



Project Assignment Phase 2
Physical Database Design and Tuning
Business domain: E-Commerce



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Present to
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A Report Submitted in Partial Fulfillment of
the Requirements for

ITCS 413: Database Design

Faculty of Information and Communication Technology
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Business Overview

Business Profile



Amazon.com, Inc. is the largest eCommerce company by Market Value and retail sales in the world founded in 1995 by *Jeff Bezos*. It is offering various products and services such as Retail goods, Web services, Electronic devices, etc. [1]

Mission Statement and Objectives

Amazon is guided by four principles: customer obsession rather than competitor focus, passion for invention, commitment to operational excellence, and long-term thinking. Amazon's mission statement is to serve consumers through online and physical stores and focus on selection, price, and convenience. On the other hand, for the vision statement, they aim to be Earth's most customer-centric company where customers can find and discover anything they want to buy online and endeavor to offer their customers the lowest possible prices.[7] The long-term goals of the company are 1) Using 100% of renewable energy throughout every operation in the company. 2) Reduce the release of carbon from the shipment by 50% by 2030. 3) Increase the representation of different employee backgrounds across every level of the organization. 4) Being the Earth's best employer 5) Giving benefits to the community and 6) Encouraging others to join zero-net carbon emission by 2040.[6]

Scope / Boundaries

In the current era, Amazon provides and serves its products and services across 5 continents around the world including North America, South America, Europe, Asia, and Australia with over 20 countries having dedicated websites for shoppers and sellers including the United States, France, Italy, the United Kingdom, Japan, and many others. The scope of Amazon's operations includes [8]

1. **E-commerce:** Amazon is primarily known for its online retail business that sells a wide range of products such as books, electronics, clothing, and more. This type is the main focus of the project.
2. **Cloud computing:** Amazon Web Services (AWS) is one of the largest cloud computing providers in the world that offers services such as data storage, computing power, and artificial intelligence.

3. **Media and entertainment:** Amazon offers streaming services for movies, TV shows, and music through Amazon Prime Video and Amazon Music.
4. **Advertising:** Amazon offers advertising services to its platform to target its customers effectively.
5. **Logistics and transportation:** Amazon has its own delivery and logistics network to deliver products to its customers quickly and efficiently.

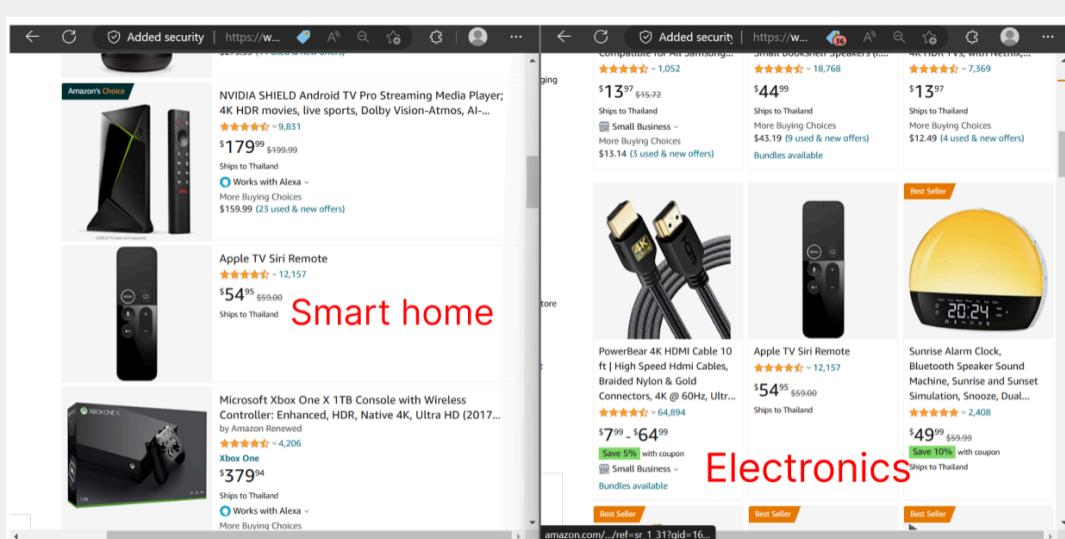
The boundaries of Amazon's operations are not limited to any particular country or region. However, they do have to comply with local laws and regulations in the countries where it operates. For instance, firearms and ammunition are often prohibited and strictly regulated and Amazon Japan does not allow the sale of these kinds of products on its platform. Amazon India does not sell prescription drugs. [9]

Target Groups of customers

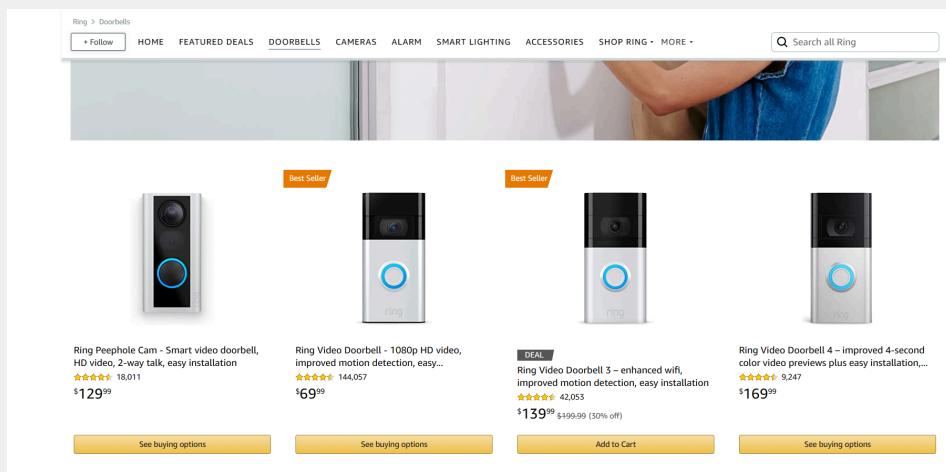
In the scope of E-commerce which is the main focus of this project, Amazon's target customers are mostly individual consumers and to understand deeper on Amazon customer is segmented into four standpoints: demographic, geographic, behavioral, and psychographic segmentation.

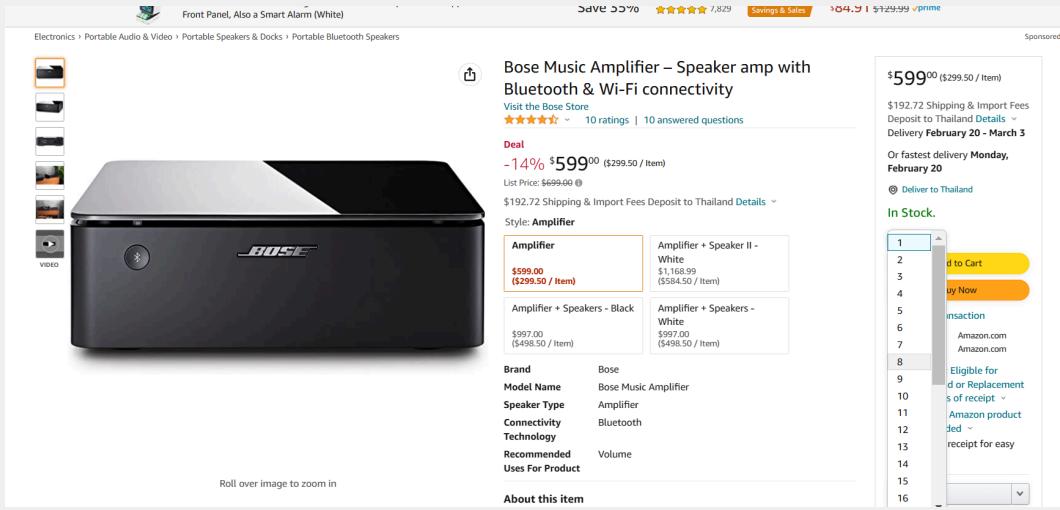
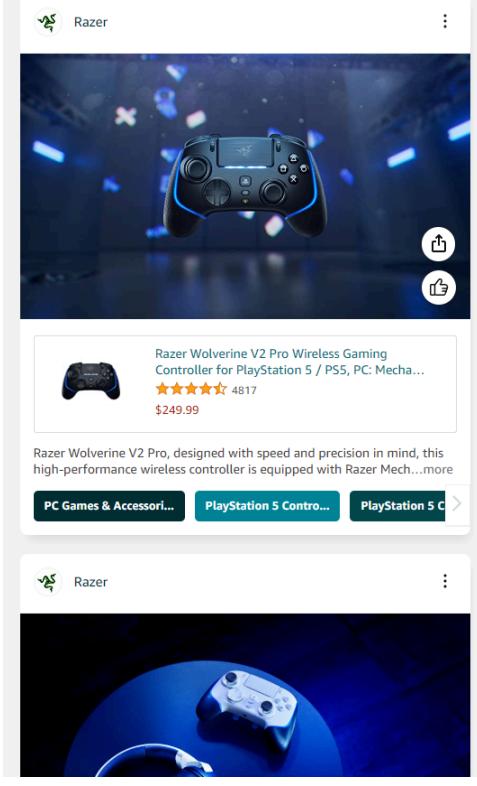
1. **Amazon demographic segmentation:** They include adults aged 18 to 60 with 45 percent in the 35-49-year-old aged group. They focus on middle-aged families with an annual household income of nearly \$85,000
2. **Amazon geographic segmentation:** Over 100 countries, more than 60 percent of its website traffic comes from the US and is followed far behind by Germany, the UK, and Japan.
3. **Amazon behavioral segmentation:** According to an Amazon customer survey, 66 percent of customers in the US stated that the main reason for shopping was the availability of almost anything they need, while 56 percent claimed that their favorite aspect was the free shipping that comes with Prime membership. 48% of those with Prime membership buy at least once a week, 74% every few weeks, and 37% of casual (non-Prime) Amazon customers purchase multiple times a year.
4. **Amazon psychographic segmentation:** There are various personality types engaging with the brand defined as "Resigned" or "Struggler" to "Aspirer", "Succeeder" and "Reformer".

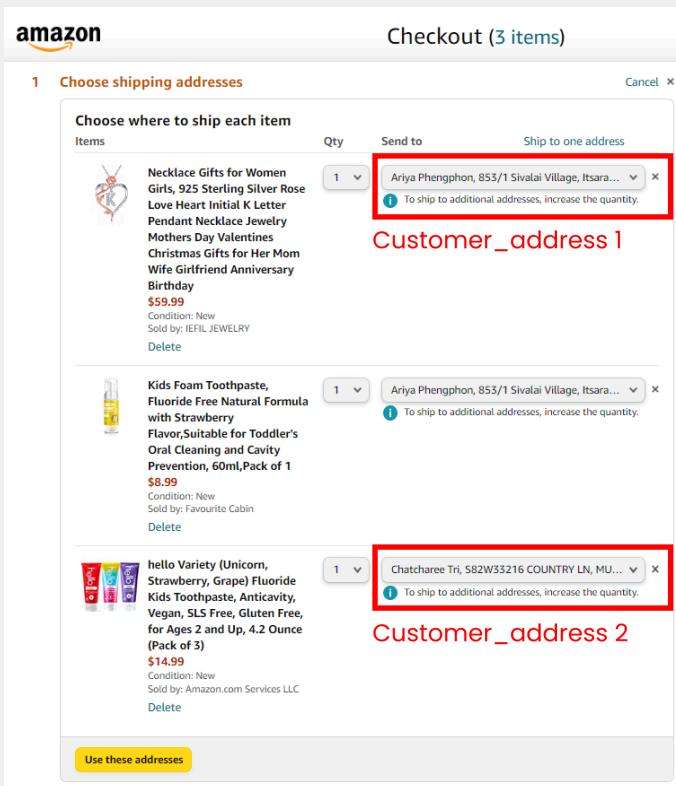
Business Rules and Constraints (from Phase 1)

