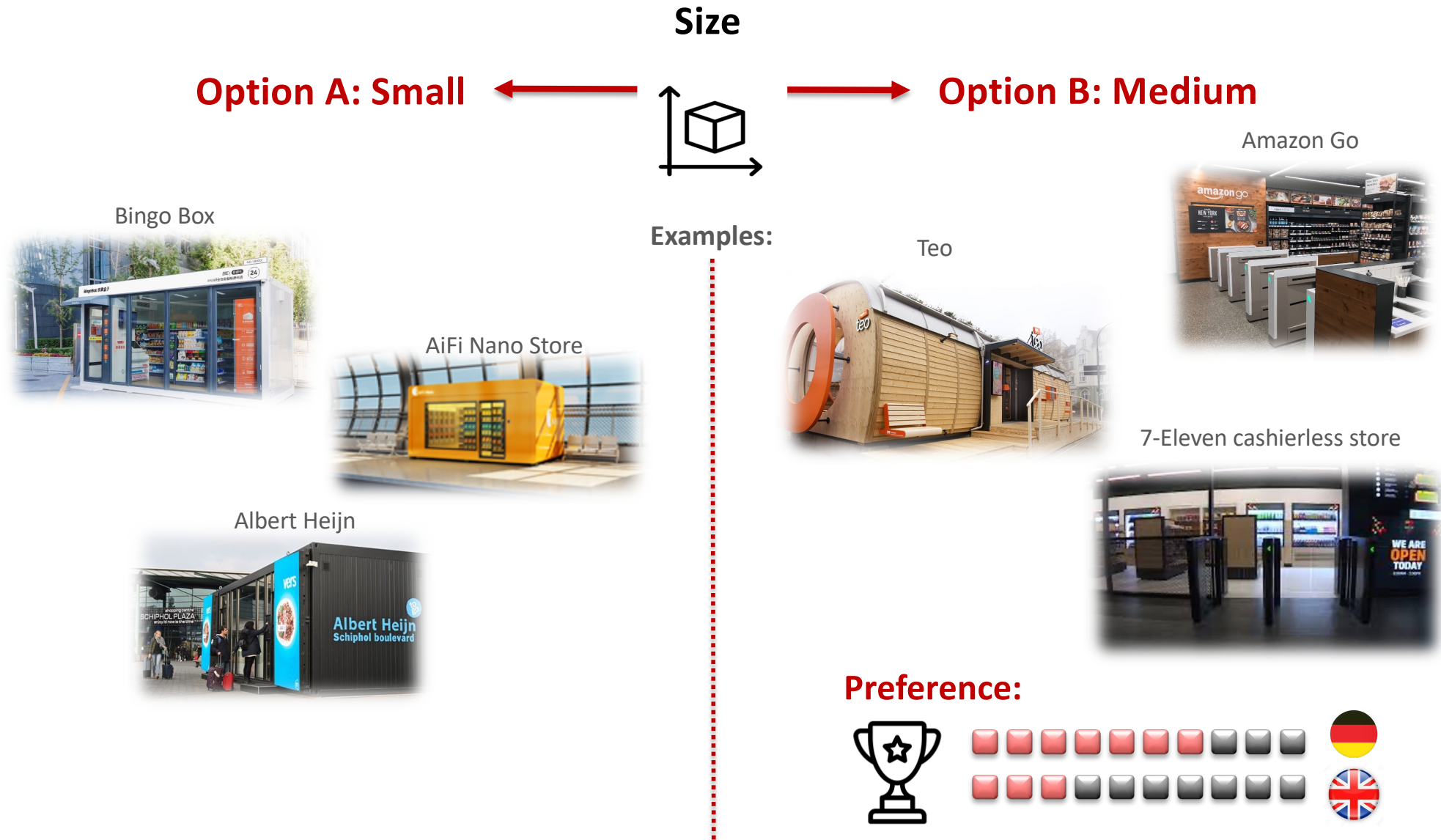
Size as dimension of the business model: **Experts**

Size

Option A: Small ← → **Option B: Medium**

Exemplary quotes from the expert interviews:

- „By trend the testing is rather utilizing small stores and a lot happen in this regards, so far not in the large ones. But this will come at some point." *(Expert 13, German)*
- **Minimum size begins [...] where machines are insufficient** or where there is simply too much activity. Where you then have to throw in money, a credit card, open different doors or the space is not there, the choice." *(Expert 13, German)*
- "For such a terminal [relating to payment] you need space and then a few shelves. You can **start with 10, 15m².**" *(Expert 13, German)*
- "It wasn't even **20 square metres**, I think it was much smaller than that, maybe 5 square metres. But everything was there." *(Expert 15, UK)*
- "It can be **as small as an autonomous refrigerator."** *(Expert 17, US)*
- "If you look at Albert Heijn at Schiphol, the one that they put there, it's **very small."** *(Expert 18, Europe)*
- "The NanoStore, which is a shipping container-size store that's only about 200 square feet." *(Expert 19, US/Asia)*
- "They're **traditionally between 15 to 18 square metres** and they traditionally hold between 300-500 SKUs." *(Expert 3, UK)*
- "I think that you will probably have like **smaller mobile unmanned stores."** *(Expert 8, Europe)*

Exemplary quotes from the expert interviews:

- "The **next stage** of unmanned stores will be that you have your traditional 15-18 square metre basically cargo container that's **been converted into a store."** *(Expert 3, UK)*
- "I've seen one shop in Shanghai that were actually **two containers** joined together. It had **double the space."** *(Expert 7, Europe/Asia)*
- „ It definitely **shouldn't be too small** so that several people at once can move around it." *(Expert 10, German)*
- "And then we will probably **have a bigger, not that mobile stores** out by like the **countryside**. Not the smallest villages but medium sized villages or towns." *(Expert 8, Europe)*
- "JDX stores in a fixed location. They **can be bigger**, have more SKUs, have more variety." *(Expert 7, Europe)*
- "I think as far as the physical size of the store, … **1,000 square feet [~90m²] — the absolute bottom."** *(Expert 5, US)*
- "I wouldn't really see it being a full-blown supermarket type, personally." *(Expert 4, UK)*
- "Why can't we see these in supermarkets and hypermarkets in the future? So, it's taking the learnings now from it, but actually I would say I would love to be able to walk around my **large supermarket** and **just walk out."** *(Expert 3, UK)*
- "I think a typical … convenience store of about **1,000 square feet**, that seems a **sweet spot."** *(Expert 19, US/Asia)*

Size

Option A: Small ← → Option B: Medium

Amazon Go

Bingo Box

Examples:

Teo

AiFi Nano Store

7-Eleven cashierless store

Albert Heijn

Preference:

🏆 🟥🟥🟥🟥🟥🟥🟥⬛⬛⬛ 🇩🇪

🟥🟥🟥⬛⬛⬛⬛⬛⬛⬛ 🇬🇧

Interpretation: The side on which the preferences are written represents the choice for Option A versus B, the squares generally represent the strength of the preference from 1 = very low, to 10=very high, whereas the red squares represent the strength in particular, i.e., 7/10 for German customers, 3/10 for UK customers.

Assortment as dimension of the business model: **Experts**

Assortment

Option A: Grocery and daily needs

Option B: Food-to-go

Exemplary quotes from the expert interviews:

- "If the store is situated in the countryside or where people live in a neighbourhood, then we think that around 85% of **what the customer used to buy** we are able to have in these stores." *(Expert 9, Europe)*
- "24/7 supermarket in a residential area then it would need to have a **complete assortment** I suppose." *(Expert 16, Europe)*
- "It is providing some **essential goods** and necessary stuff near your home, I think that's very important." *(Expert 19, US/Asia)*
- „ Where you can **basically get everything** from snacks to drinks, perhaps a service or two and non-food offers, allowing for a **complete provision** just as if you were going for a total shop." *(Expert 10, German)*
- „... ... larger locations, ... then I have ... everything that is also available in a small Edeka or a small REWE, let's just call it a small local supplier, including a few toys, a few drugstore items, dog food, cat food and all those products which I just listed." *(Expert 20, German)*
- "What an unmanned store should carry ... **all the staple basics**, you know, restocked every night with milk, bread, eggs, that sort of thing." *(Expert 2, UK)*

Exemplary quotes from the expert interviews:

- "If the store is located in a square in the centre of London then it's going to be a **convenience and beverage store.**" *(Expert 9, Europe)*
- "Some unmanned stores even have a **microwave** so you can heat up some products that you buy there." *(Expert 7, Europe)*
- "In terms of the type of the products that will be carried because it's convenience, it will be your chips, your candies, drinks. I think it can venture into like **grab-and-go prepared foods**, again, thinking with my airport hat on." *(Expert 5, Europe)*
- "If it's unmanned I think **food to go** will have to be very basic and pre-packaged." *(Expert 2, UK)*
- "Let's take Amazon Go, it's a **new form of QSR**, it's fast moving, **premium prepared foods.**" *(Expert 17, US)*
- "[Talking about the success of Amazon Go] ... The SKUs look more like a quick service restaurant than a convenience store." *(Expert 17, US)*
- "[Talking about Amazon Go] ... the **focus** is mostly on **snacks, salads, small lunch, prepacked lunches**, drinks. So, really on-the-go food, convenience food." *(Expert 16, Europe/Asia)*
- "It's somewhere you would go to buy **something for lunch** rather than to do your main big shop." *(Expert 14, Europe)*

Assortment

Option A: Groceries and daily needs plus convenience assortment

← →

Option B: Food to go, plus convenience assortment

Coop Sweden

Examples:

Teo

Coop Norway

Mirco-Markt

Herr Anton

Preference:

🇩🇪

🇬🇧

Interpretation: The side on which the preferences are written represents the choice for Option A versus B, the squares generally represent the strength of the preference from 1 = very low, to 10=very high, whereas the red squares represent the strength in particular, i.e., 6/10 for German customers, 4/10 for UK customers.

Checkout as dimension of the business model: **Experts**

Checkout process

Option A: Self-service, self-checkout ← → **Option B: Fully automated**

Exemplary quotes from the expert interviews:

- "When you exit you **self-scan all of the products** … That's relatively **low-tech** compared to the one that JD used with facial recognition and all the RFID … some of the high-tech version seem to go back to just **taking out all the high tech** and go back to the simple self-scan." *(Expert 7, Europe/Asia)*
- "I think that something that is more based on self-scanning not so much high-tech would have a higher chance of success." *(Expert 7, Europe/Asia)*
- "Facial technology makes sense and is easier as such, but I do think that people do want still to have some **degree of control."** *(Expert 4, UK)*
- "It can kind of be done with **scan and go** on my mobile. But we still have a checkout process … It'll be more of a barcode scan and go through your mobile then transitioning into just pick up and walk out." *(Expert 3, UK)*
- **"Scan and go** process as long as it's done right … certainly the way we do it … is the perfect hybrid of traditional shopping and high-tech shopping all in one place." *(Expert 2, UK)*
- "What I see now is that traditional retailers, supermarkets are offering the possibility of **scanning goods with your own smartphone**, for example. I don't find that a real convenient way of working." *(Expert 16, Europe/Asia)*

Exemplary quotes from the expert interviews:

- "Autonomous is focusing on the user experience where customers can walk in, **grab stuff and then leave**; and leaving everything automatic for AI to decide who is grabbing what." *(Expert 19, US/Asia)*
- "Using RFID reading is a way to actually do **a lot more autonomous** and there are major retailers investing in that." *(Expert 18, US)*
- "You pick the products, you stand on a plate in a checkout aisle, it recognises your face, it **recognised the products** based on an RFID tag and **you walk out of the store**. So, that's a very very smooth process … the RFID tags make it much more costly." *(Expert 7, Europe/Asia)*
- "To me, it should be **truly grab-and-go."** *(Expert 5, US)*
- "I think from a consumer perspective, it makes the **payment process just invisible really**, it's just the thought of walking into a store picking something up walking out with it. And that's it. As it comes more to Europe. … there is certainly going to be more restrictions around facial recognition .. places like Germany are quite different." *(Expert 4, UK)*
- "Then there's this system from China … [unclear]. From my point of view, however, this is an **absolute data collection machine**, because I **pay with the laying on of hands**. … and we just won't get that implemented in Germany according to the **GDPR."** *(Expert 20, German)*

Checkout as dimension of the business model: **Consumers**

Checkout process

Self-service/checkout ← → **Fully automated**

Examples:

Wundermart

Avec box

Cheers

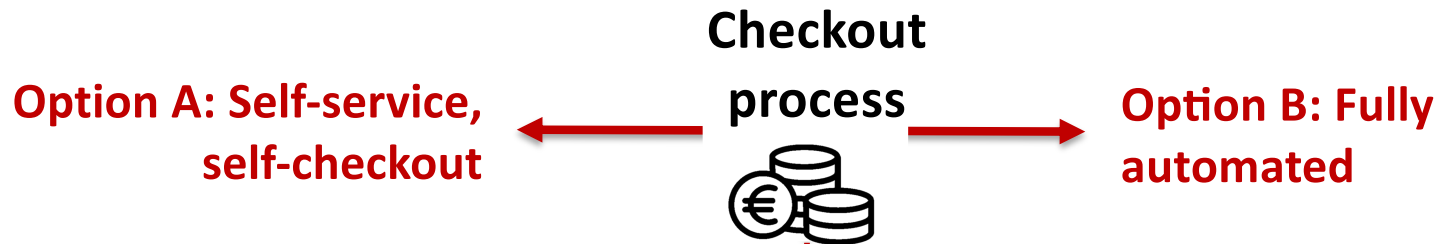Albert Heijn store
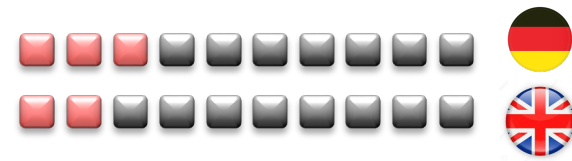
Amazon Go

7-Eleven cashierless store

Preference:

🇩🇪

🇬🇧

Interpretation: The side on which the preferences are written represents the choice for Option A versus B, the squares generally represent the strength of the preference from 1 = very low, to 10=very high, whereas the red squares represent the strength in particular, i.e., 3/10 for German customers, 2/10 for UK customers.

Favoured business model for unmanned store: details

COMPETENCE CENTER for on-the-go Consumption

The combination of the following **dimensions** of the unmanned store business models were favoured by German consumers:

Dimension	Option A	Option B
Location	Community: Recently an unmanned store has opened in an environment in which you have some connection to other users of the store, such as in the building of your employer, in your apartment complex, or at your university campus.	Anonymous: Recently an unmanned store has opened in an environment in which you do not have a direct connection to other users of the store, such as at a traffic hub, a train station, an airport, or in a busy urban location.
Construction	Container: The store is located in one or more container(s).	Fixed: The store is located in a steady-built brick building.
Access to store	App: The store can be accessed through an app from the provider of the store.	Credit/debit card: The store can be accessed through swiping a credit/debit card.
Provider	Retailer: The store is operated by one of the leading grocery retailers in the country.	Technology provider: The store is operated by one of the leading technology providers in collaboration with a grocery chain.
Store size	Small: The store itself is fairly small, about the size of one or two freight containers (ca. 14-28 m^2/ca. 150-300ft^2).	Medium: The store itself is like a small supermarket, approximately four to six times the size of one freight container (ca. 56-84m^2/603-904ft^2).
Assortment	Grocery/daily needs: The merchandise mainly consists of everyday groceries, such as milk, bread, eggs, fruit and vegetables, as well as newspapers and tobacco.	Food to-go: The merchandise mainly consists of food and drinks to-go, such as coffee, sandwiches, croissants and salads, as well as newspapers and tobacco.
Checkout process	Self-service/checkout: To check out and leave the store, consumers have to use self-service, e.g, scan their items.	Fully automated: Shoppers can just leave the store. The checkout works fully automated; there is no dedicated checkout process.

More important criterion ◀━━━━━━━▶ Less important criterion

Concept versus ideal business model: Teo

How does the concept compare to the ideal business model?

Teo

"Teo"
First store near Tegut Headquarter, positioned with sustainable material

Launch: 2020

Types

Retail Mix

Location
Community stores

Provider
New format for retailer

Delivery
Fully unmanned

Provider: Tegut
Size & built: 50m², train wagon optic with green roof and wood fixtures, semi-fixed
Location: Fulda, Germany at Tegut Headquarter
Target group: employees
Products: grocery and fresh assortment (approximately 950)
Access to store: via app and QR code or credit/debit card
Access to products: free
Checkout: self-scanning, payment via debit/credit card
Replenishment: Daily, through dedicated employees
Expansion plans: 10 Teos until the end of 2021, mid term more than 300 in Germany

Location: **community** ✓

Checkout process: **automated** ✗

Construction: **fixed** ✓

Ideal

Assortment: **grocery & c-store** ✓

Access to store: **ambivalent**

Store size **medium** ✓

Provider: **ambivalent**
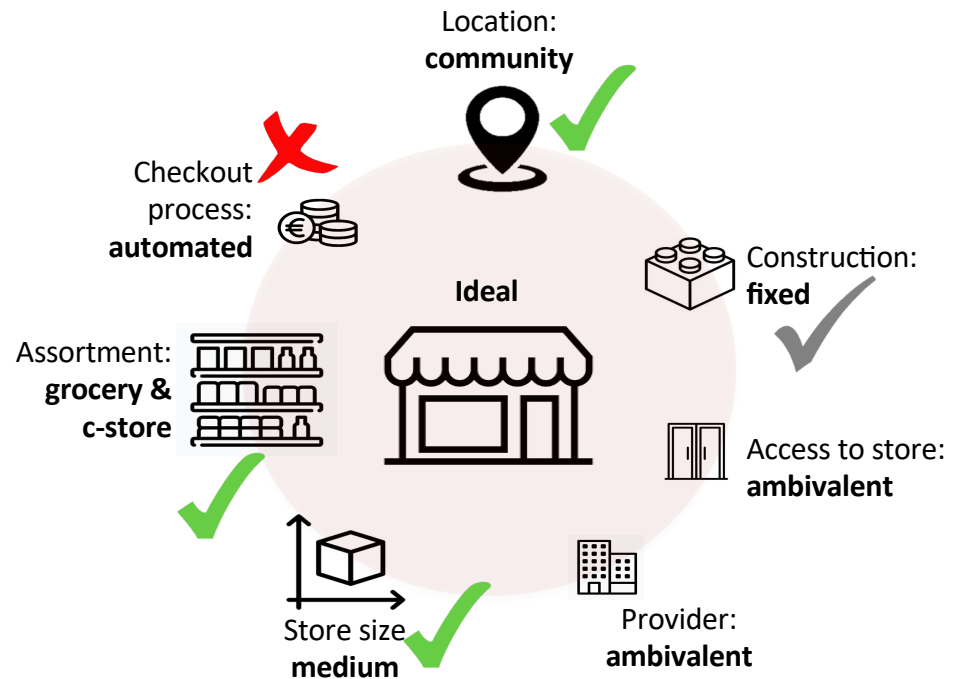
✓ = currently present

✓ = partly fulfilled or variable on the provider side

✗ = currently not present

Size of the icons represents importance

Preferences based on empirical data collection presented above

Concept versus ideal business model: Livello Markt

➡️ **How does the concept compare to the ideal business model?**

Livello

COMPETENCE CENTER
for on-the-go Consumption

"Livello Markt, Smart Store, Micro-Markt"
In cooperation with OHA regional food provider

Launch: 2021

Types

Location	Provider	Delivery
Community stores	Hybrid & Cooperation	Fully unmanned
High footfall locations		

Retail Mix

Provider: Livello
Size & built: 18m2, semi-fixed
Location: Immenstadt, Germany
Target group: not specified
Products: c-store assortment and regional food to go products (approximately 300 SKUs)
Access to store: via app
Access to products: freely accessible
Checkout: fully automatic through automatic detection of products
Replenishment: unclear
Expansion plans: unclear