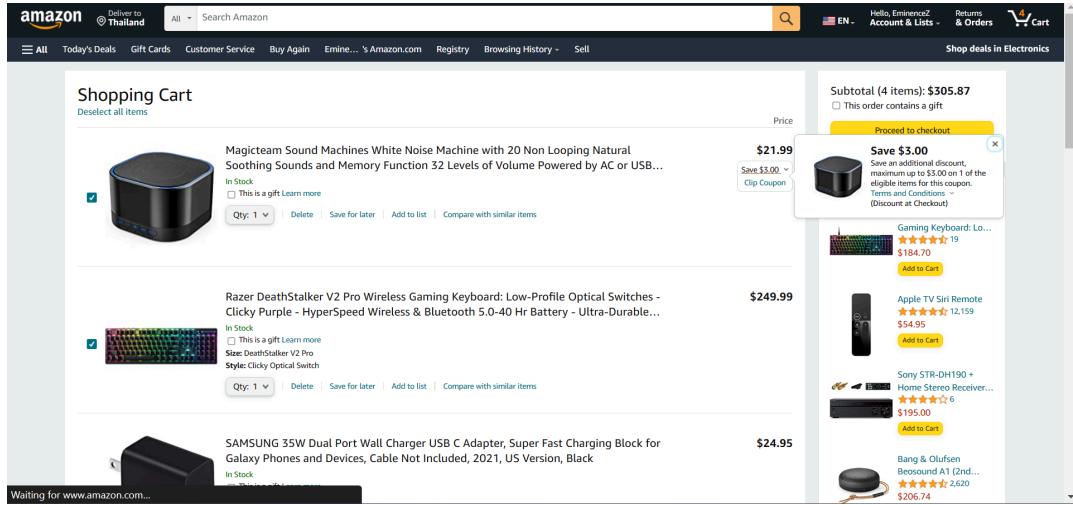
No	Business rules	Relationships
TR1	<p>One Product can be included in many Product_departments.</p> <p>One Product_department can include many Products.</p> 	M:M
TR2	<p>One Product_inventory can include many Product_departments.</p> <p>One Product_department can be included in only one Product_inventory.</p> 	1:M

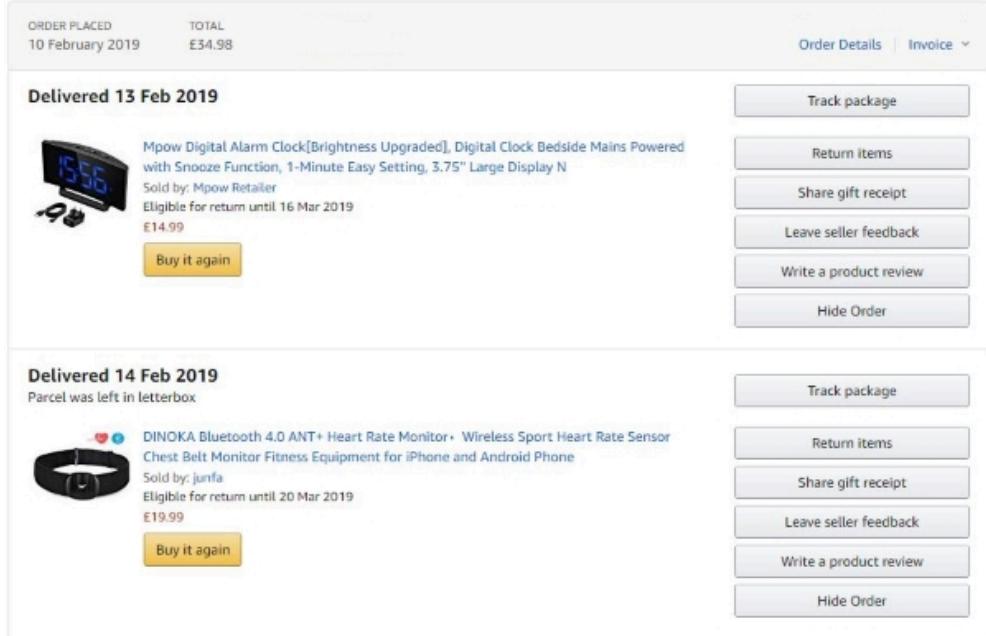
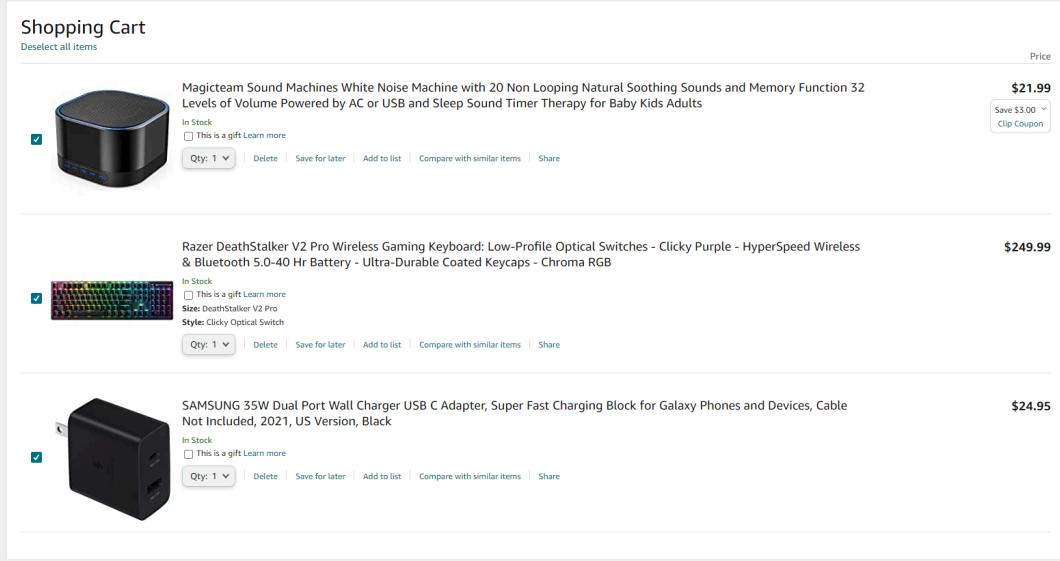
Ref: <https://www.bangkokbiznews.com/news/970092>

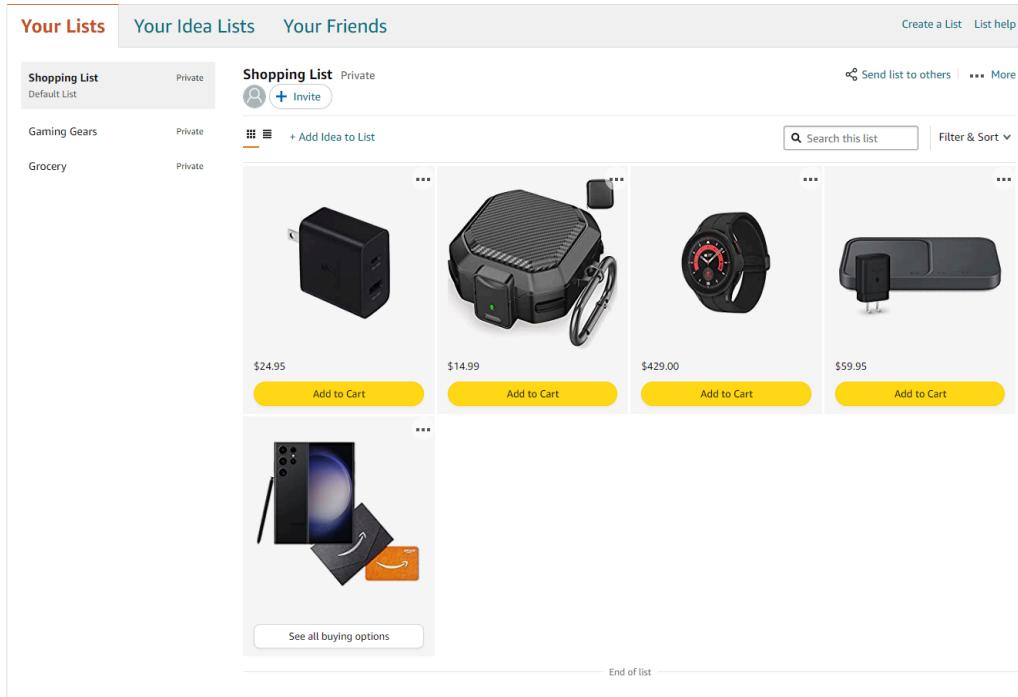
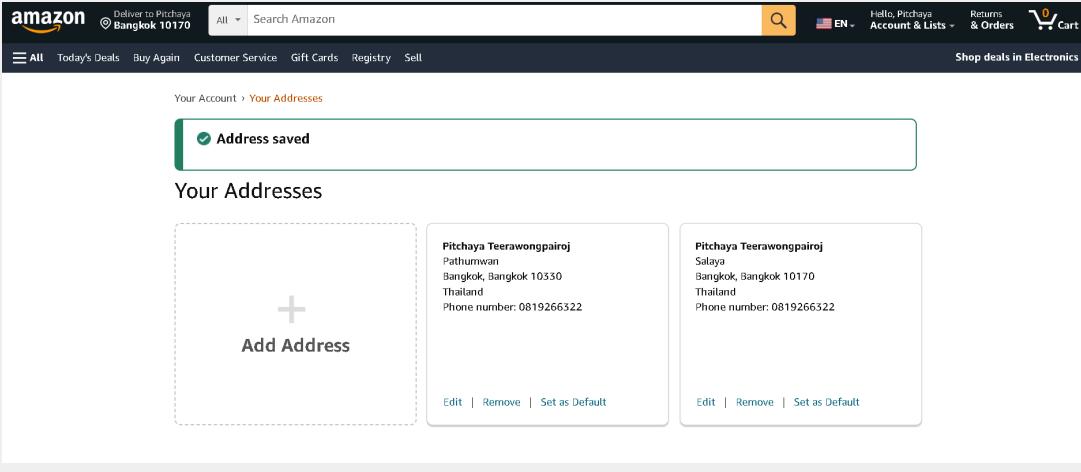
No	Business rules	Relationships															
TR3	<p>One Product_vendor can sell many Products. (or 0)</p> <p>One Product can be sold by many Product_vendors.</p>	M:M															
	 <p>The screenshot shows a product listing for Ring video doorbells. It features four products: Ring Peephole Cam, Ring Video Doorbell, Ring Video Doorbell 3, and Ring Video Doorbell 4. Each product has a small image, a 'Best Seller' badge, a brief description, and a price. Below each product are buttons for 'See buying options' and 'Add to Cart'.</p> <table border="1"> <thead> <tr> <th>Product</th> <th>Description</th> <th>Price</th> </tr> </thead> <tbody> <tr> <td>Ring Peephole Cam</td> <td>Smart video doorbell, HD video, 2-way talk, easy installation</td> <td>\$129⁹⁹</td> </tr> <tr> <td>Ring Video Doorbell</td> <td>1080p HD video, improved motion detection, easy...</td> <td>\$69⁹⁹</td> </tr> <tr> <td>Ring Video Doorbell 3</td> <td>enhanced wifi, improved motion detection, easy installation</td> <td>\$139⁹⁹ (\$49.99 off)</td> </tr> <tr> <td>Ring Video Doorbell 4</td> <td>improved 4-second color video previews plus easy installation,...</td> <td>\$169⁹⁹</td> </tr> </tbody> </table>	Product	Description	Price	Ring Peephole Cam	Smart video doorbell, HD video, 2-way talk, easy installation	\$129 ⁹⁹	Ring Video Doorbell	1080p HD video, improved motion detection, easy...	\$69 ⁹⁹	Ring Video Doorbell 3	enhanced wifi, improved motion detection, easy installation	\$139 ⁹⁹ (\$49.99 off)	Ring Video Doorbell 4	improved 4-second color video previews plus easy installation,...	\$169 ⁹⁹	
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No	Business rules	Relationships
TR5	<p>One Product_vendor can be included in many Product_inventories.</p> <p>One Product_inventory can include many Product_vendors.</p> 	M:M
TR6	<p>One Product_vendor can upload many Posts.</p> <p>One Post is uploaded by a Product_vendor.</p> 	1:M