Location: **community** ❌

Checkout process: **automated** ✔️

Construction: **fixed** ✔️

Ideal

Assortment: **grocery & c-store** ✔️

Access to store: **ambivalent**

Store size **medium** ❌

Provider: **ambivalent**

✔️ = currently present

✔️ (grey) = partly fulfilled or variable on the provider side

❌ = currently not present

Size of the icons represents importance

Preferences based on empirical data collection presented above

Concept versus ideal business model: E24/7 from Edeka

➡️ **How does the concept compare to the ideal business model?**

E24/7 from Edeka

COMPETENCE CENTER for on-the-go Consumption

"E24/7" In cooperation with Deutsche Bahn at a train station	Launch: 2021

Types

Retail Mix

Location — Traffic hub locations

Provider — Hybrid & Cooperation

Delivery — Fully unmanned

Provider: Edeka in cooperation with Deutsche Bahn and Smark (tech provider)
Size & built: 60m2, containers, semi-fixed
Location: Renningen, Germany at train station
Target group: travelers and community
Products: c-store assortment (approximately 300 SKUs with planned 500)
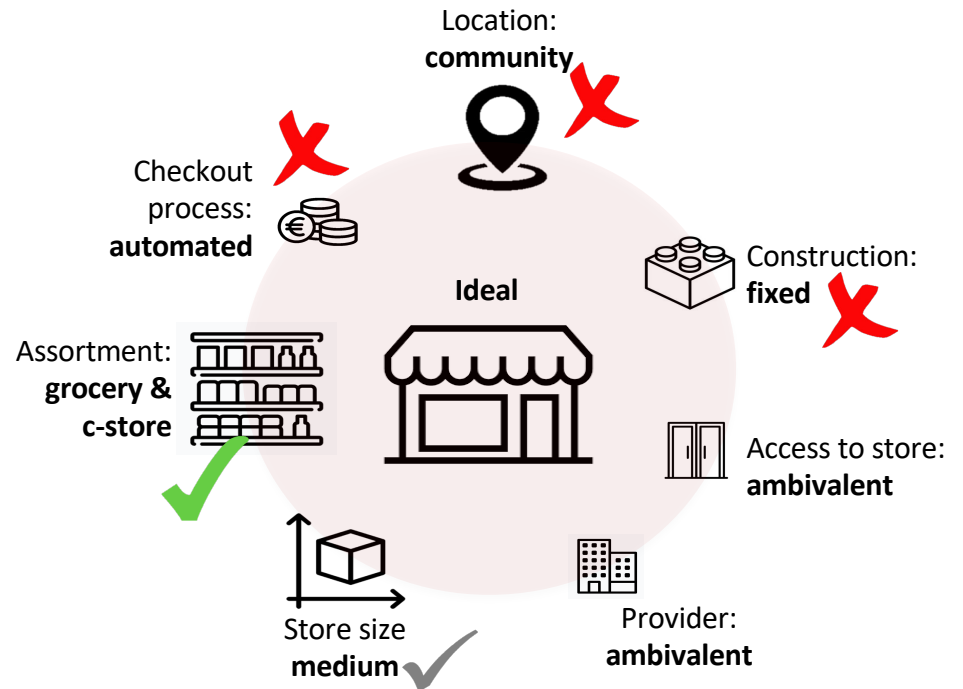**Access to store**: via app and QR code
Access to products: partly restricted, access through touchscreens, partly free accessible via self-service
Checkout: via debit/credit card or App, delivery after payment
Replenishment: via robots in the back of the store
Expansion plans: unclear
Specialty: Is combined with manned bakery next door

Location: **community** ✗

Checkout process: **automated** ✗

Construction: **fixed** ✗

Ideal

Assortment: **grocery & c-store** ✓

Access to store: **ambivalent**

Store size **medium** ✓

Provider: **ambivalent**

✓ = currently present

✓ (grey) = partly fulfilled or variable on the provider side

✗ = currently not present

Size of the icons represents importance

Preferences based on empirical data collection presented above

Cost / benefit ratio of different concepts

Cost considerations can lead to a departure from the ideal business model. Whenever there is a departure, it is advisable to chose criteria less important (such as checkout or construction).

No fully unmanned checkout

No fixed build

Projected costs

Fit to the preferences
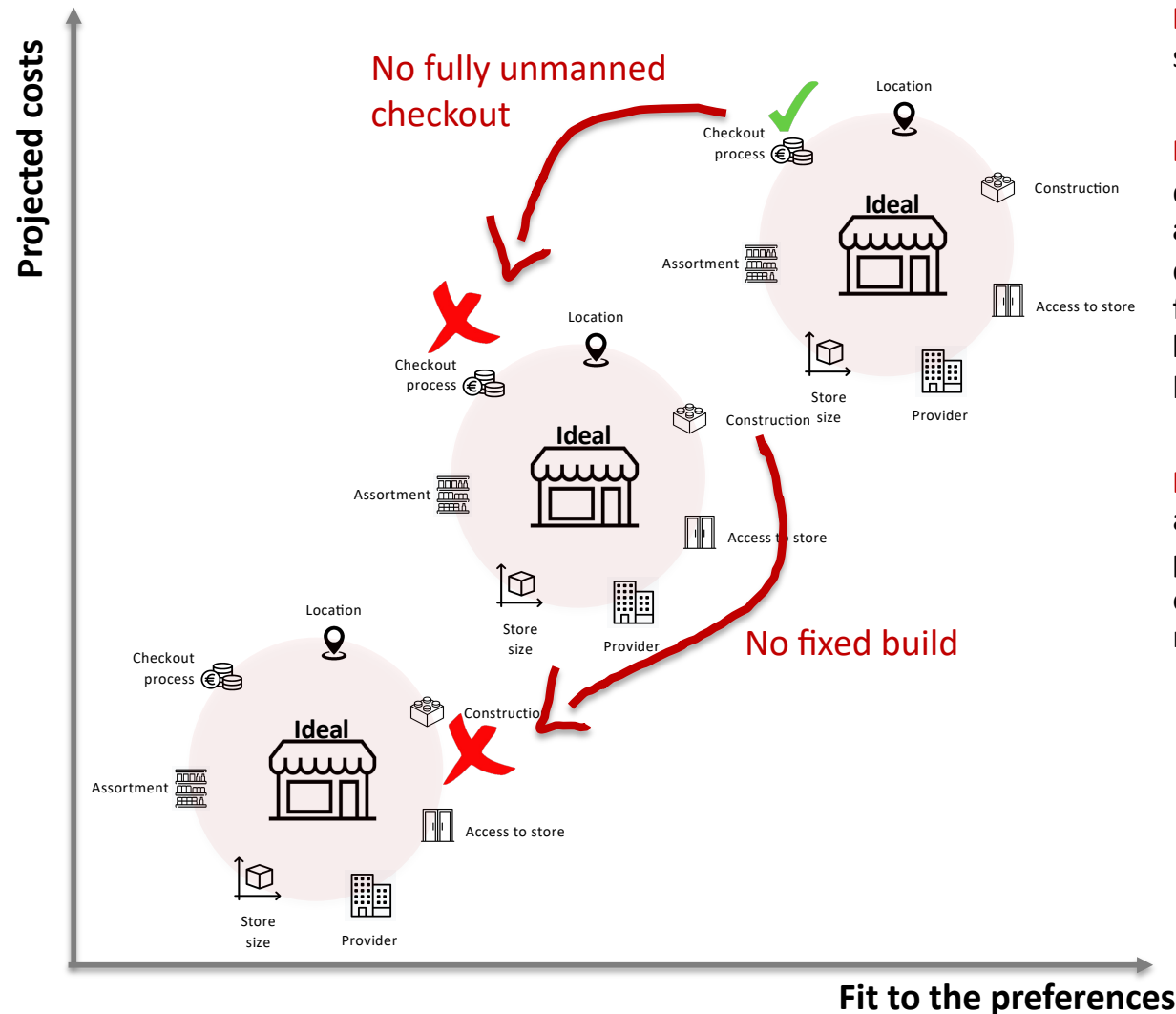
Expert 1, Germany: "I **don't use a camera**, just a self-check-out cash register because it's **cheaper**."

Expert 6, Retailer East Europe: "We haven't decided on any other concepts at the moment. **We are looking into all possibilities**, but we haven't chosen anything to pilot so far. And it mostly comes from the point of view of technologies, that **we haven't really found it reasonable, financially, yet**, but that may change over time."

Expert 13, Germany: "Everywhere where there are already C-store-like areas that are **currently not profitably** operated, or operate under self-exploitation, or where there is a chance of simply making **greater profit**."

Agenda

- **Relevance: Status quo and driving factors**
- Problems: Non-acceptance and failures
- Definition: Fully unmanned: realistic?
- Types of unmanned stores
  - Location types
  - Provider types
  - Delivery types
- Business models of unmanned stores
  - Dimensions of the business model
  - The optimal business model
  - Existing versus optimal business models
- **Operational aspects**
  - Target groups
  - Cost considerations and rollout
  - Self-checkout and misbehaviour and theft
  - Product visibility
  - Store access
- Prediction of future development
- Appendix

Target groups for unmanned stores

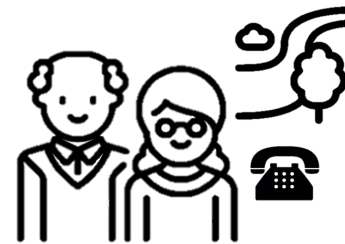Young and tech-savvy in the city? ▶ **Main target group when alternative stores are available**

Young and tech-savvy in the city? & Captive audiences in workplaces, hotels and hospitals? & Everyone including older and less tech-savvy in the countryside? ▶ **Main target group when no alternative stores are available**

Expert 9 (Europe): "… we think that **everybody** can come into our stores and it's up to us to help them into the stores and be able to shop at these stores. So, no we haven't divided it in any way…"

Expert 10 (German): "You could say that older people nowadays, those up to 60, are actually all pretty well-placed when it comes to the subject. … I think the **younger target groups** are above all those who accept the [unmanned stores]. .. Of course, you have to differentiate a bit where the shop is located. Unmanned stores are also an example for in-house stores, especially stores located in companies. Since it's such a protected space. So, of course, if I had 1000 employees of all age groups, it would be relatively equally accepted by **all age groups**."

Expert 18 (US): "Before COVID-19, I would have said it was **mainly the tech-savvy** because the other people are all afraid of technology. **COVID-19 is starting to change some of that perception**."

Expert 11 (US): "**Amazon Go** stores are located well, if you look at where they put them in Seattle when they **started**, they were just at the base of their own buildings, you know, they were selling to their **own employees**. If you look at where they're deployed right now, they're in major **urban markets,** they're in wealthier areas. They're around consumers that are probably more likely to be willing to download the app, aren't going to have trouble with this at all."
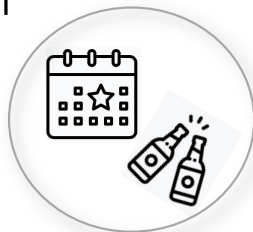
Main target group depends on location

Rural food deserts

High footfall locations

Seasonal stores

High footfall locations

Expert 9 (Europe): "We are targeting […] **different kinds:**

- The one kind is the store that we have outside the big cities like in the **countryside** and

- then we have the stores that can be in **parts of the city where there's a lot of people living** but where we don't have a store and where there isn't enough space, room to build a big store where we can situate this smaller store like this one.

- But we also see it that you can have a **seasonal store**. People go skiing, for example; they do that six months a year or four months a year. And in these skis resorts you can put it there for a couple of months then you can move it where your customers go for the summer. So, it's also movable for us, we believe.

- We have one more also and that's like in the **city centres** at squares, for example; you also can put it but then what you offer inside the stores is a bit different, the actual articles like it's more convenience and sodas and drinks and less maybe of the food that you make for dinner at home."