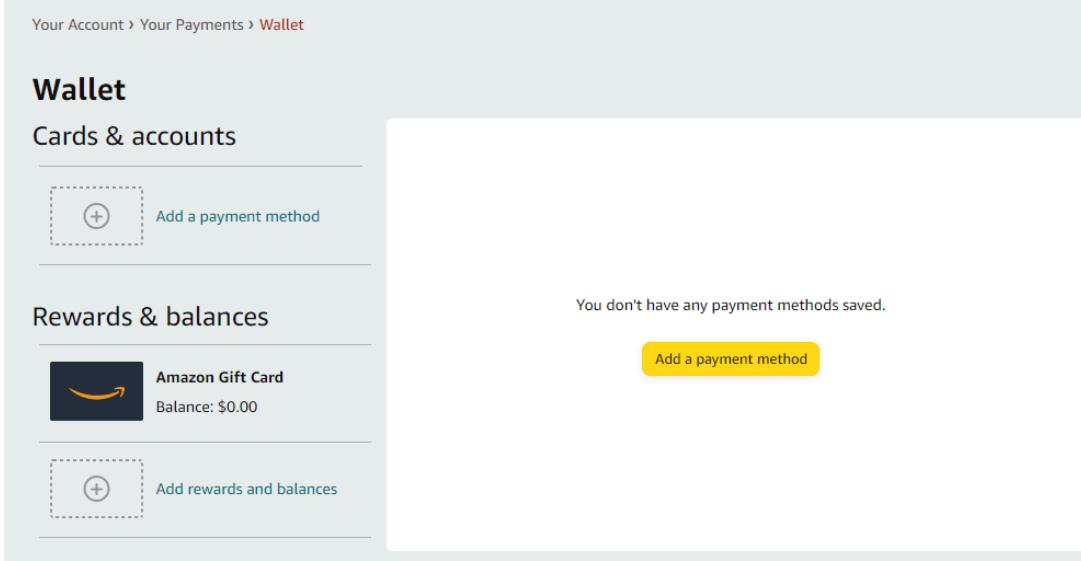
No	Business rules	Relationships
TR7	<p>*Relational Schema</p> <p>One Order_item can include one customer_addresses.</p> <p>One customer_address can be included in many Order_items.</p> <p>(or 0)</p>	1:M
	 <p>The screenshot shows the 'Choose shipping addresses' step in the Amazon checkout process. Three items are listed:</p> <ul style="list-style-type: none"> Necklace Gifts for Women Girls, 925 Sterling Silver Rose Love Heart Initial K Letter Pendant Necklace Jewelry Mothers Day Valentines Christmas Gifts for Her Mom Wife Girlfriend Anniversary Birthday \$59.99 Condition: New Sold by: IEFIL JEWELRY Kids Foam Toothpaste, Fluoride Free Natural Formula with Strawberry Flavor, Suitable for Toddler's Oral Cleaning and Cavity Prevention, 60ml, Pack of 1 \$8.99 Condition: New Sold by: Favourite Cabin hello Variety (Unicorn, Strawberry, Grape) Fluoride Kids Toothpaste, Anticavity, Vegan, SLS Free, Gluten Free, for Ages 2 and Up, 4.2 Ounce (Pack of 3) \$14.99 Condition: New Sold by: Amazon.com Services LLC <p>For each item, there is a dropdown menu labeled 'Send to' with a single address selected. A red box highlights the dropdown menu for the first item, which contains the address 'Ariya Phengphon, 853/1 Sivalai Village, Itsara...'. Below this dropdown, a tooltip says 'To ship to additional addresses, increase the quantity.' To the right of the dropdown, the text 'Customer_address 1' is written in red.</p> <p>At the bottom of the screen, there is a yellow button labeled 'Use these addresses'.</p>	
TR8	<p>One Coupon can discount one Order_item.</p> <p>One Order_item can be discounted with many Coupons. (or 0)</p>	1:M Coupon Stack

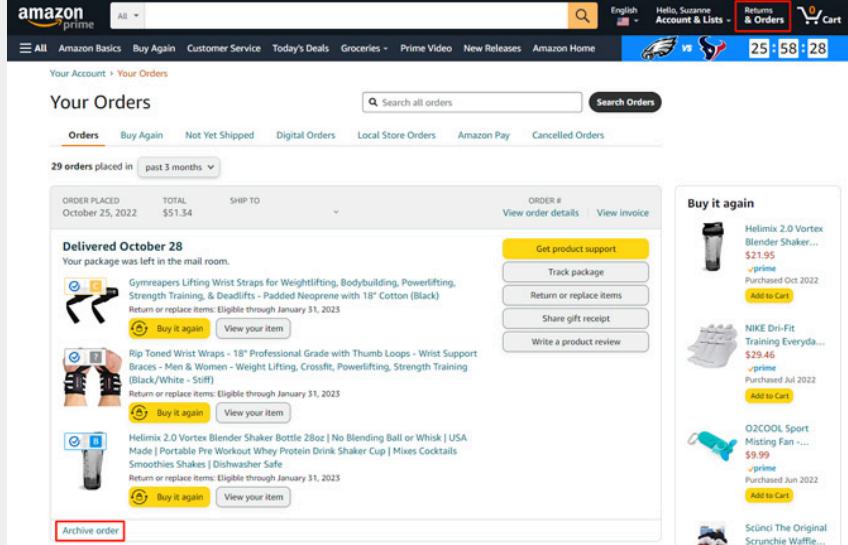
No	Business rules	Relationships
		
TR9	<p>One Order_detail can be shipped to one customer.</p> <p>One customer can receive many Order_details.</p>	1:M
TR10	<p>One Order_item can contain one Product.</p> <p>One Product can be included in many Order_items.</p>	1:M

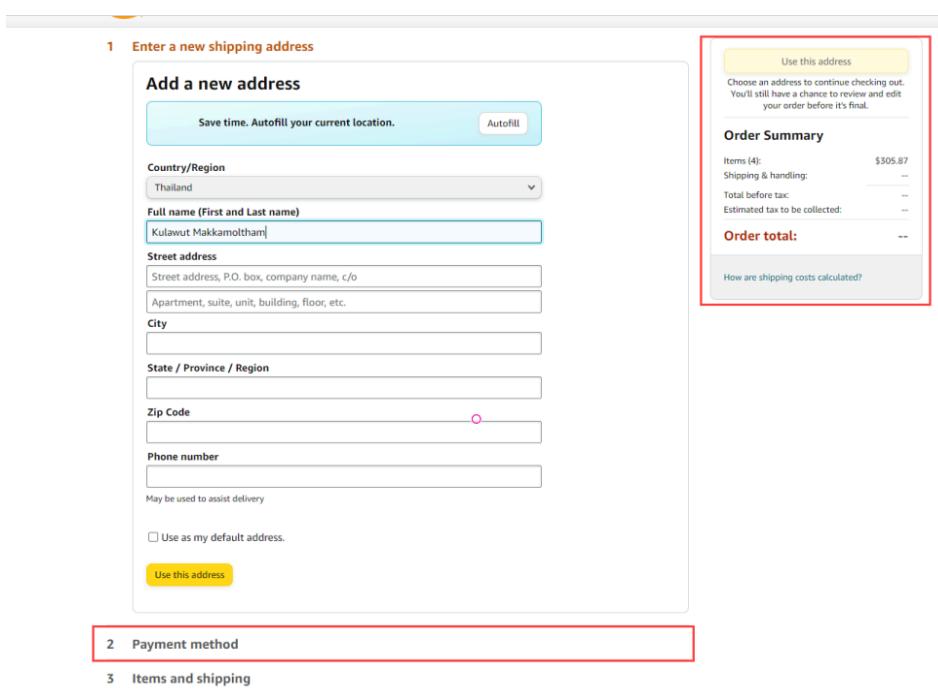
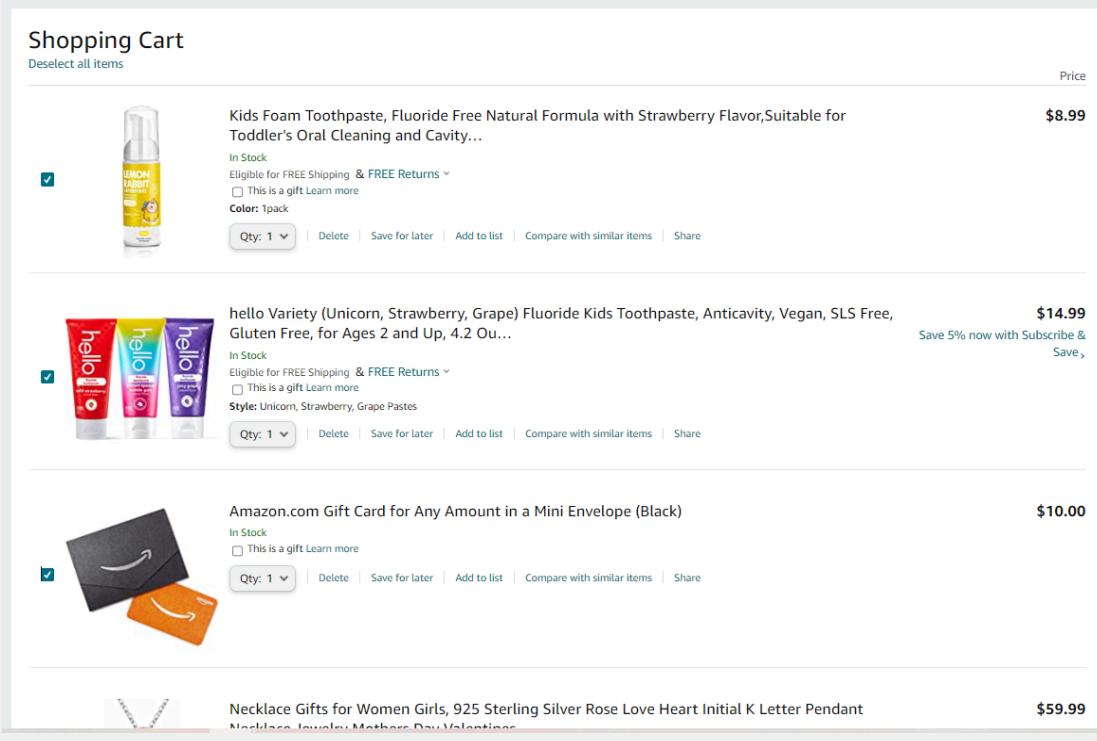
No	Business rules	Relationships
	 <p>Delivered 13 Feb 2019 Mpow Digital Alarm Clock[Brightness Upgraded], Digital Clock Bedside Mains Powered with Snooze Function, 1-Minute Easy Setting, 3.75" Large Display N Sold by: Mpow Retailer Eligible for return until 16 Mar 2019 £14.99 Buy it again</p> <p>Delivered 14 Feb 2019 Parcel was left in letterbox DINOKA Bluetooth 4.0 ANT+ Heart Rate Monitor+ Wireless Sport Heart Rate Sensor Chest Belt Monitor Fitness Equipment for iPhone and Android Phone Sold by: junfa Eligible for return until 20 Mar 2019 £19.99 Buy it again</p>	
	<p>Ref: https://www.alphr.com/hide-amazon-orders/</p>	
TR11	<p>One Product can be added to many customers' Carts. (or 0)</p> <p>One Cart can be added by many Products. (or 0)</p> 	M:M
TR12	<p>One Product can be included in many Shopping_lists. (or 0)</p> <p>One Shopping_list can be included with many Products. (or 0)</p>	M:M

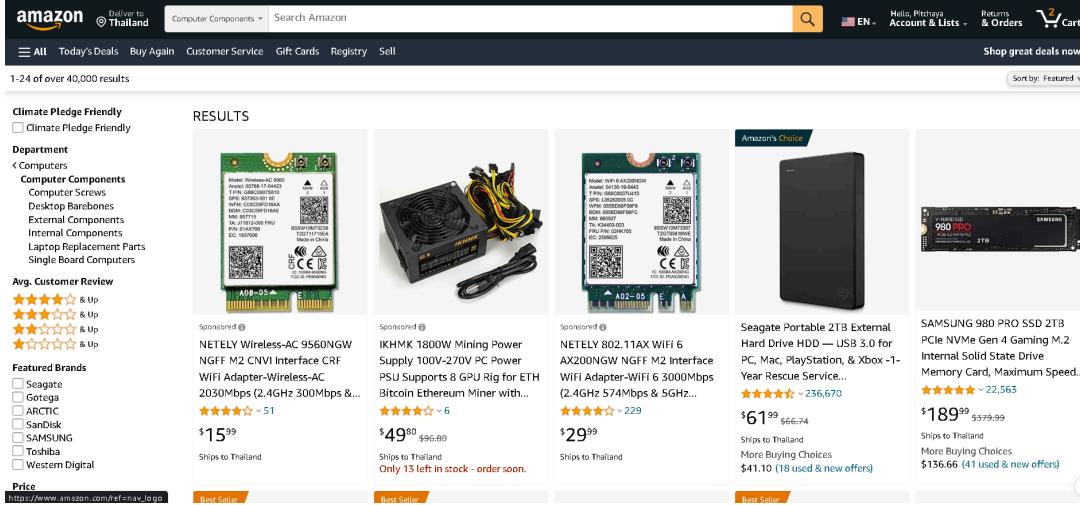
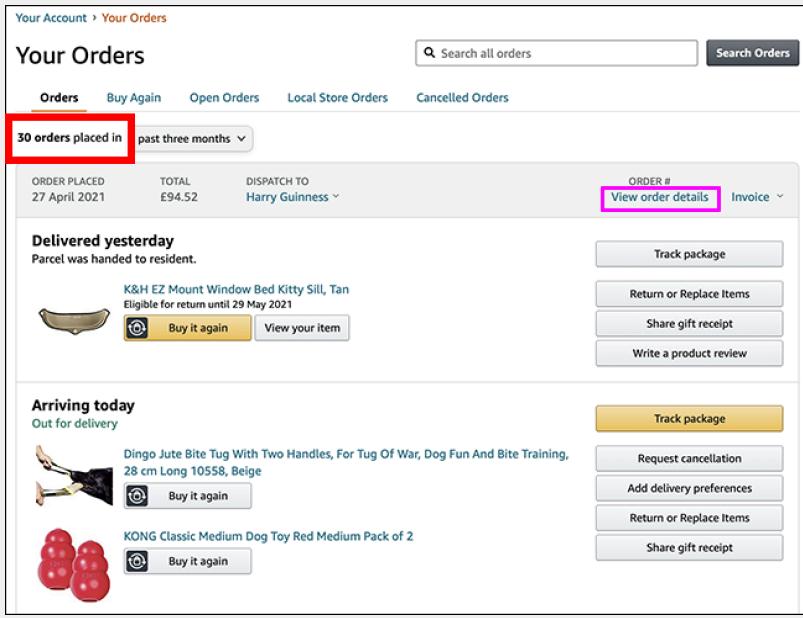
No	Business rules	Relationships
		
TR13	<p>*Relational Schema</p> <p>One customer can have many customer_addresses.</p> <p>One customer_address can belong to only one customer.</p>	1:M
		
TR14	<p>*Coupon Eligibility</p> <p>One Coupon can apply to many Products.</p> <p>One Product can be applied by many Coupons.</p>	M:M

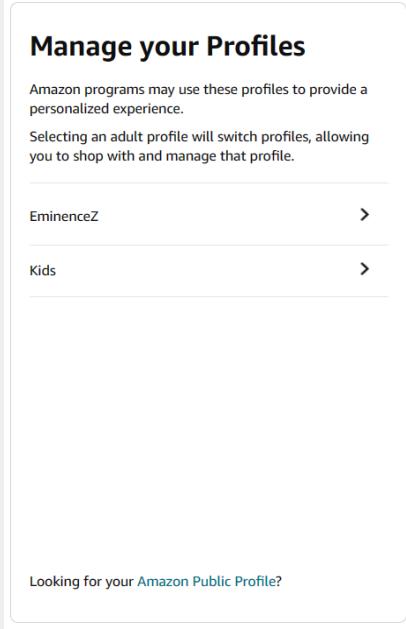
No	Business rules	Relationships			
	<p>Save \$20 on Blackout Curtains with Silver Backing</p> <p>0 items from this promotion in your cart: \$0.00</p> <p>Price</p> <p>\$ Min \$ Max Go</p> <ul style="list-style-type: none"> ★★★★★ & Up ★★★★☆ & Up ★★★☆☆ & Up ★★☆☆☆ & Up <table border="1"> <tr> <td> Deconovo Curtains 108 Inch Length - Soundproof Drapes with Silver Coating Deconovo ★★★★★ 4,644 \$45.79 \$22.90/Count Color: Grey Size: 52x108 Inch Only 7 left in stock - order soon. </td> <td> Deconovo Blue Heat Blocking Curtains for Bedroom - Room Darkening Curtains Deconovo ★★★★★ 4,644 \$43.79 \$21.90/Count Color: Sky Blue Size: 52x108 Inch Only 12 left in stock - order soon. </td> <td> Deconovo Heat Blocking Curtains for Living Room - Curtains 63 Inch Length Deconovo ★★★★★ 4,644 \$33.79 \$16.80/Count Color: Beige Size: 52x63 inch Only 11 left in stock - order soon. </td> </tr> </table> <p>Add to Cart Add to Cart Add to Cart</p>	Deconovo Curtains 108 Inch Length - Soundproof Drapes with Silver Coating Deconovo ★★★★★ 4,644 \$45.79 \$22.90/Count Color: Grey Size: 52x108 Inch Only 7 left in stock - order soon.	Deconovo Blue Heat Blocking Curtains for Bedroom - Room Darkening Curtains Deconovo ★★★★★ 4,644 \$43.79 \$21.90/Count Color: Sky Blue Size: 52x108 Inch Only 12 left in stock - order soon.	Deconovo Heat Blocking Curtains for Living Room - Curtains 63 Inch Length Deconovo ★★★★★ 4,644 \$33.79 \$16.80/Count Color: Beige Size: 52x63 inch Only 11 left in stock - order soon.	
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TR15	<p>One customer can have many Shopping_lists.</p> <p>One Shopping_list belongs to one customer.</p> <p>Your Lists Your Idea Lists Your Friends</p> <p>Shopping List Private Default List</p> <p>Gaming Gears Private</p> <p>Grocery Private</p> <p>Shopping List Private + Invite</p> <p>+ Add Idea to List</p> <p>\$24.95</p> <p>Add to Cart</p>	1:M			

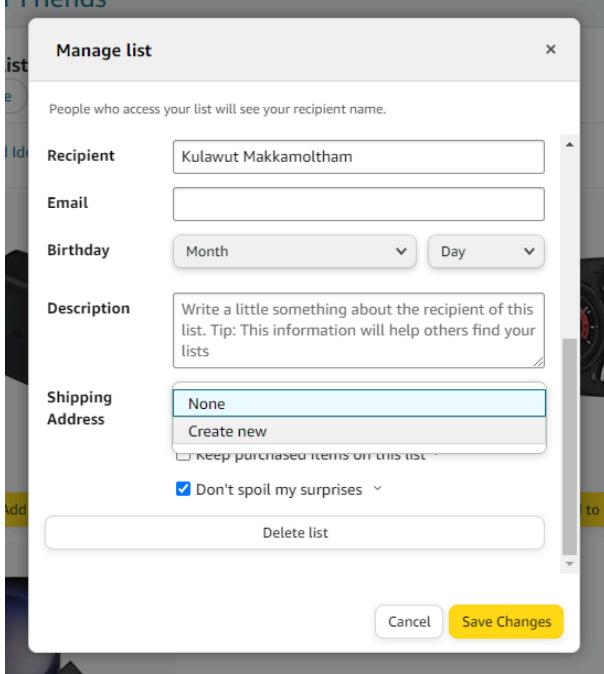
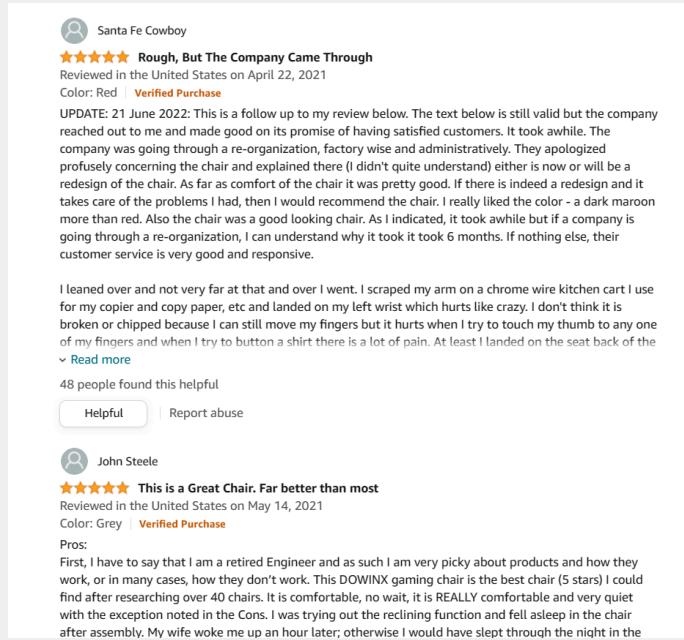
No	Business rules	Relationships
TR16	<p>One customer can add many Payment_methods.</p> <p>One Payment_method belongs to one customer.</p>	1:M
	<p>Your Account > Your Payments > Wallet</p>  <p>The screenshot shows the 'Wallet' section of the Amazon account. It has two main sections: 'Cards & accounts' and 'Rewards & balances'. In the 'Cards & accounts' section, there's a button to 'Add a payment method'. Below it, there's a message: 'You don't have any payment methods saved.' and another 'Add a payment method' button. In the 'Rewards & balances' section, there's an 'Amazon Gift Card' entry with a balance of '\$0.00' and a button to 'Add rewards and balances'.</p>	
TR17	<p>One customer can have many Gift_Cards.</p> <p>One Gift_Card belongs to one customer.</p>	1:M
	<p>Gifts, Gift Cards and Registries > Gift Cards</p> <h3>About Amazon.com Gift Card Restrictions and Prohibited Activities</h3> <p>There are certain restrictions in connection with the use of Amazon.com Gift Cards. If you engage in these activities, Amazon.com may prevent you from claiming or redeeming gift cards, or may take further action on your account without a refund. You may not:</p> <ul style="list-style-type: none"> • Sell or exchange a gift card for cash or for any other prepaid payment instrument. • Give or receive a gift card as payment for goods or services off of Amazon. A non-Amazon entity or individual asking for Amazon.com or third-party gift cards as a payment method for goods or services may be a scam. See our common gift card scams page for more details. • Purchase a gift card from an unauthorized third party as we cannot guarantee that they are legitimate. • Use a gift card as payment for orders placed for commercial reasons (i.e. sourcing inventory online). That is, you may not use our Amazon.com Gift Cards to fulfill sales or fund purchases that you are making with the intent of reselling or exporting the goods or services. • Use a gift card to purchase certain ineligible goods and services such as collectible coins or other gift cards. The goods and services eligible for purchase with our Amazon.com Gift Cards are subject to change in our sole discretion. You'll need to provide a credit card, debit card, or other valid payment method to pay for an order that includes any ineligible items. • Transfer a gift card to another account once the claim code has been redeemed. • Redeem a gift card to an account if you are not the intended recipient. An example of when you are the intended recipient is if you received the gift card as a gift. You are not the intended recipient if you fraudulently deceived the purchaser into giving or selling you a gift card (even if they willingly do so at the time of transfer). • Use a gift card for any illegal or unauthorized purpose. 	