Cost reference point for different concepts

Personal service

Unmanned options

Click and collect stations

Last mile delivery

€
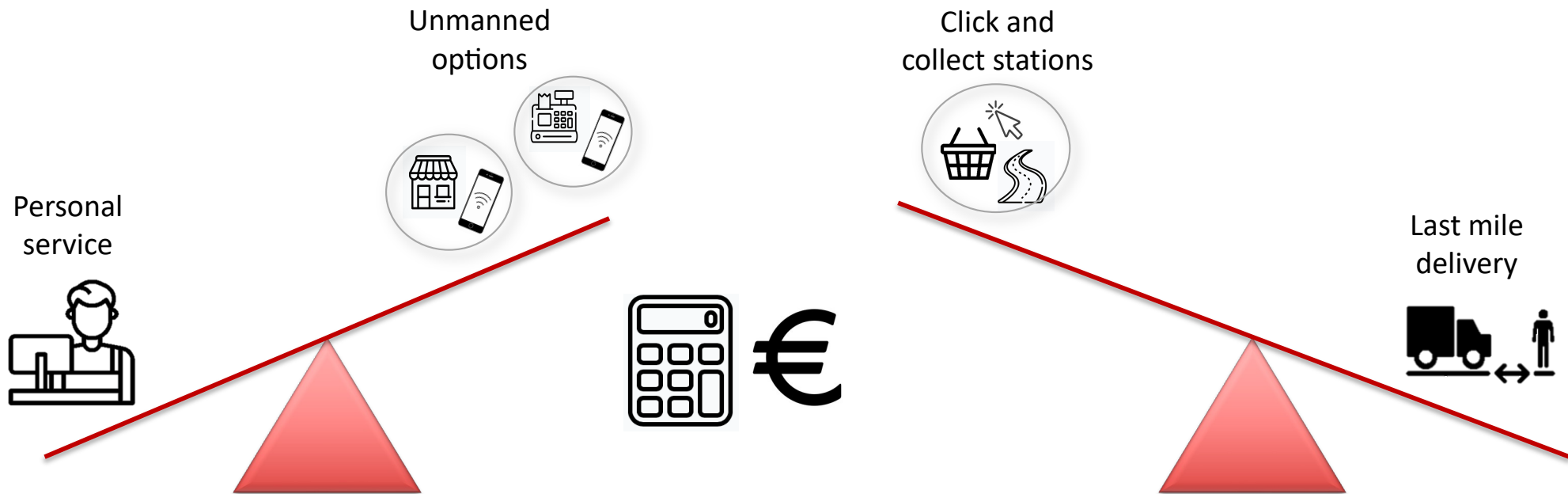
Expert 15 (UK): "The big benefit for unmanned stores is in markets with **high labour costs**. So, Japan is one, US is another; if you can put in processes that reduce the need to have 20 bucks-an-hour people, there is a benefit."

Expert 9 (Europe): "… we make a big difference on the efficiency between lockers and **home delivery**. The majority is still home delivery because we don't have a pricing difference between home delivery and locker. I believe that in the future we will."

Expert 6 (Europe): "We haven't decided any other concepts at the moment. **We are looking into all the possibilities**, but we haven't chosen anything to pilot with so far. And it mostly comes from the point of view of technologies, that **we haven't really found it reasonable, financially, yet**, but that may change over time."

Expert 11 (US): "I think the cost of this is probably **rapidly changing**."

Amazon Go: Poster boy or pure vehicle?

amazon go

- Easy solution
- High PR-profile technology
- Technology becoming cheaper

- For Amazon it's trying to sell the technology

- High investment costs

Expert 1 (German): "That's basically a complete supermarket with Amazon Go technology. ... Technically totally out there, but looking at it soberly - what do you save as a company? The goods still have to be stacked and look good. The only thing you save is the checkout and the space that a modern checkout takes up. We're not talking about huge space requirements. In my opinion, the **business case** for such an unmanned store as it is today is **relatively difficult to calculate**."

Expert 18 (US): "I think that there's a couple things at play with Amazon. Number one, they have a captive audience. The **captive audience** is 100 plus million people of prime that they can actually track... If you look up, it's amazing the amount of cameras they have up there. But those cameras are getting cheaper. Those cameras are doing more at the edge. The computing power is increasing. There is a role for that... The reason they want Amazon Go to succeed, they want to sell it to other retailers. Not because of the technology, but because of the **cloud space that it uses**. The dirty secret about Amazon is they make about **70% to 75% of their profit from cloud**. They make very little on all that stuff they sell you online."

Expert 18 (US): "I mean **Amazon will spend more on innovation** in the next five years than 10 retailers combined. I mean they actually are constantly figuring out that next model – same thing with Alibaba."

Unmanned stores and self-checkout

Example:

Expert 1 (German): „We had the idea to use **self-check-out at such high-frequency locations** simply in order to have more checkout capacity, because that's usually the bottleneck in the whole process."

Expert 18 (US): "One of the things that's happening, for example, here in the US is self-checkout. By itself, **it's just exploding**. Walmart, for example, just in the past week, opened an entire Walmart with just self-checkout.

- Addresses bottlenecks
- Efficient compared to personal checkout

- Currently often offered as alternative
- Technology acceptance, but works in other countries and from other providers

- High investment costs compared to scan pay go
- Theft

Unmanned stores and misbehaviour and theft

Problem: theft

Solution: more technology

Threat: exclusion from ecosystem

Expert 13 (German): "Of course, the **higher the risk of theft**, the more technology you need to incorporate to avoid or deter it. The more you are in environments where there is some control, such as hotels, the less technology you actually need."

Expert 18 (US): "**Stealing is a big problem**. The average shrink rate in the US is 1.5% to 2% of retail sales. The studies that I've seen is that going totally frictionless can raise that to 3% plus. That's a very big number if you think about the billions that a lot of these major retailers have."

Expert 11 (US): "I think using cameras and/or a combination of, you know, pressure-sensitive shelves is going to be the way forward… The problem with **self-checkouts** too is you're exposed to a lot of **risk from theft**. I mean, you can't steal from a store that knows what you picked up."

Expert 11 (US): "Amazon's going to know exactly, down to a multiple, you know, down to a very particular point, what the **rate of failure** is on that system and what the margin of error is. If you're **outside of that on a consistent basis** as a consumer, I have no doubt that **they'll just cut you off from that store**. And Amazon's interesting to me because and I don't know this for certain, but if I had to guess, Amazon would have the ability to just **cut you off from their entire ecosystem**, which is becoming a pretty big ecosystem. It's like, **why would I risk stealing candy bars if that would put my Prime membership at risk**, if that would put my TV streaming at risk, if that would put my ability to buy from their website at risk. I mean, there's all these things that I use Amazon for that I'm just not willing to risk because I want to steal a candy bar. And Amazon's big enough, they cut a few people off from their ecosystem it's not going to matter to them at all. Won't make any difference."

Self-checkout versus checkout via phone app
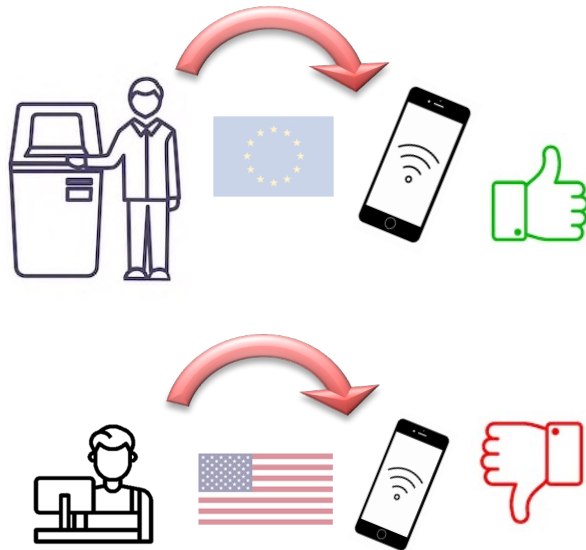
Expert 9 (Europe): "We have these **self-scan cashiers** that we use in our regular stores… So, we have them in nearly all of our stores and they work very well. The first thing we said was okay should we have them and then we develop this app scan and pay, and we said yeah scan and pay is much better, but it has to work for 100% because I have no staff in the store to help the customer if something goes wrong, and now we develop it and now we're testing it. So, **during the process of this project, we went from having the self-cashier to having an app**."

Expert 18 (US): "Here in the US [.] **self-checkout** … it's **just exploding**. Walmart, for example, just in the past week, opened an entire Walmart with just self-checkout… Walmart also tried another approach, just mobile – giving you an **app** so you can shop with your mobile phone and just walk right out. That failed miserably for Walmart because of **theft**."

Expert 1 (German): "One [**acceptance barrier**] is without a doubt the technological barrier for some when faced with self-check-out. Especially when it's too complicated. For example, if you **first have to download an app** and the checkout process is also relatively complicated. People don't do that. They don't download an app for each individual shop."

Expert 1 (German): "I think it's easier for **locations** with places in **offices** or somewhere where you go either daily or regularly. The probability that you will then share your data or download an app is of course much higher than with places where you only pass by every couple of weeks."