No	Business rules	Relationships
TR18	<p>One customer can have many Coupons. (or 0)</p> <p>One Coupon belongs to one customer.</p>	1:M
	<p>Amazon.com Promotional Terms & Conditions Lightning Deals Claim a Lightning Deal Join a Lightning Deal Waitlist Get Multiple Item or Best Value Discounts Best Value Discounts Terms & Conditions Multiple Item Discount Terms & Conditions Claim a Mail-In Rebate Claim Free Product Offers Redeem Promotional Codes Redeem a Product Voucher View Amazon Product Voucher Balance Amazon Coupon Terms & Conditions Lightning Deal Terms & Conditions Sweepstakes Terms and</p>	<p>Payment, Pricing & Promotions > Promotions & Membership Programs ></p> <h2>Amazon Coupon Terms & Conditions</h2> <p>Read the Amazon Coupon terms and conditions.</p> <ul style="list-style-type: none"> • Coupons are valid for a limited time only. Amazon reserves the right to modify or cancel coupons at any time. • If you do not purchase the qualifying items added to your Cart when the coupon is in effect, the discount will not apply. • The coupon applies only to qualifying items displaying the coupon offer in your Coupon Book and on the item detail page. • The coupon offer will not be valid until it is applied to the qualifying item. • The coupon may only be used on www.amazon.com and in conjunction with the purchase of products shipped and sold by Amazon.com and not on products sold by third-party sellers. • <u>The promotion is limited to one coupon per customer.</u> • Promotion may not be combinable with mail-in rebates. • If you return any of the items purchased with a coupon, the coupon discount or value may be subtracted from the return credit. • Applicable shipping and handling charges apply to all products. • Add-on Items require a minimum purchase. See amazon.com/addon for details. • Offer good while supplies last. • Void where prohibited. • Amazon has no obligation for payment of any tax in conjunction with the distribution or
TR19	<p>One Order_details can have many Order_items.</p> <p>One Order_item can be included in one Order_detail.</p>	1:M
		<p>Ref: https://help.libbey.com/hc/article_attachments/360074512651/mceclip0.png</p>
TR20	<p>One Order_details can be paid with one Payment_method.</p> <p>One Payment_method can be involved in many Order_details.</p>	1:M

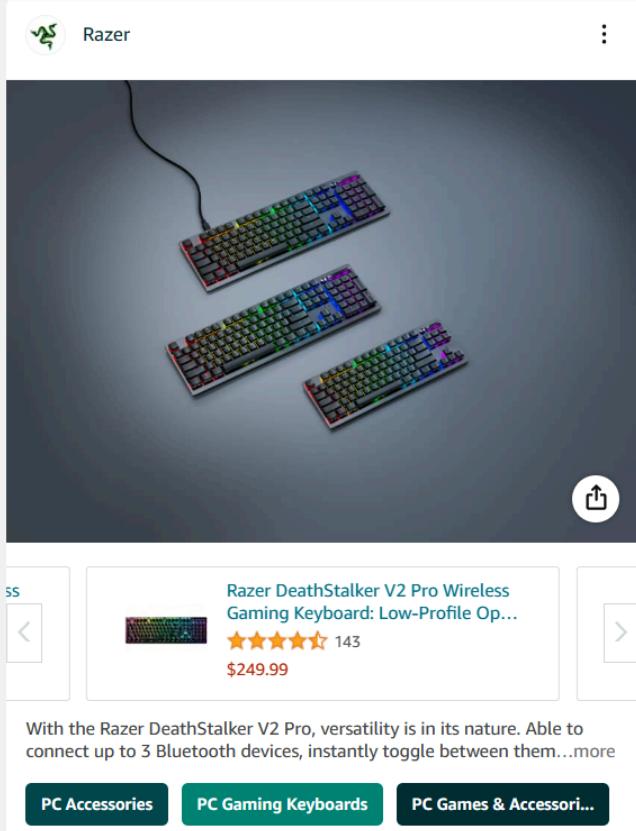
No	Business rules	Relationships															
	 <p>1 Enter a new shipping address</p> <p>Add a new address</p> <p>Save time. Autofill your current location. <input type="button" value="Autofill"/></p> <p>Country/Region <input type="text" value="Thailand"/></p> <p>Full name (First and Last name) <input type="text" value="Kulawut Makkamolthan"/></p> <p>Street address <input type="text" value="Street address, P.O. box, company name, c/o"/></p> <p>Apartment, suite, unit, building, floor, etc. <input type="text"/></p> <p>City <input type="text"/></p> <p>State / Province / Region <input type="text"/></p> <p>Zip Code <input type="text"/></p> <p>Phone number <input type="text"/></p> <p>May be used to assist delivery <input type="checkbox"/></p> <p><input type="checkbox"/> Use as my default address.</p> <p><input type="button" value="Use this address"/></p> <p>2 Payment method</p> <p>3 Items and shipping</p>																
TR21	<p>One customer can have one Carts.</p> <p>One Cart belongs to one customer.</p>	1:1															
	 <p>Shopping Cart</p> <p>Deselect all items</p> <table border="1"> <thead> <tr> <th></th> <th></th> <th>Price</th> </tr> </thead> <tbody> <tr> <td></td> <td>Kids Foam Toothpaste, Fluoride Free Natural Formula with Strawberry Flavor,Suitable for Toddler's Oral Cleaning and Cavity...</td> <td>\$8.99</td> </tr> <tr> <td></td> <td>hello Variety (Unicorn, Strawberry, Grape) Fluoride Kids Toothpaste, Anticavity, Vegan, SLS Free, Gluten Free, for Ages 2 and Up, 4.2 Ou...</td> <td>\$14.99 Save 5% now with Subscribe & Save,</td> </tr> <tr> <td></td> <td>Amazon.com Gift Card for Any Amount in a Mini Envelope (Black)</td> <td>\$10.00</td> </tr> <tr> <td></td> <td>Necklace Gifts for Women Girls, 925 Sterling Silver Rose Love Heart Initial K Letter Pendant</td> <td>\$59.99</td> </tr> </tbody> </table>			Price		Kids Foam Toothpaste, Fluoride Free Natural Formula with Strawberry Flavor,Suitable for Toddler's Oral Cleaning and Cavity...	\$8.99		hello Variety (Unicorn, Strawberry, Grape) Fluoride Kids Toothpaste, Anticavity, Vegan, SLS Free, Gluten Free, for Ages 2 and Up, 4.2 Ou...	\$14.99 Save 5% now with Subscribe & Save,		Amazon.com Gift Card for Any Amount in a Mini Envelope (Black)	\$10.00		Necklace Gifts for Women Girls, 925 Sterling Silver Rose Love Heart Initial K Letter Pendant	\$59.99	
		Price															
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	Amazon.com Gift Card for Any Amount in a Mini Envelope (Black)	\$10.00															
	Necklace Gifts for Women Girls, 925 Sterling Silver Rose Love Heart Initial K Letter Pendant	\$59.99															
TR22	One Product can be included in many Product_sub_categories .	M:M															

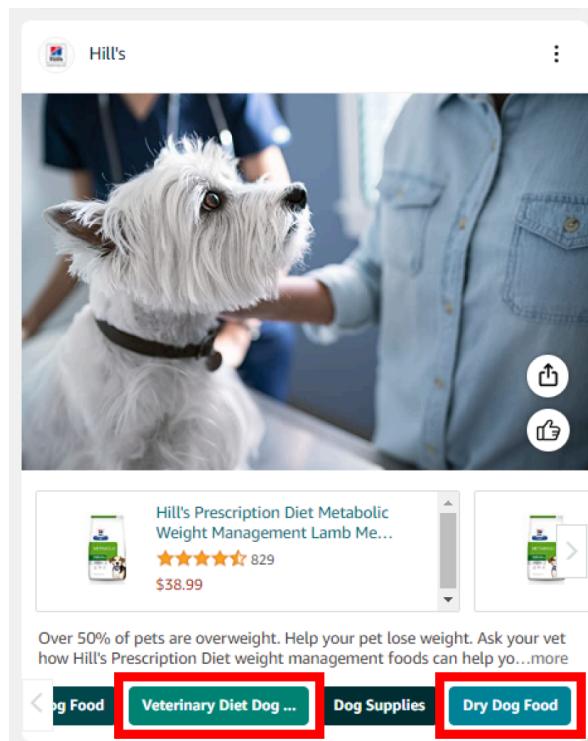
No	Business rules	Relationships
	One Product_sub_category can include many Products.	
		
TR23	<p>One Order_item belongs to only one customer.</p> <p>One customer can own many Order_items.</p>	1:M
		
TR24	<p>One Product_department can include many Product_sub_categories.</p> <p>One Product_sub_category can be included in only one Product_department.</p>	1:M

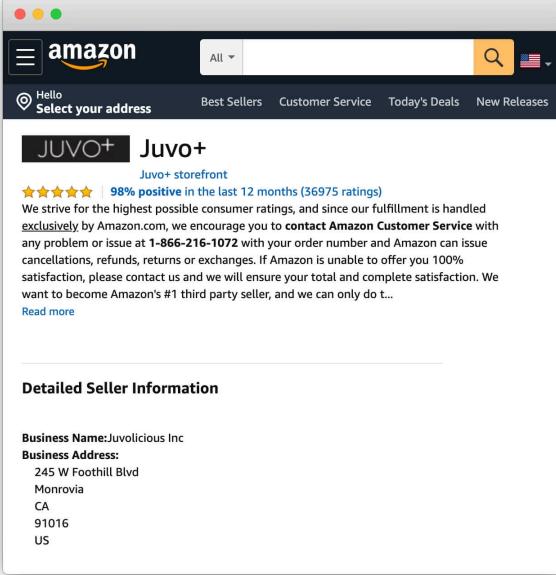
No	Business rules	Relationships
	<p>Department</p> <p>↳ Computers</p> <p>Computer Accessories & Peripherals</p> <ul style="list-style-type: none"> Audio & Video Accessories Blank Media Cable Security Devices Cables & Accessories Cleaning & Repair Computer Cable Adapters Game Hardware Hard Drive Accessories Input Devices Keyboards, Mice & Accessories Media Storage Memory Card Accessories Memory Cards Monitor Accessories Printer Accessories Printer Ink & Toner Racks & Cabinets Scanner Accessories Uninterruptible Power Supply (UPS) USB Gadgets USB Hubs Video Projector Accessories 	
TR25	<p>One customer can have many Profiles.</p> <p>One Profile belongs to one customer.</p>	1:M
		
TR26	<p>*Relational Schema</p> <p>One Shopping_list contains one customer_address.</p> <p>One customer_address can belong to many Shopping_lists.</p>	1:M

No	Business rules	Relationships
		
TR27	<p>One Product can have many Reviews.</p> <p>One Review belongs to one Product.</p> 	1:M
TR28	<p>One customer can create many Reviews.</p> <p>One Review is made by one customer.</p>	1:M

No	Business rules	Relationships
	<p> Ben Jay reviewed a product · Nov 6, 2022</p> <p>★★★★★ Awful adhesion. Limited customizability. They make it seem like you can make any shape you want but, in reality, they only give you a few brackets that hold the rope with tape on the other side that you have to use. The brackets they come with are the only way to mou... See full review</p> <div style="border: 1px solid #ccc; padding: 5px; margin-top: 10px;">  Govee Neon Rope Lights, RGBIC Rope Lights with Music Sync, DIY Design, Works with Alexa, Google Assistant, Gaming Light... ★★★★★ 1,170 </div> <p>1 helpful vote</p> <p> Ben Jay reviewed a product · Nov 1, 2022</p> <p>★★★★★ Verified Purchase Better than Logitech G915 in MOST ways Just received this keyboard in TKL linear after using the Logitech g915 tkl tactile for a week. ... See full review</p> <div style="border: 1px solid #ccc; padding: 5px; margin-top: 10px;">  Razer DeathStalker V2 Pro TKL Wireless Gaming Keyboard: Low-Profile Optical Switches - Linear Red - HyperSpeed Wirele... ★★★★★ 143 </div> <p>9 helpful votes</p>	
TR29	<p>One Post can include many Products.</p> <p>One Product can be included in many Posts.</p>	M:M

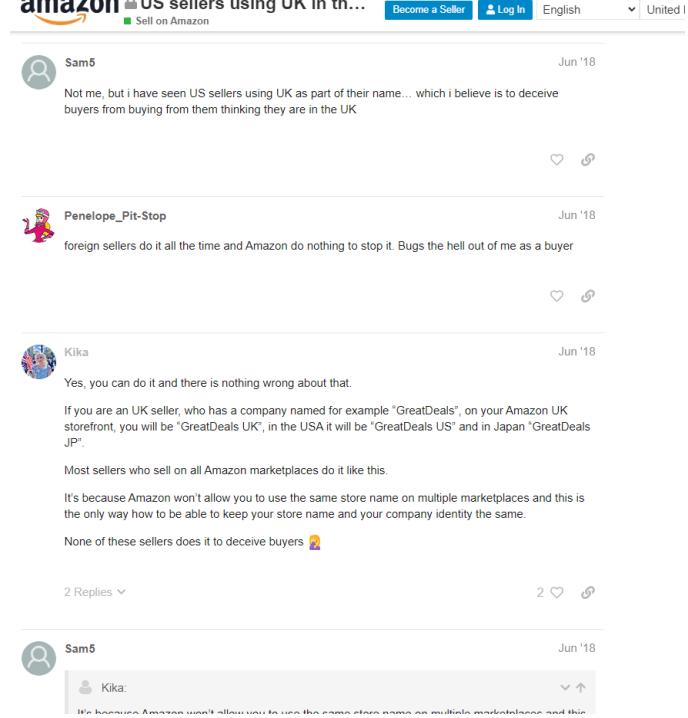
No	Business rules	Relationships
	 <p>With the Razer DeathStalker V2 Pro, versatility is in its nature. Able to connect up to 3 Bluetooth devices, instantly toggle between them...more</p> <p>PC Accessories PC Gaming Keyboards PC Games & Accessori...</p>	
TR30	<p>One Gift_Card can discount one Order_detail.</p> <p>One Order_detail can be discounted by many Gift_Cards.</p>	1:M
	<p>Product features</p> <ul style="list-style-type: none"> Amazon.com Gift Cards never expire and carry no fees. Multiple gift card designs and denominations to choose from. Redeemable towards millions of items store-wide at Amazon.com or certain affiliated websites. Available for immediate delivery. Gift cards sent by email can be scheduled up to a year in advance. No returns and no refunds on Gift Cards. Amazon.com Gift Cards can only be used to purchase eligible goods and services on Amazon.com and certain related sites as provided in the Amazon.com Gift Card Terms and Conditions. To purchase a gift card for use on an Amazon website in another country, please visit: Amazon.ca, Amazon.cn, Amazon.fr, Amazon.de, Amazon.in, Amazon.it, Amazon.co.jp, Amazon.co.uk, Amazon.es, or Amazon.com.au. ASIN : B09PF1QNWS Best Sellers Rank: #1 in Gift Cards (See Top 100 in Gift Cards) #1 in For Him #1 in Christmas (Gift Cards) 	
TR31	<p>One Payment_method can redeem many Gift_Cards.</p> <p>One Gift_Card can be redeemed in only one Payment_method.</p>	1:M

No	Business rules	Relationships
	<p>2 Choose a payment method</p> <p>Devon, get a \$100 gift card instantly upon approval of the Amazon Prime Store Card. Your cost could be \$0.00 instead of \$48.70!</p> <p>Learn more</p> <p>Your credit and debit cards Name on card Expires on</p> <p>Discover Devon Delfino</p> <p>Shop With Points is currently unavailable.(Why?)</p> <p>+ Add a credit or debit card Amazon accepts all major credit cards.</p> <p>Your available balance</p> <p><input checked="" type="checkbox"/> Use your \$10.00 gift card balance</p> <p>+ Enter code Apply</p> <p>Other payment methods</p> <p>+ Apply for an Amazon Store Card Access to exclusive financing offers. No annual fee. Zero fraud liability.</p> <p>+ Add a bank account Use your US based personal checking account. Learn more</p> <p>Use this payment method</p>	
TR32	<p>One Product can have many tags of Product_unit_categories.</p> <p>One Product_unit_category can be included in many Products.</p>	M:M
	 <p>Over 50% of pets are overweight. Help your pet lose weight. Ask your vet how Hill's Prescription Diet weight management foods can help you...more</p> <p>< Dog Food Veterinary Diet Dog ... Dog Supplies Dry Dog Food ></p>	
TR33	<p>One Product_vendor can have many Vendor_addresses.</p> <p>One Vendor_address can belong to only one Product_vendor.</p>	1:M

No	Business rules	Relationships
	 <p>The screenshot shows the Amazon website with the Juvo+ storefront. It displays a 4.5-star rating (98% positive) and a brief description of their fulfillment process. Below this, there's a section titled "Detailed Seller Information" listing the business name and address.</p> <p>Detailed Seller Information</p> <p>Business Name:Juvolicious Inc Business Address: 245 W Foothill Blvd Monrovia CA 91016 US</p>	<p>Added Business Details</p> 

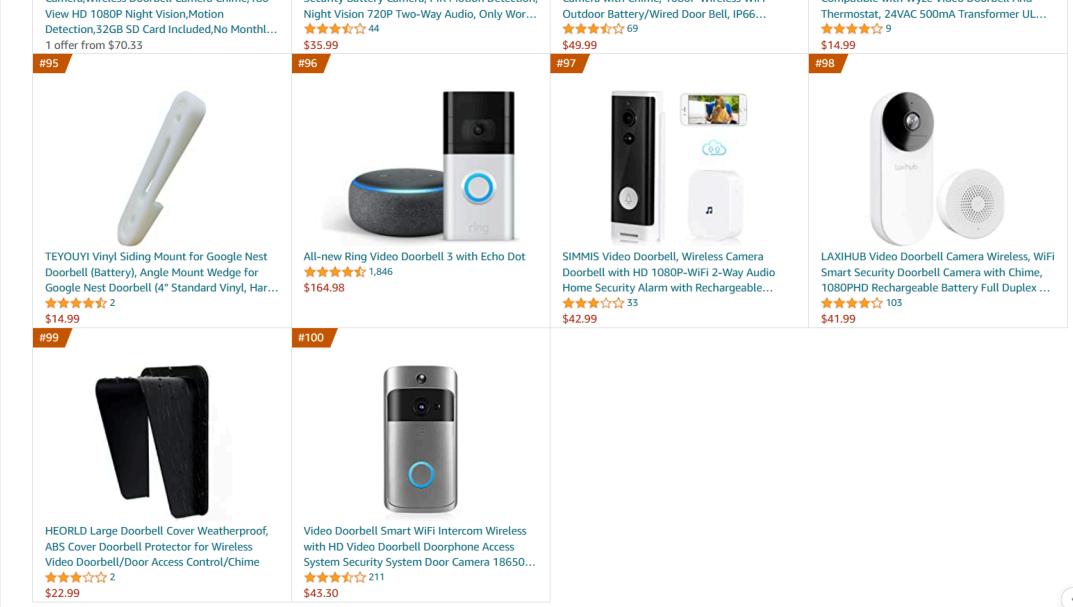
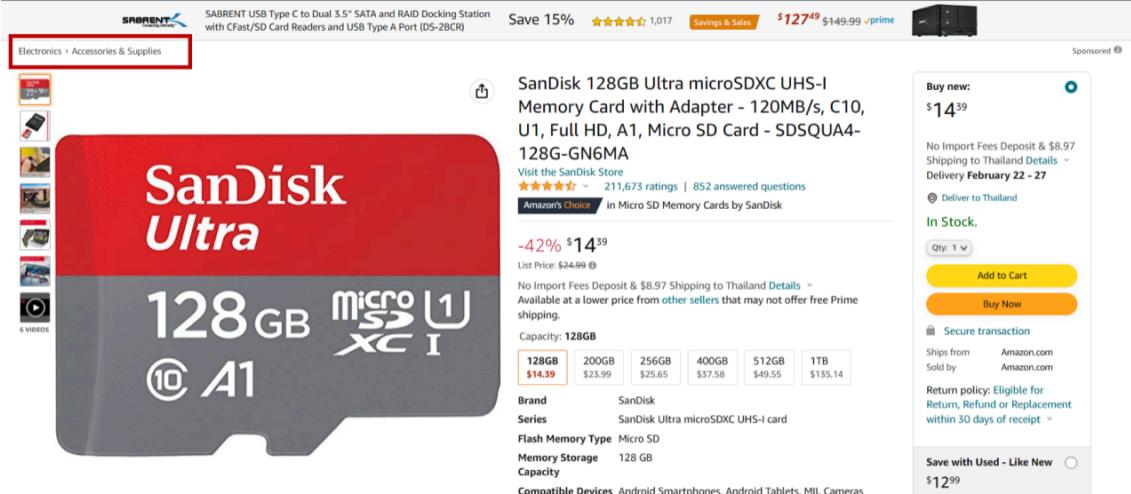
Ref: <https://www.amazon.com/gp/help/customer/display.html?nodeId=201613230>

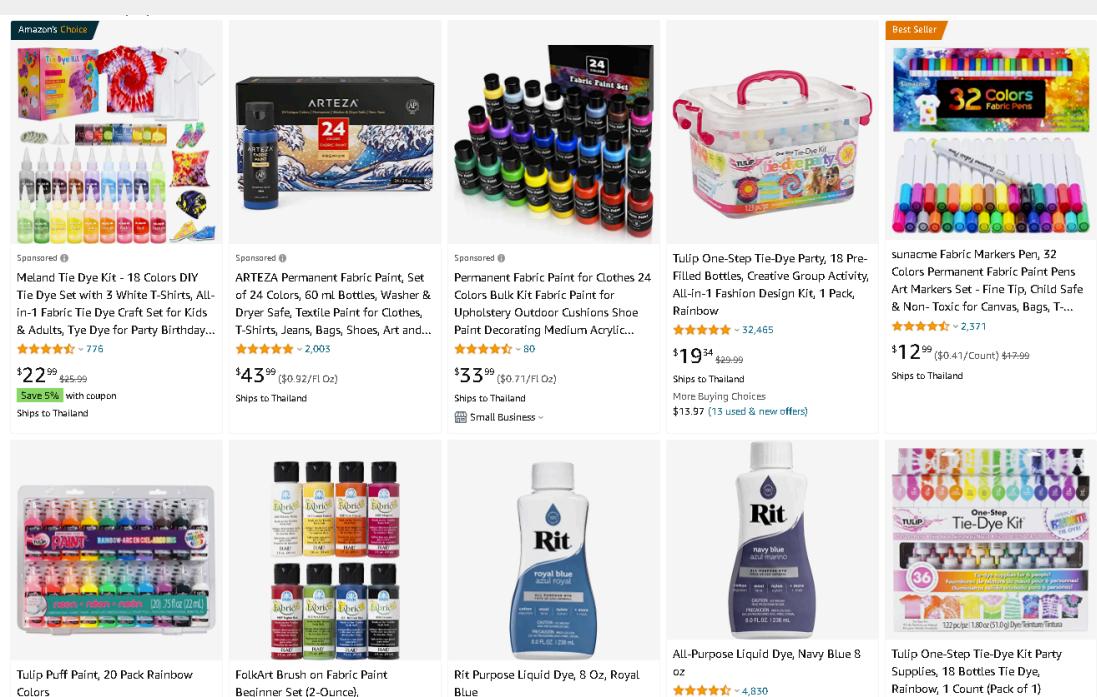
No	Constraints
TR1	Expired Coupon cannot be used.