Traffic hub locations

High footfall locations

Community stores

Rural food deserts

**Expert 9 (Europe)**: "So, if you have a **lot of these small stores** in a small area, like we have had 30 of these maybe the centre of [capital of country], then you can have like one or two people that are only employed to take care of these stores... This in small cities where we're not located far away from the closest store, where we maybe employ somebody part-time that can take care of the store.
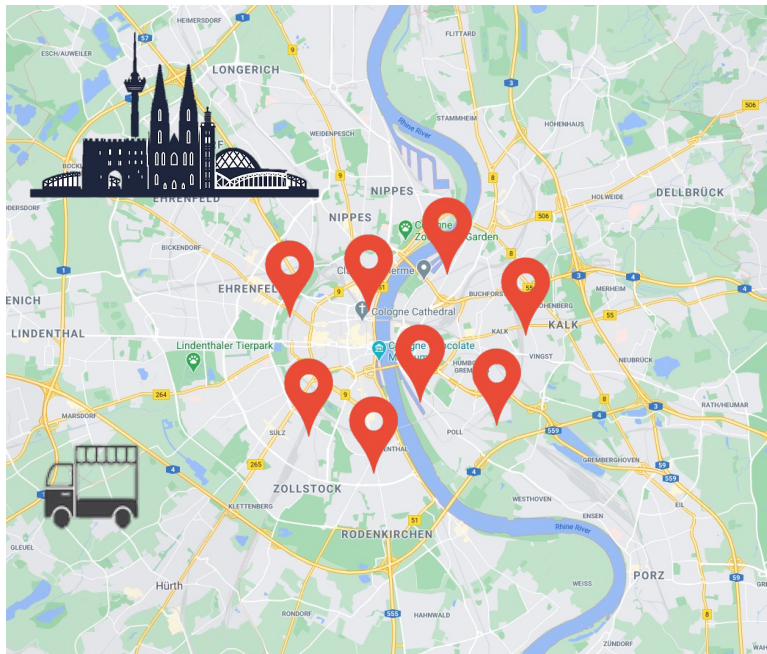
... but for example, we're going to make a pilot and it's not close to a big city. It's a little bit out in the **countryside**. Then we've said that we think it's better that you have one **Grandpa store** that supports this store. We have a store, one big store in one city and that store takes care of this self-service store. So, there's going to be a person dedicated [in the Grandpa store] to make sure that the shelves are filled and stuff like that. So, yeah, so that's for the pilot."
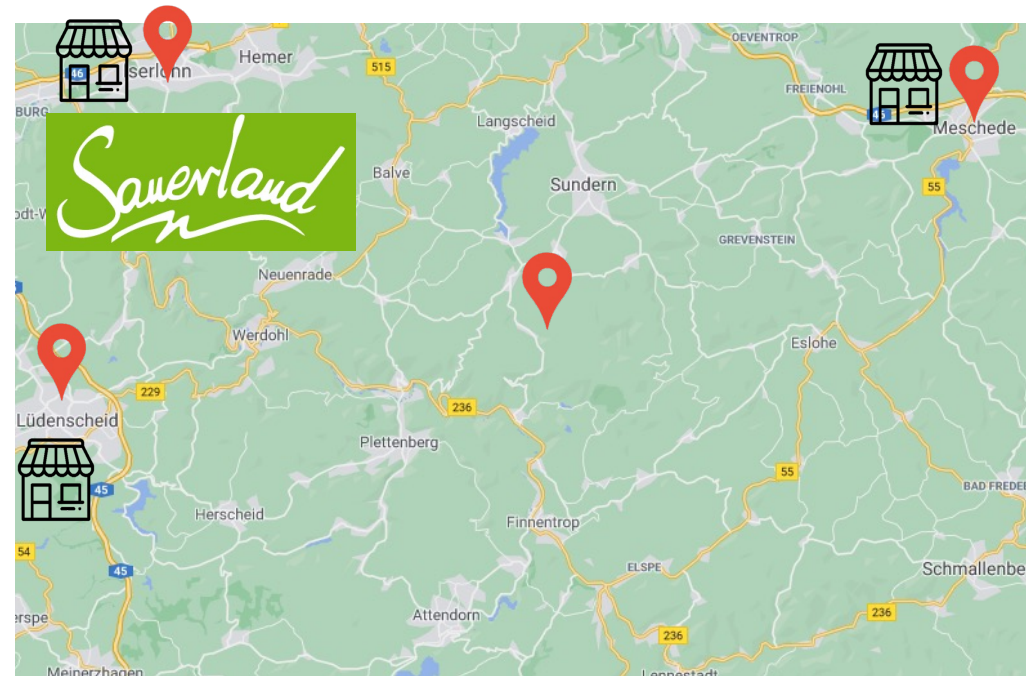
Similarly, **Expert 6 (Europe):** "We have seen, like, different concepts here. We have a **dedicated warehouse** where we do the picking for all the e-commerce. But that is what is done by many retailers all over the world. But a lot of retailers are getting started in e-commerce with **store picking** and this is possible to do with relatively small volumes."

Food deserts as potential for unmanned stores

Rural food deserts

Expert 6 (Europe): "But the next round let's say, the next lockers that are coming, with those, we are moving out of [capital city] and those we're going to test in **smaller villages**, let's say. With around 500 to 1,000 people living, but **where we don't see a point to make a physical store**."

Click and collect stations

Expert 13 (German): "All these discussions come from **places where there is no longer a supermarket**. There are also various initiatives that every now and then attempt to add something, a village shop or something like that. That could be an option, or where the effort for a permanent store is simply too great and where you just put a container."

Retailer cost considerations

Expert 10 (German): "We have big problems all over Germany. The Swabian Alps, The Eifel, and The Sauerland. There are really **huge problems with local supplies**. ... In Germany's **rural areas**, they need new ideas and concepts."

Consumer acceptance

Expert 10 (German): "In principle, I think that in the first stage, locations that still allow a bit of social control are suitable ... Stand-alone, just somewhere in the middle of nowhere, is a bit difficult for people. Especially since, like I said, you don't know exactly whether **if you will [be able to] get out** or something [if] and everything will work."

Walk-in vending and product visibility

Example:

Concept discontinued

👍
- Inventory efficiency
- Standardised appearance
- Tidy all day long

✋
- Works in other outlets, e.g. McDonald's

👎
- Only indirect impulse

Expert 10 (German): "The customer then either goes to a control terminal, orders the things, and takes them out from somewhere, or pre-orders it on their mobile phone, comes over, and gets the goods. The biggest difference, but I don't yet know **how efficient** these stores are, but I'm sure they are more efficient, but the **customer does not see the goods**. For a retailer this is of course something that I struggle with a little. You come into the store and basically just see a screen with beautiful goods on it.

Then there is the analogy with *Burger King* and *McDonalds*, which they do now. You have these self-order terminals. I only know at the end of the day what a BigMac looks like. There you have a completely standardised product experience.

... Of course you have negatives too, if you goods can be seen [and touched] they have to be put away neatly and continually ensure that everything looks smart in an unmanned store."

Agenda

- **Relevance: Status quo and driving factors**
- Problems: Non-acceptance and failures
- Definition: Fully unmanned: Realistic?
- Types of unmanned stores
  - Location types
  - Provider types
  - Delivery types
- Business models of unmanned stores
  - Dimensions of the business model
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  - Existing versus optimal business models
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  - Self checkout and misbehaviour and theft
  - Product visibility
  - Store access
- **Prediction of future development**
- Appendix

Future development unmanned store

Asked for the perfect location:

- Context-dependency: the right store for the right location
- Enough consumer frequency
- Lacking alternatives of other retailers
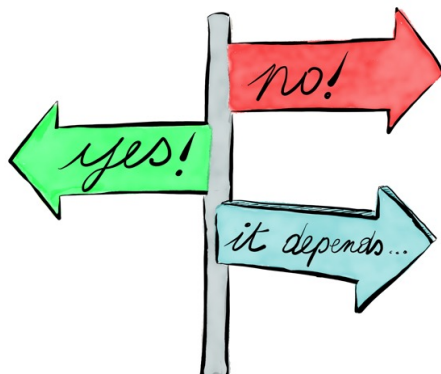
Results from the expert interviews

Exemplary quotes for…
Context–dependency:

- **Expert 3 (UK):** I wouldn't like to say there's one perfect model. I think it'll be about perfect for the location. So, it's appropriate technology to the appropriate location.
- **Expert 13 (German):** "… which is a really important question: At which locations do you have **enough frequency,** on the one hand and with which system do you gain entry?"

Enough consumer frequency:

- **Expert 18 (US):** …any place where you got congregation or population that would buy … The idea is where you're going to maximise the amount of visits.
- **Expert 11 (US):** …wherever there's agglomeration…

Lacking alternatives

- **Expert 7 (European):** If they're in a convenient place with a lack of alternatives, then it could come in handy.
- **Expert 11 (US):** They're targeting places that have traditionally been very frustrating for people.

Transition from manned to unmanned

**First
Generation
Unmanned**

**Second
Generation
Unmanned**

Manned
store

Unmanned
check-out

Fully unmanned
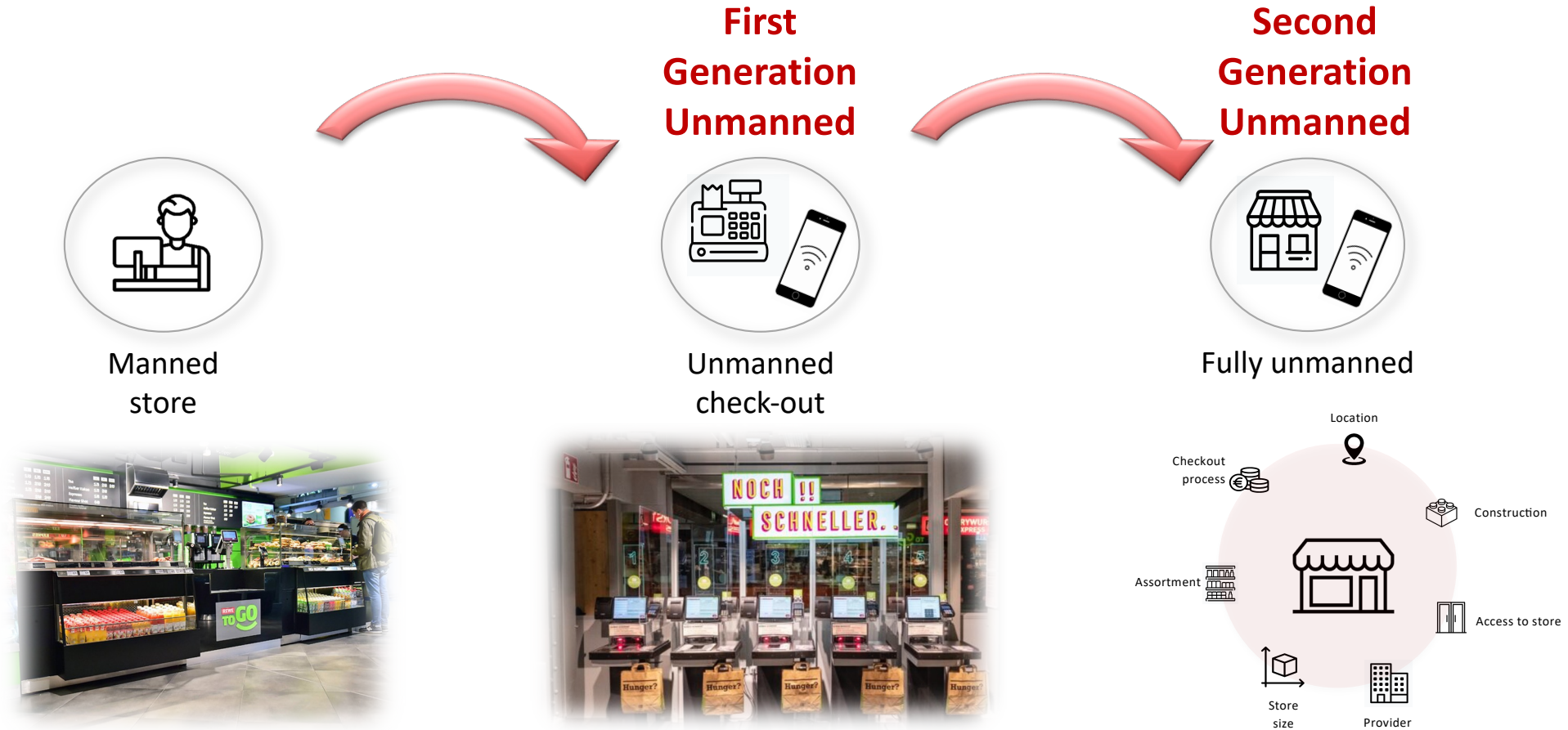
- **Expert 13 (German):** "Convenience stores at high-frequency locations, where you simply **gradually replace normal checkouts with self-scanning ones** and thus become **a bit staff-less.**"
- **Expert 15 (UK):** "**Self-checkout is a hybrid** unmanned store at the end of the day."

Transition from manned to unmanned

Unmanned, part-time

Unmanned, full-time

Manned store

Fully unmanned — 23.00-7.00

Fully unmanned — 24

Rewe To Go

Coop Norway

Location
Checkout process
Construction
Assortment
Access to store
Store size
Provider

Waredock.com "...It functions like a **regular daytime shop** but as soon as darkness falls and everyone goes home, the store is transformed – it **switches to autonomous mode** and then all trade is handled digitally. All those who have to shop after 23:00 and before 07:00 can do so in an unmanned and cashless shop."

Transition from vending to unmanned stores
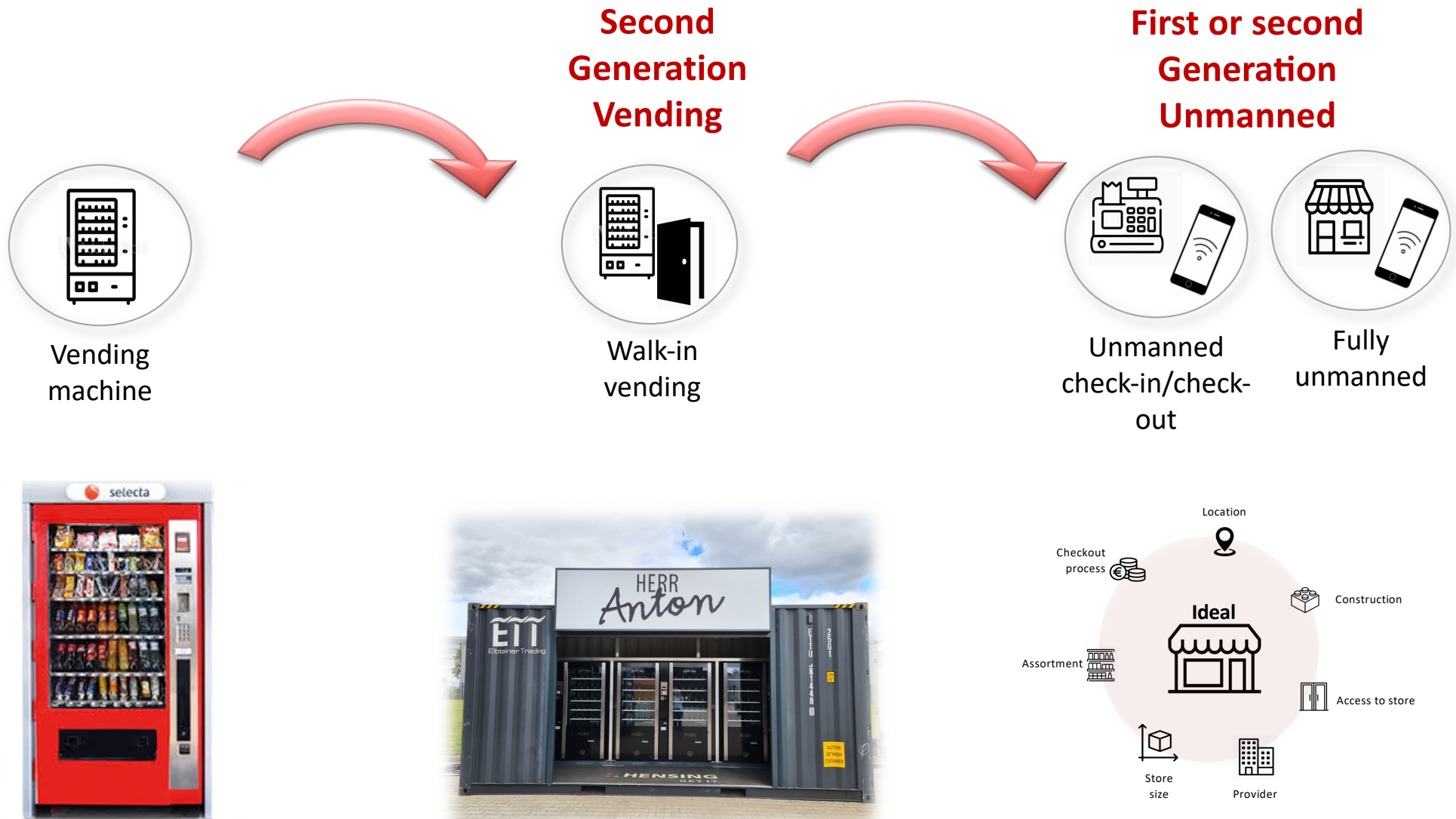
Second Generation Vending

First or second Generation Unmanned

Vending machine

Walk-in vending

Unmanned check-in/check-out

Fully unmanned

Future predictions rollout

- The **trend** towards unmanned stores will be **growing** substantially, not only in Europe, but also in Germany

- The **change** is going to be **gradual,** which has different dimensions:
  - Gradually replacing manned service with technology
  - Gradually, i.e. part-time, operating the store unmanned
  - Gradually to only a section of the store unmanned
  - Gradually enlarging vending to create a store-like environment
  - Gradually introducing unmanned pick-up of pre-paid product baskets

- In this change process, stores should not be seen as "manned" versus "unmanned", but as more or less manned

- Currently we are in the phase of **competing technologies**

- **Amazon** will be further going to try to sell their **just walk out technology** to other retailers such as to Hudson (US), which could lead to this becoming the standard technology and acceleration of acceptance

Expert 13 (German):
Especially when it comes to supermarkets in larger areas, I think it will be a gradual transition. But that's [...] currently still in the testing stage for almost all of them. It's not that they've somehow started the rollout. But I think it's a matter of when. They test them, optimise them and for certain locations, I do believe that in the next two years we will see more, also in Europe.

Appendix

- Background information
  - Definition of concepts
  - Quotations from participants

- Methodology
  - List of experts
  - Information on the sample and data collection
  - Information on statistical analysis

- Further current unmanned store concepts

An **unmanned store** is an accessible retail outlet, with no regular staff present, in which consumers have to check in to access the store and potentially check out in self-service.

An **autonomous store** is an accessible retail outlet, with regular staff present, in which consumer have to check in to access the store and potentially check out in self-service.

Vending is a standalone machine in which consumers can access products after individually paying for them.

Walk-in vending is a standalone store through which consumers can access products after individually paying for them.

Drive-through vending is a standalone store through which consumers can access without leaving their vehicle products after paying for them.

Pick-up lockers are a standalone structure through which consumers can access pre-ordered products after either pre-paying for them or paying on site for the locker.

A **staffed store** is an accessible retail outlet, with regular staff present.

Reasons: More convenient

Support of unmanned store due to

- Quicker and easier
- Opening hours
- No waiting time
- On purchase urgency

Open comments from German participants:

- "I find the topic **exciting,** and I hope that the technology will soon be used round here to enable **easier and faster shopping.**" *(Male, 20, lives with family, suburban)*
- "Unmanned shops would only be an option for me if I **forgot** something and there was such a shop nearby." *(Male, 30, lives alone, urban)*
- "The shops would be practical if they didn't have to keep to shop closing times, so you can **shop 24/7**" *(Female, 53, lives with family, rural)*
- "Shops that don't need staff would improve lots of things e.g. There would be **no more waiting time** at the checkout. Not only would it save personnel costs, but it would also make things a lot **easier.**" *(Male, 36, lives with family, urban)*
- "In airports, train stations, etc., unmanned shops are very important because there is **not much time** to shop." *(Male, 58, lives with family, suburban)*
- "I am in favour, especially if it makes **shopping easier or faster** , for example when paying!" *(Male, 38, lives with family, suburban)*

Sample: n=299 German participants, open comments at the end of the survey

Reasons: Technology openness

Support of unmanned store due to

- Technology "openness" and "curiosity"
- Alternative and more choice
- Opening hours
- Unique experience

Original open comments from German participants:

- "I think it's an **interesting addition** to "manned" shops. **Practical** when things have to be done quickly or when other shops are closed." *(Female, 52, lives with partner, rural)*
- "Unmanned business is a **good approach** and will (hopefully) soon be realized." *(Female, 56, lives with partner, urban)*
- "**I'm looking forward** to the new technology!" *(Male, 45, lives with partner, urban)*
- "I hope that such shops will soon become a reality." *(Female, 35, lives with family, urban)*
- "Personally, I like the idea of unmanned shops, simply **the unique new experience of shopping there.** I would like to try it out." *(Male, 48, lives with family, rural)*
- "That's a very **interesting idea**." *(Female, 37, lives with family, suburban)*
- "Super Idea" *(Female, 38, lives with family, rural)*
- "I would **definitely be ready** to shop in such an unmanned store." *(Female, 41, lives with family, suburban)*
- "I hope I can **test such a shop** soon." *(Male, 32, lives alone, urban)*

Sample: n=299 German participants, open comments at the end of the survey

Support of unmanned store

- Conditional on similar benefit-price ratio
- Prices and assortment need to be similar to manned stores
- Core service is relevant, all else is not

Open comments from German participants:

- "Personally, I would like the idea of unmanned shops (...) However, the grocery **prices** must **not be too high,** comparble to other grocery stores." *(Male, 48, lives with family, rural)*
- "Basically, it would be interesting for me to shop in unmanned shops, but **not if** I had to **pay significantly more for it**. Due to the lower personnel costs, prices should even be a lot lower." *(Male, 46, lives alone, urban)*
- "I'm interested in **price, quality and safety**. **Everything else is irrelevant**." *(Male, 44, lives with family, suburban)*
- "Whether I would use unmanned shops would also depend heavily on the **range of goods and prices**." *(Female, 54, lives with family, suburban)*

Sample: n=299 German participants, open comments at the end of the survey

Reasons: No personal contact needed

Support of unmanned stores

- Since personal contact is not appreciated
- No need for personal contact / small talk
- In particular during the pandemic
- More comfortable interacting with technology

Open comments from German participants:

- "In principle, I don't find the idea of unmanned shops bad because I **don't need personal contact with a salesperson** in most situations." *(Female, 41, lives with partner, rural)*
- "I think unmanned shops is a good idea because I **don't go shopping for social contacts**, but for the products I need. I also **don't like small talk** with cashiers and only use self-service checkouts." *(Female, 57, lives alone, urban)*
- "I find unmanned business useful in terms **of contact restrictions** during times of the **pandemic**." *(Male, 33, lives with partner, urban)*
- "Especially in the current **Covid situation** , shopping without interacting with other people would be advantageous." *(Female, 57, lives alone, urban)*
- "I would be happy if there was this possibility (...) especially during **pandemic** times it would be wonderful." *(Female, 44, lives alone, urban)*
- "I feel **more comfortable interacting with technology** than with people. Accordingly, a payment process without interaction with a human cashier is very desirable." *(Female, 31, lives with partner, urban)*
- "Having a social phobia, **unmanned business** would be a boon for me, despite privacy concerns." *(Male, 34, lives alone, urban)*