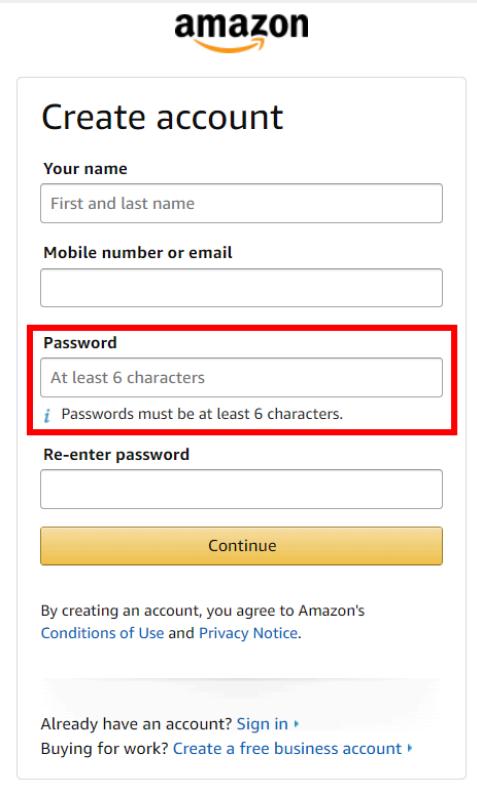
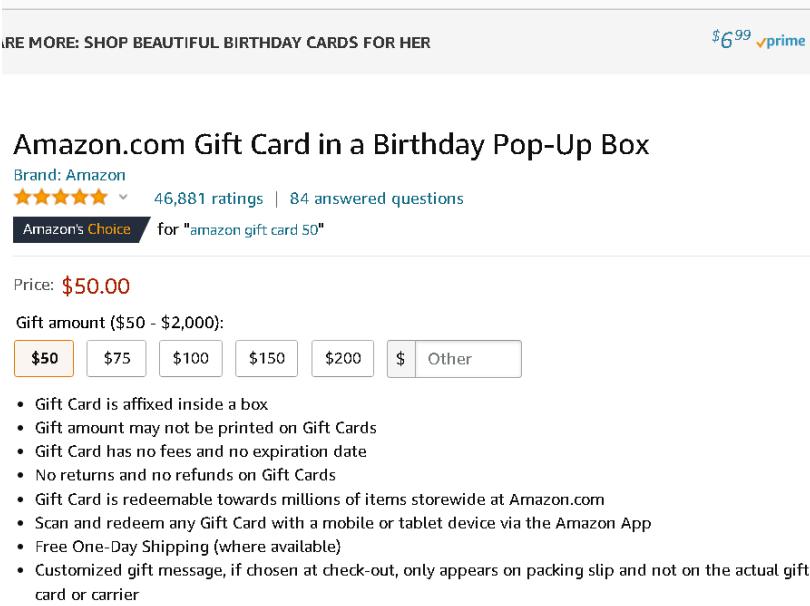
No	Constraints
	<p>Payment, Pricing & Promotions > Promotions & Membership Programs ></p> <h2>Amazon Coupon Terms & Conditions</h2> <p>Read the Amazon Coupon terms and conditions.</p> <ul style="list-style-type: none"> • Coupons are valid for a limited time only. Amazon reserves the right to modify or cancel coupons at any time. • If you do not purchase the qualifying items added to your Cart when the coupon is in effect, the discount will not apply. • The coupon applies only to qualifying items displaying the coupon offer in your Coupon Book and on the item detail page. • The coupon offer will not be valid until it is applied to the qualifying item. • The coupon may only be used on www.amazon.com and in conjunction with the purchase of products shipped and sold by Amazon.com and not on products sold by third-party sellers. • The promotion is limited to one coupon per customer. • Promotion may not be combinable with mail-in rebates. • If you return any of the items purchased with a coupon, the coupon discount or value may be subtracted from the return credit. • Applicable shipping and handling charges apply to all products. • Add-on Items require a minimum purchase. See amazon.com/addon for details. • Offer good while supplies last. • Void where prohibited. • Amazon has no obligation for payment of any tax in conjunction with the distribution or use of any coupon. • Consumer is required to pay any applicable sales tax related to the use of the coupon. • Coupons are void if restricted or prohibited by law.
TR2	<p>Product vendors must not have the same name.</p> <p></p> <p>Ref: https://sellercentral-europe.amazon.com/forums/t/us-sellers-using-uk-in-the-name/162863/3</p>
TR3	<p>Product Rating must fall in the range of 1-5 stars.</p>

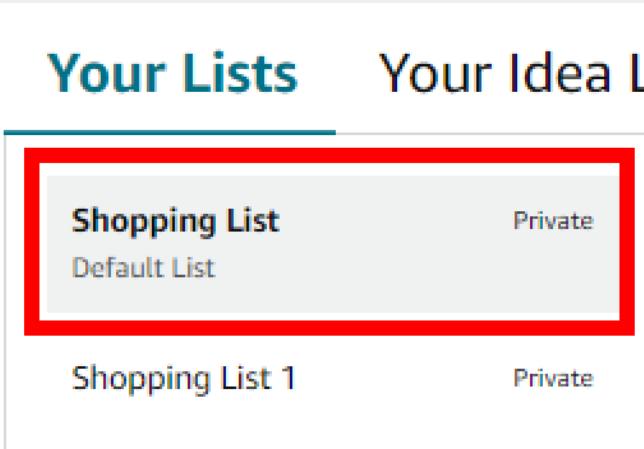
No	Constraints																
	<p>Customer reviews</p> <p>★★★★★ 4.7 out of 5</p> <p>12,157 global ratings</p> <table border="1"> <tr> <td>5 star</td> <td>88%</td> </tr> <tr> <td>4 star</td> <td>6%</td> </tr> <tr> <td>3 star</td> <td>2%</td> </tr> <tr> <td>2 star</td> <td>1%</td> </tr> <tr> <td>1 star</td> <td>3%</td> </tr> </table> <p>▼ How customer reviews and ratings work</p> <hr/> <p>By feature</p> <table> <tr> <td>Volume control</td> <td>★★★★★ 4.6</td> </tr> <tr> <td>Easy to use</td> <td>★★★★★ 4.4</td> </tr> <tr> <td>Remote Control</td> <td>★★★★★ 4.3</td> </tr> </table> <p>▼ See more</p>	5 star	88%	4 star	6%	3 star	2%	2 star	1%	1 star	3%	Volume control	★★★★★ 4.6	Easy to use	★★★★★ 4.4	Remote Control	★★★★★ 4.3
5 star	88%																
4 star	6%																
3 star	2%																
2 star	1%																
1 star	3%																
Volume control	★★★★★ 4.6																
Easy to use	★★★★★ 4.4																
Remote Control	★★★★★ 4.3																
TR4	<p>The customer needs to spend at least 50 USD in the past 12 months to create reviews.</p> <div style="border: 1px solid red; padding: 5px; margin-top: 10px;"> <p>! We apologize but this account has not met the minimum eligibility requirements to write a review. If you would like to learn more about our eligibility requirements, please see our community guidelines.</p> </div> <p>Who can participate</p> <p>If you have an Amazon account, you can:</p> <ul style="list-style-type: none"> • Create and update shopping lists, wish lists, or registries • Update your profile page • Participate in digital and device forums <div style="border: 1px solid red; padding: 5px; margin-top: 10px;"> <p>To do any of the following, you need to have spent at least \$50 on Amazon.com, using a valid credit or debit card, in the past 12 months:</p> <ul style="list-style-type: none"> • Create reviews (including star ratings) • Answer customer questions • Submit helpful votes • Create idea lists • Follow other contributors <p>Promotional discounts don't count towards the \$50 minimum spending requirement.</p> </div>																
TR5	If the product is out of stock, it cannot be added to the cart.																

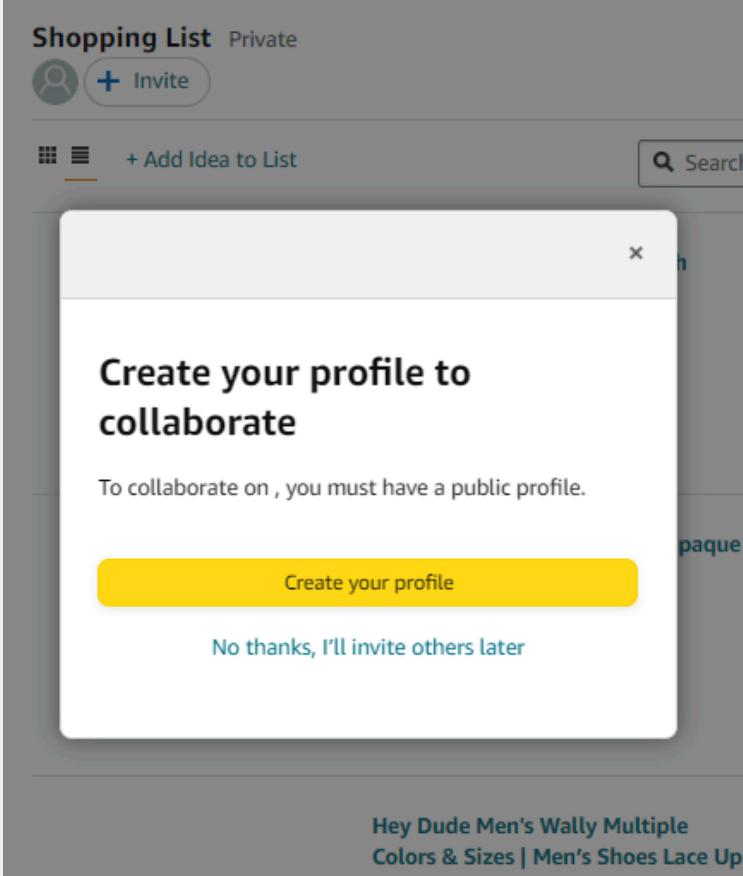
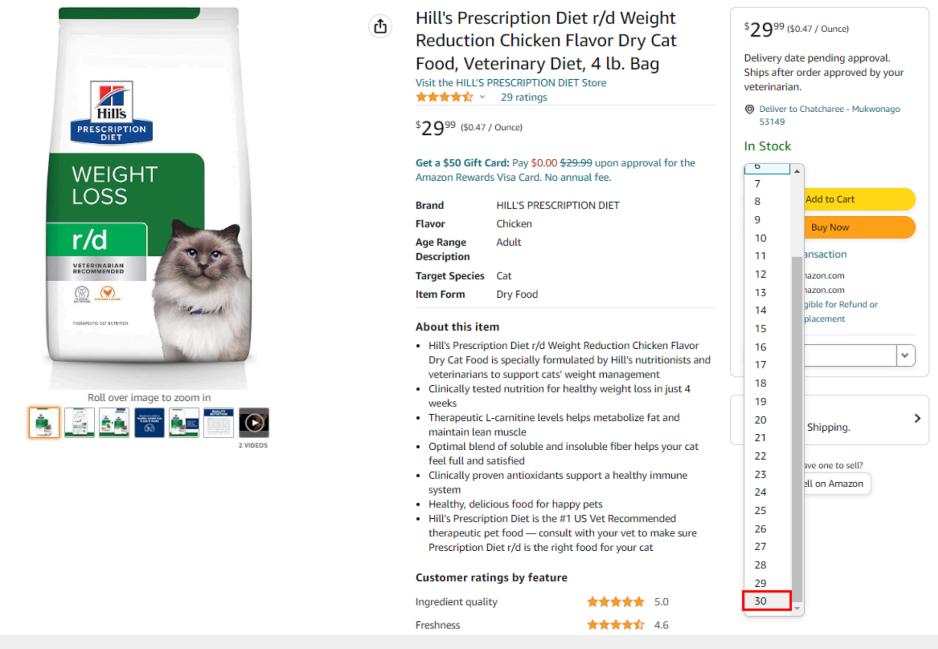
No	Constraints
	<p>MAKING YOUR LIFE EASIER AND MORE ENJOYABLE</p> <p>\$7.69 <small>vprime</small></p> <p>CardNinja Ultra-slim Self Adhesive Credit Card Wallet for Smartphones, Gold</p> <p>Visit the CardNinja Store</p> <p>★★★★★ 5,000 ratings 257 answered questions</p> <p>Currently unavailable. We don't know when or if this item will be back in stock.</p> <p>Style: Classic Color: Gold</p> <p>Brand: CardNinja Color: Gold Formfactor: Pouch Compatible Devices: Smartphones Compatible Phone Models: Compatible with the following smartphones: iPhone 11 / 11 Pro / 11 Pro Max / XS / XS Max / XR / X / 8 / 8 Plus / 7 / 7 Plus / 6 / 6 Plus / 5 / 5s / 5c / 4 / 4s, Samsung Galaxy...</p> <p>See more</p> <p>About this item</p> <ul style="list-style-type: none"> CardNinja can store up to 8 cards AND cash using a durable elastic fabric (driver's license, gym card, train pass) Using 3M adhesive, CardNinja securely attaches to the back of your device. It removes cleanly too! Compatible with the following smartphones: iPhone 11 / 11 Pro / 11 Pro Max / XS / XS Max / XR / X / 8 / 8 Plus / 7 / 7 Plus / 6 / 6 Plus / 5 / 5s / 5c / 4 / 4s, Samsung Galaxy S6 / S5 / S4 / S3, Galaxy Note 5 / 4 / 3 / 2 / 1, LG G3 / G2 / Optimus series, Nexus 6 / 5 / 4, HTC M8 / EVO / Desire / Sense, iPod Touch, Sony Xperia and much more! Works with nearly ANY phone case including: Otterbox, Lifeproof, CaseMate, Belkin, Speck, Apple and more Reviewed by the biggest names in tech: CNET, The New York Times, Macworld, USA Today, The Wall Street Journal, The Next Web, and Cult of Mac
TR6	<p>A customer can have up to 6 profiles.</p> <p>Digital Services & Content › Prime Video › Prime Video Profiles ›</p> <h2>Create and Manage Prime Video Profiles via Website</h2> <p>You can create and manage Prime Video Profiles through the website.</p> <p>You can have up to six user profiles (the default profile, plus up to five additional profiles, which can be either adult or Kid's profiles) within Prime Video on a single Amazon account.</p> <p>To create and manage (edit/delete) a Prime Video profile on the website:</p> <ul style="list-style-type: none"> On the Prime Video home page, select the profile name next to Who's Watching? Click +Add new to create a new profile. You'll be asked to give it a name before saving it. Click Manage profiles then click Edit profile on the next screen. Select the profile you wish to edit, remembering to save your changes. The option to remove profiles is also on this screen.
TR7	<p>A rank position in the bestseller lists includes only the top 100 best-selling products.</p>