Sample: n=299 German participants, open comments at the end of the survey

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for on-the-go Consumption

Support of unmanned stores

- Because of convenience with regard to the checkout process
- Self scanning perceived as inconvenient
- Self scanning is a waste of time

Open comments from German participants:

- "It would be an advantage if the **payment process is automated** and I don't have to register in an app." *(Male, 30, lives alone, urban)*
- "I would like to use **cash registers, especially without a scan."** *(Male, 41, lives with family, suburban)*
- "It is **extremely important** that I **don't have to scan** each article individually. Then I could better go to a conventional supermarket." *(Male, 41, lives with partner, urban)*
- "I am in favour, especially if it makes shopping **easier** or faster, for example when **paying**!" *(Male, 38, lives with family, suburban)*
- "**Checkouts are a waste of human life** ... both for me as a customer and for the person at the checkout. See Amazon in Silicon Valley, which (if it works) will change supermarkets for the better. No interaction, just in and out." *(Male, 31, lives with partner, suburban)*

Sample: n=299 German participants, open comments at the end of the survey

Reasons: Appreciation of personal contact

Hesitation towards unmanned stores

- Personal interactions are a highlight
- Would miss interactions
- Too much anonymity

Open comments from German participants:

- "The **cashiers are often [one of] the highlight[s] of** my shopping trip." *(Male, 19, lives with family, suburban)*
- "I appreciate the **interaction with the staff** (mostly you've known each other for a long time) and the opportunity to have a direct **contact person for questions about** the range or complaints." *(Female, 33, lives with partner, urban)*
- "**For me, contact with the staff of** a store determines where I go shopping." *(Male, 41, lives alone, urban)*
- "Still, I **don't want to miss short contact** with people, even if it's just the cashier." *(Female, 64, lives alone, suburban)*
- "The **short chat at the cash register** is missing. People and human contact are becoming less and less important. Really terrible! Everything is only designed in such a way that it is time-saving instead of consciously living this moment." *(Female, 51, lives with family, urban)*
- "Now apart from Corona, I find the **human contact in the shop more positive** , especially as someone who lives in the country." *(Male, 57, lives alone, rural)*
- "I **like the interaction** with the staff." *(Female, 36, lives alone, urban)*
- "But **I would miss interacting with people very much** . The pandemic has shown that we are social beings who need each other. An unmanned business increases anonymity." *(Female, 48, lives with family, urban)*
- "I only use these [self-scan registers] when I'm in a hurry because I don't **interact with people** when I shop like this." *(Female, 33, lives with partner, urban)*

Sample: n=299 German participants, open comments at the end of the survey

Reasons: Too small

Hesitation towards unmanned stores

- Too small stores and assortment

Open comments from German participants:

- "In addition, the shops in the scenarios you described were too small for me, which then goes hand in hand **with a limited range.**" *(Female, 56, lives with partner, rural)*
- "In general, I find the idea interesting and would also use it, but I hardly ever go shopping in such **small shops** and would only find it interesting if normal-sized shops with a full range offer this. I don't just need snacks for immediate consumption or the basic products, so it is of no interest to me." *(Female, 34, lives with partner, urban)*
- "I already use scanning technology at Globus. However, I don't want to buy in small containers, but in large markets." *(Male, 55, lives alone, urban)*

Sample: n=299 German participants, open comments at the end of the survey

Reasons: Potential technical difficulties

Hesitation towards unmanned stores

- Technical difficulty / faultiness

- No staff available to ask in exceptional situations

- Loss of control

Open comments from German participants:

- "I think the idea in and of itself is great, but I would wonder what would happen if there were a **technical defect** at the checkout." *(Female, 32, living alone, suburban)*

- "What I would find problematic in an unmanned store would be the fact that there is **no one there** who can help **with technical problems.** Unfortunately, these happen quite often here and one of the staff is always within reach. So my opinion on the subject is probably a bit negative when there is actually nobody around." *(Female, 33, lives with partner, urban)*

- "I appreciate (...) the possibility of having a **contact person directly for questions about** the range or complaints." *(Female, 33, lives with partner, urban)*

- "I can't **ask anyone** if I can't find something." *(Female, 51, lives with family, urban)*

- "I (...) use Scan & Go when I can. But I would find a completely unmanned business unpleasant, a **contact person** should be available." *(Female, 56, lives with partner, rural)*

- "Even if shops are unmanned, it should be possible to get **in touch with an employee on site** - via chat in the app or facetime or telephone." *(Female, 54, lives alone, urban)*

- "The automated checkout process was often decisive for my decision. It would be too unsafe for me to shop in a store where I **have no final control** over how much money I spend and whether it is billed correctly." *(Female, 21, lives alone, urban)*

Sample: n=299 German participants, open comments at the end of the survey

Reasons: Data-sharing hesitation

Hesitation towards unmanned stores

- Protection of personal data is important
- Video observations causes uneasiness
- Too much technology is scary
- Too much transparency about behaviour

Open comments from German participants:

- "**Data protection** would definitely be an important factor." *(Male, 28, lives with partner, urban)*
- "Depending on who has access to this data, I find that questionable. [...] That sounds very German [...] but I **don't want to be a transparent customer** .." *(Female, 33, lives with family, rural)*
- "Very ambiguous relationship with **privacy concerns** . On the one hand I am sometimes sceptical about the use of my data, on the other hand I now use thousands of apps and websites that openly and openly use my data and metadata." *(Female, 47, lives alone, urban)*
- "In principle, I think the idea of unmanned shops is not bad (...) I would also find it uncomfortable to **shop in a video-monitored** shop. (I assume that the business would have to be guarded to prevent abuse)." *(Female, 41, lives with partner, rural)*
- "I find the technology / approach fascinating, but somehow also a **bit "scary"** because you become a transparent consumer." *(Male, 52, lives alone, urban)*
- "I have concerns about becoming more and more of a **transparent person** , revealing more and more data (such as shopping behaviour) about myself." *(Female, 53, lives with family, rural)*

Sample: n=299 German participants, open comments at the end of the survey

Reasons: Job losses

Hesitation towards unmanned stores

- Fear that unmanned stores lead to job losses
- Uneasiness of supporting something that might lead others to be out of work

Open comments from German participants:

- "It's easier for the customer, but **so many jobs get lost** . I would prefer a supermarket that creates jobs, even if it would be a more annoying shop for me." *(Male, 33, lives alone, urban)*
- "I just think it's a shame that **jobs will be** lost as a result." *(Female, 26, lives with partner, urban)*
- "In principle, I don't think the idea of unmanned shops is bad (...). But I have in mind that this will mean that **fewer jobs will be** available in the future, especially in regions where there are few other options for people with the appropriate qualifications." *(Female, 41, lives with partner, rural)*
- "Concerned about the **loss of jobs**." *(Female, 52, lives with family, suburban)*
- "In addition, **important jobs** depend on trade." *(Male, 57, lives alone, rural)*
- "I am against unmanned business because it means **jobs are lost**." *(Female, 56, lives with partner, suburban)*
- "I (...) think it's important that these **jobs are protected**." *(Female, 36, lives alone, urban)*
- "My concerns about"unmanned"shops (...): In retail, both qualified and semi-skilled people often work under reasonable conditions (...). If the idea of staff-less businesses gain a foothold, **these people's jobs** would be at risk. I would feel extremely uncomfortable supporting such a development!" *(Female, 62, lives with family, urban)*
- "**I find the loss of jobs** due to the establishment of unmanned shops worrying. That's why I'm skeptical about self-service, etc." *(Male, 39, lives with family, urban)*
- "… **Concern about staff** who become unemployed as a result of unmanned shops …" *(Female, 39, lives alone, suburban)*

Sample: n=299 German participants, open comments at the end of the survey

Reasons: Product quality & packaging

Hesitation towards unmanned stores

- Fear of lacking product quality and cleanliness
- Expectation of more plastic packaging

Open comments from German participants:

- "Who ensures that the **goods are not contaminated / already touched** by others." *(Female, 51, lives with family, urban)*
- "I would be happy if there was this opportunity, as long as the **store is clean and tidy**." *(Female, 44, lives alone, urban)*
- "... For this, a lot more **plastic packaging is** needed, which would be really counterproductive in terms of climate protection." *(Female, 51, lives with family, urban)*

Sample: n=299 German participants, open comments at the end of the survey

Reasons: Personal security

Hesitation towards unmanned stores

- Personal security
- Too much anonymity

Open comments from German participants:

- "Main concern in an unmanned business: that other people will try to steal your money or your card when you are there alone (**personal safety**)." *(Female, 57, lives with partner, urban)*
- "Unmanned shops make me feel like I'm on the move as a robot because there **is no interaction**." *(Female, 54, lives with family, suburban)*
- "I am against unmanned business because (...) **shopping is becoming too sterile** and no longer fun .... I would miss customer advice and a nice hello." *(Female, 56, lives with partner, suburban)*

Sample: n=299 German participants, open comments at the end of the survey

Appendix: List of Experts

Number	Sector	Country	No of words	Duration	Timing
Expert 1	Wholesaler	Germany	6274	51 min	2020
Expert 2	Technology provider	UK	6489	36	2020
Expert 3	Market research	UK	5893	38	2020
Expert 4	Retail real estate	UK	3099	20	2020
Expert 5	Insurance and risk management	US	6104	34	2020
Expert 6	Retailer	East Europe	3293	27	2020
Expert 7	Retail journalist	Benelux /Asia	8147	57	2020
Expert 8	Wholesale	Scandinavia	6167	49	2021
Expert 9	Retailer	Scandinavia	5391	50	2020
Expert 10	Retail journalist	Germany	3378	28	2020
Expert 11	Retail consultant	US	8971	49	2020
Expert 12	Retail consultant	UK	3568	27	2020
Expert 13	Wholesaler	Germany	5236	41	2020
Expert 14	Marketing / retail consultant	UK	6127	49	2021
Expert 15	Retail consultant	UK	3474	27	2020
Expert 16	Retail journalist	Benelux	4324	33	2020
Expert 17	Retail consultant	US	9591	73	2020
Expert 18	Retail consultant	US	5175	32	2020
Expert 19	Technology provider	US / Asia	6932	46	2021
Expert 20	Technology provider	Germany	3805	34	2021

Fundamentals of factorial surveys. A Factorial Survey (FS) first used by Rossi *et al*. (1974) allows deep insights to be gained into respondents' judgement principles by combining the advantages of experiments and their high internal validity with surveys with their high external validity (Aguinis and Bradley, 2014). In an FS, respondents are exposed to a small sample of vignettes (e.g. ten) that each describe a scenario consisting of varying dimensions that are simultaneously manipulated (Wallander, 2009). In our case these are descriptions of unmanned store business models with their varying dimensions. After each vignette, the respondents asked for an overall judgement, also called rating task, i.e. attitude or behavioural intentions (Wallander, 2009).

Suitability of factorial surveys. FSs are particularly suitable when little is known about consumers' decision-making and the influence of various features (Oll *et al.*, 2016; Hahn *et al.*, 2020). In our setting, FSs are advantageous mainly for three reasons: First, FSs are very realistic in capturing consumer decision-making for visiting a retail store involving tradeoffs between various elements (Auspurg and Hinz, 2015). Second, all dimensions and factor values can be systematically varied (Oll *et al.*, 2016) to a point that combinations of dimensions (aka unmanned store business models) can be displayed that do not (yet) exist in reality (Auspurg and Hinz, 2015). Third, the survey element of the FSs allows the inclusion of various socio-psychographic variables, allowing for the separation of the influence of object factors (the dimensions of the unmanned store) from social factors (e.g. technology readiness or privacy concerns (Auspurg and Hinz, 2015).

Creation of vignettes. The vignettes were developed based on the seven dimensions deduced in section 3.3. We followed Rossi *et al.* (1974) recommending that dimensions should be theoretically relevant but also easily observable. Seven dimensions, which are ideally independent from each other (i.e. orthogonal) lie within the range of the recommended number of dimensions (6–9) with regard to complexity having been shown to reach the highest levels of accuracy and consistency in respondent judgement (Auspurg and Hinz, 2015). All dimensions had two valences each; again, in line with literature recommending a) to limit the valences or levels to a minimum, and b) to avoid number-of-level effects, to avoid varying the number of levels across dimensions, such as having three levels for one dimension and two levels for another dimension (Auspurg and Hinz, 2015). This leads to a vignette universe of 128 which is calculated as a Cartesian product of the number of levels of all dimensions (2^7). The vignette dimensions were transformed into continuous text to help participants imagine the scenario accompanied by icons (as recommended by Auspurg and Hinz, 2015) and can be seen on the slides (overview dimensions slides 88 and 123).

Dependent variables. Due to the repeated measure design of the rating tasks, the standard is to ask single-item questions on 11-point rating scales to capture small differences (Auspurg and Hinz, 2015). In line with FSs standard we used a single-item 11-point scale to capture patronage intention directly by asking: I would regularly shop in this store: 11-point scale ranging from absolutely not to absolutely yes.

Appendix: Methodology

Independent variables: Factorial surveys include two types of independent variables: the vignette dimensions, which are level one variables in the hierarchical model, and the respondent characteristics, which are individual level or level two variables (Auspurg and Hinz, 2015; Hahn *et al.*, 2020). In line with recommendations in literature, the individual level variables were not part of the vignette universe (Oll *et al.*, 2016). We included individual level variables to test our interaction effects relating to technology (e.g. technology readiness), grocery shopping (e.g. responsibility and enjoyment) as well as socio-demographics (e.g. household size or income).

Sampling. As is standard, we employed a self-administered online questionnaire (Auspurg and Hinz, 2015) and commissioned the market research firm Prolific, known for its high quality (Peer *et al.*, 2017) to recruit a sample of 318 German participants and 313 UK participants through their online panel. Each respondent got a randomly drawn subset of ten vignettes from the vignette universe (128 = 2^7) which is the most commonly used procedure in FSs (Wallander, 2009). This number is ideal since a larger numbers of vignettes can create fatigue, boredom and inconsistent responses (Sauer *et al.*, 2011). Given the vignette universe of 128 the sample size (n=318 and n=313) and the repeated measure of 10 this leads to 3,180 and 3,130 observations (sample size * 10) which are chosen to ensure each vignette is evaluated by enough participants (3,180/128 and 3,130/128 ~ 25 per vignette), whereas five are considered as minimum (Auspurg and Hinz, 2015). All participants received a small monetary incentive for participation (£=2.50 / €2.50).

Quality controls. To ensure valid data, we applied a number of quality controls. First, we clarified in the introduction that attention will be checked and that respondents failing the attention checks, i.e. click "totally agree" when reading this will be removed from participation without warning (n=29, GE=19 and UK=10). Second, for our vignettes and to ensure participants carefully read the text we implemented a minimum time (at first 30 seconds, decreasing gradually) before participants were able to progress with the survey. Third, we checked on whether we needed to exclude respondents who completed the study in less than half the median response time (n = 0) or took longer than three times the median response time (n = 0). The final sample included GE=299 and UK=303. Data were collected based on quota sampling representing the UK population, such that the overall sample and each experimental group were balanced in terms of gender (female GE = 42.1%, UK = 51.4) and age (GE: M = 39yrs., age_{min} = 19 yrs. to age_{max} = 69 yrs.; UK: M = 44.96yrs., age_{min} = 19 yrs. to age_{max} = 78 yrs.).

Multilevel models: Because the respondents evaluated multiple vignettes, the data is nested in the individual and needs to be considered as hierarchical, since variance of the dependent variables can be decomposed into variance within respondents (due to the different types of vignettes) and the variance between respondents (due to different types of personal characteristics) (Auspurg and Hinz, 2015). The standard method to analyse hierarchical data is multilevel models (Dülmer, 2015) also recommended (Oll *et al.*, 2016) or used in more recent articles using factorial surveys (e.g. Hahn *et al.*, 2020). We analyse our data with different multilevel models (following recommendations by Hayes, 2006 and Luke, 2011) with the final model including level one and two variables. The results are presented on slides 89–122.

Irispay E-Concept Store

"Irispay E-Concept Store"
Irispay launched a walk-in vending solution in Malaysia. Now seems to be permanently closed
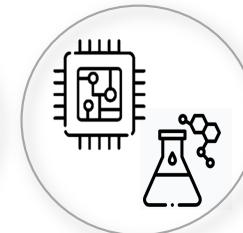
Launch: 2018

Types

Location
High footfall locations

Provider
Test lab for tech provider

Delivery
Walk-in vending

Retail Mix

Provider: Irispay, Malayan Payment Provider
Size & build: larger, fixed walk-in vending solution
Location: Malaysia
Target group: not specified
Products: C-store assortment and hot food service solutions
Access to store: seems free
Access to products: restricted, vending solution
Checkout: in-app mobile payment via vending solution
Replenishment: unclear
Expansion plans: goal of 250 stores communicated in 2018, not materialised, plans seems to be discontinued

Naraffar

"Naraffar"
A local entrepreneur launched this unmanned store in a rural Swedish community

Launch:
2016

Types

Location

Rural food deserts

Provider

New format for retailer

Delivery

Fully unmanned

Retail Mix

Provider: originally independent retailer, now part of MobyMart

Size & build: normal fixed store in remote location

Location: Vilken, Sweden

Target group: not specified

Products: supermarket assortment

Access to store: via app

Access to products: free

Checkout: self-checkout via app with monthly payment

Replenishment: unclear

Expansion plans: unclear, seems discontinued

The Moby Mart

"The Moby Mart"

The startup, Wheelys, has released a self-driving mobile unmanned store.
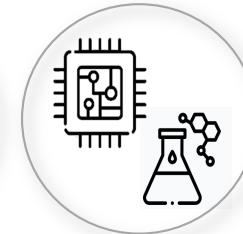
Launch: 2017

Types

Location

High footfall locations

Provider

Test lab for tech provider

Delivery

Fully unmanned

Retail Mix

Provider: MobyMart
Size & build: container size, moveable (self-driving), later semi-fixed
Location: Shanghai, China,
Target group: not specified
Products: C-store assortment
Access to store: via app
Access to products: free
Checkout: RFID based and via app
Replenishment: unclear
Expansion plans: 10 more store announced in 2018, does not seem to have happened, company looking for additional funding, website is empty

Hirota Express en Casa

"Hirota Express en Casa"
Hirota retailer launched 2 unmanned container-type stores as a response to Covid-19

Launch: 2020

Types

Location
High footfall locations

Provider
New format for retailer

Delivery
Fully unmanned

Retail Mix

Provider: Hirota, Brazilian Retailer
Size & build: 15-30m2, container size, fixed
Location: Sao Paulo
Target group: not specified
Products: C-store assortment (500 SKUs)
Access to store: via app
Access to products: not restricted
Products:
Checkout: self-checkout terminals
Replenishment: through supply chain of Hirota supermarkets
Expansion plans: 2 stores opened in 2020 as a COVID response, plans to reach 100 microstores by the end of 2022

F5 Future Store

"F5 Future Store"
Chinese startup that acts as walk-in vending for hot and cold food
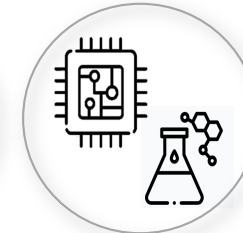
Launch: 2014

Types

Location

High footfall locations

Provider

Test lab for tech provider

Delivery

Walk-in vending

Retail Mix

Provider: Chinese tech startup
Size & build: 30-60m2, fixed
Location: first test store in 2014 in China, multiple locations across China
Target group: not specified
Products: C-store assortment and food service
Access to store: no restrictions
Access to products: through vending solution
Checkout: via vending, in-app mobile payment
Replenishment: unclear
Expansion plans: unclear

Eat Box

"Eat Box"

Eat Box launched this container-style store in 2017. With around 100 stores now open across Beijing

Launch: 2017

Types

Location
High footfall locations

Provider
New format for retailer

Delivery
Fully unmanned

Retail Mix

Provider: Eat Box

Size & build: 30m^2**,** large container size, semi-fixed

Location: China

Target group: not specified

Products: C-store assortment (approximately 600 SKUs)

Access to store: via app and QR code and facial recognition

Access to products: free, but equipped with RFID chips

Checkout: via app and facial recognition, double doors exit linked to payment

Replenishment: unclear

Expansion plans: unlikely from 2018, does not seem to have materialised

Touch To Go

"Touch to Go"
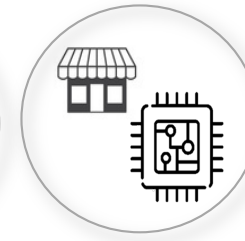JR East launched this unmanned store at a Japanese railway station

Launch: 2019

TICKET TO TOMORROW

Types

Location

Traffic hub locations

Provider

Hybrid & Cooperation

Delivery

Fully unmanned

Retail Mix

Provider: joint venture JR East Startup and Singpost Co
Size & build: 60m2, semi-fixed
Location: Tokyo, Japan
Target group: commuters
Products: C-store assortment
Access to store: restricted via QR code & phone
Access to products: free, but RFID tagged
Checkout: automated via terminal that verifies products and exit linked to payment
Replenishment: unclear
Expansion plans: not clear