No	Constraints
	 <p>The screenshot shows a grid of 10 product cards from an Amazon search results page. The products include:</p> <ul style="list-style-type: none"> #95: Camera Wireless Outdoor Camera Chime, 1080P HD 1080P Night Vision Motion Detection, 32GB SD Card Included, No Monthly Fee, \$70.53 #96: Security Battery Camera, PIR Motion Detection, Night Vision 720P Two-Way Audio, Only Works with Echo Show/Echo Dot, \$35.99 #97: Camera with Chime, 1080P Wireless WiFi Outdoor Battery/Wired Door Bell, IP66 Weatherproof, \$49.99 #98: Compatible with Wyze Video Doorbell and Thermostat, 24VAC 500mA Transformer UL Listed, \$14.99 #99: TEYOUI Vinyl Siding Mount for Google Nest Doorbell (Battery), Angle Mount Wedge for Google Nest Doorbell (4" Standard Vinyl, Hard Plastic), \$14.99 #100: All-new Ring Video Doorbell 3 with Echo Dot, \$164.98 SIMMIS Video Doorbell, Wireless Camera Doorbell with HD 1080P WiFi 2-Way Audio Home Security Alarm with Rechargeable Battery, \$42.99 LAXIHUB Video Doorbell Camera Wireless, WiFi Smart Security Doorbell Camera with Chime, 1080PHD Rechargeable Battery Full Duplex, \$41.99 HEORLD Large Doorbell Cover Weatherproof, ABS Cover Doorbell Protector for Wireless Video Doorbell/Door Access Control/Chime, \$22.99 Video Doorbell Smart WiFi Intercom Wireless with HD Video Doorbell Doorphone Access System Security System Door Camera 18650, \$43.30
TR8	<p>Every product must be assigned to at least 1 department and sub-category.</p>  <p>The screenshot shows a product page for a SanDisk Ultra 128GB microSDXC UHS-I memory card. Key details on the page include:</p> <ul style="list-style-type: none"> Product Name: SanDisk Ultra microSDXC UHS-I Memory Card with Adapter - 120MB/s, C10, U1, Full HD, A1, Micro SD Card - SDSQUA4-128G-GN6MA Ratings: ★★★★☆ 211,673 ratings 852 answered questions Price: \$127.49 (Save 15%) Offer: Buy new: \$14.39 Shipping: No Import Fees Deposit & \$8.97 Shipping to Thailand Details Delivery: February 22 - 27 Buy Options: Add to Cart, Buy Now Secure Transaction: Ships from Amazon.com Sold by Amazon.com Return Policy: Eligible for Return, Refund or Replacement within 30 days of receipt
TR9	Every product must have a product name.

No	Constraints
	 <p>The screenshot shows a grid of nine Amazon product listings related to tie-dye supplies. The products include:</p> <ul style="list-style-type: none"> Meland Tie-Dye Kit - 18 Colors DIY Tie Dye Set with 3 White T-Shirts, All-in-1 Fabric Tie Dye Craft Set for Kids & Adults, Tie Dye for Party Birthday... (4.5 stars, 776 reviews) ARTEZA Permanent Fabric Paint, Set of 24 Colors, 60 ml Bottles, Washer & Dryer Safe, Textile Paint for Clothes, T-Shirts, Jeans, Bags, Shoes, Art and... (4.5 stars, 2,003 reviews) Permanent Fabric Paint for Clothes 24 Colors Bulk Kit Fabric Paint for Upholstery Outdoor Cushions Shoe Paint Decorating Medium Acrylic... (4.5 stars, 80 reviews) Tulip One-Step Tie-Dye Party, 18 Pre-filled Bottles, Creative Group Activity, All-in-1 Fashion Design Kit, 1 Pack, Rainbow (4.5 stars, 32,465 reviews) sunacme Fabric Markers Pen, 32 Colors Permanent Fabric Paint Pens Art Markers Set - Fine Tip, Child Safe & Non-Toxic for Canvas, Bags, T-... (4.5 stars, 2,371 reviews) Tulip Puff Paint, 20 Pack Rainbow Colors FolkArt Brush on Fabric Paint Beginner Set (2-Ounce), Rit Purpose Liquid Dye, 8 Oz, Royal Blue All-Purpose Liquid Dye, Navy Blue 8 oz (4.5 stars, 4,830 reviews) Tulip One-Step Tie-Dye Kit Party Supplies, 18 Bottles Tie Dye, Rainbow, 1 Count (Pack of 1)
TR10	<p>In the registration process, the full name, email, password, and Re-enter password must be filled out before continuing to the next process.</p>  <p>The screenshot shows the 'Create account' form on the Amazon website. It includes fields for 'Your name', 'Mobile number or email', 'Password' (with a note that it must be at least 6 characters), 'Re-enter password', and a 'Continue' button. Below the form, there is a note about agreeing to the Conditions of Use and Privacy Notice, and links for existing accounts and business accounts.</p>
TR11	<p>In the registration process, the customer password should be at least 6 characters.</p>

No	Constraints
	 <p>The screenshot shows the Amazon 'Create account' form. The 'Password' field is highlighted with a red border, indicating an error. Below it, a message says 'At least 6 characters'. Underneath that, a tooltip says 'Passwords must be at least 6 characters.' Other fields include 'Your name' (placeholder 'First and last name'), 'Mobile number or email' (empty), 'Re-enter password' (empty), and a 'Continue' button.</p>
TR12	<p>Physical gift cards cannot be shipped to some countries.</p>  <p>The screenshot shows a product listing for 'Amazon.com Gift Card in a Birthday Pop-Up Box'. The price is \$50.00. A note on the right side states: 'This item cannot be shipped to your selected delivery location. Please choose a different delivery location.' It also mentions 'Deliver to Thailand' and 'See similar items shipping to Thailand.' There is a 'See Similar Items' button and an 'Add other items:' section.</p>
TR13	<p>Some Orders cannot be shipped to some countries e.g., Cuba, Iran, North Korea, etc., and some products are being restricted/prohibited in some countries.</p>

No	Constraints
	<p>Restrictions on delivery in sanctioned or sensitive countries</p> <p>We cannot accept orders for delivery to some countries.</p> <p>We cannot accept any orders for delivery to the following countries:</p> <ul style="list-style-type: none"> • Cuba • Iran • North Korea • Sudan • Syria <p>A number of locations also restrict certain items due to their content:</p> <ul style="list-style-type: none"> • Algeria • Bahrain • Bangladesh • Bhutan • Bosnia-Herzegovina • Brunei • China • Egypt • India • Iran • Israel • Japan • Jordan • Kuwait • Lebanon • Libya • Malaysia • Morocco • Myanmar (Burma) • Oman • Pakistan • Qatar • Saudi Arabia • Singapore • Sudan • Syria • Tunisia • Turkey • United Arab Emirates
	<p>Ref: https://www.amazon.com/gp/help/customer/display.html?nodeId=G8UUUV583T397XQ3R</p>
TR14	Your list (or shopping list) will be set to “Shopping List” as a default list.
	 <p>The screenshot shows the 'Your Lists' section of the Amazon mobile app. At the top, there are two tabs: 'Your Lists' (highlighted in blue) and 'Your Idea List' (highlighted in orange). Below these tabs, there are two cards. The first card, 'Shopping List', has a red border around it. Inside the card, the text 'Shopping List' is in bold blue, and 'Default List' is in smaller blue text below it. To the right of the card, the word 'Private' is in small grey text. The second card, 'Shopping List 1', is partially visible below the first one. It also has 'Shopping List' in bold blue and 'Private' in small grey text to its right.</p>
TR15	Profile must be created before inviting others to join the Shopping List.

No	Constraints				
					
TR16	The minimum purchase quantity of the product is 1, and the maximum is limited to 30.				
	 <p>Hill's Prescription Diet r/d Weight Reduction Chicken Flavor Dry Cat Food, Veterinary Diet, 4 lb. Bag</p> <p>\$29.99 (\$0.47 / Ounce)</p> <p>Brand: HILL'S PRESCRIPTION DIET Flavor: Chicken Age Range: Adult Description: Target Species: Cat Item Form: Dry Food</p> <p>About this item</p> <ul style="list-style-type: none"> Hill's Prescription Diet r/d Weight Reduction Chicken Flavor Dry Cat Food is specially formulated by Hill's nutritionists and veterinarians to support cats' weight management. Clinically tested nutrition for healthy weight loss in just 4 weeks Therapeutic L-carnitine levels helps metabolize fat and maintain lean muscle Optimal blend of soluble and insoluble fiber helps your cat feel full and satisfied Clinically proven antioxidants support a healthy immune system Healthy, delicious food for happy pets Hill's Prescription Diet is the #1 US Vet Recommended therapeutic pet food — consult with your vet to make sure Prescription Diet r/d is the right food for your cat <p>Customer ratings by feature</p> <table> <tr> <td>Ingredient quality</td> <td>★★★★★ 5.0</td> </tr> <tr> <td>Freshness</td> <td>★★★★★ 4.6</td> </tr> </table>	Ingredient quality	★★★★★ 5.0	Freshness	★★★★★ 4.6
Ingredient quality	★★★★★ 5.0				
Freshness	★★★★★ 4.6				

Functional Decomposition Diagram

Regarding the business rules and constraints in Phase 1, there are three main functions of the E-commerce platform: Product Management, Customer/User Management, and Shopping Process, and those functions can be divided into many functional requirements or processes as shown below, and this use case will be used in the Transactional Requirements Specifications.

1. Product Management

(Main entity: Product, Product_vendor, Vendor_address, Review, Review_images)

- 1.1. Show the lists of products with their details
- 1.2. Create/Edit/Delete the products
- 1.3. Write/Edit/Delete the review description and images of each product
- 1.4. Delete product
- 1.5. Delete the review

2. User Management

(Main entity: user, user_address, Product_vendor, Order, Order_detail, Order_item)

- 2.1. Register
- 2.2. Login
- 2.3. See the order history of each customer

3. Shopping Process

(Main entity: Payment_method, Product, customer)

- 3.1. Add product to the cart
- 3.2. Process the payment

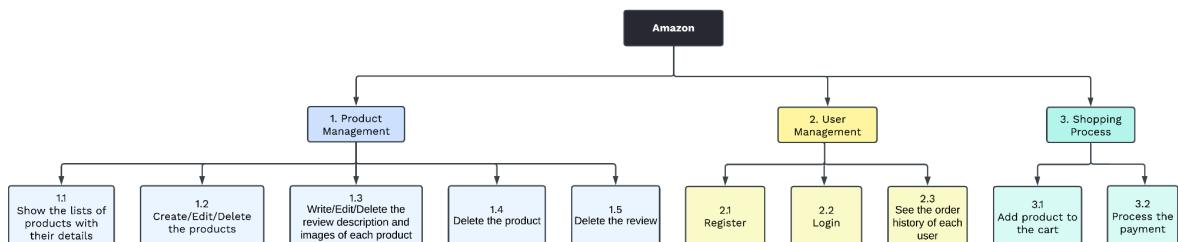


Figure 1: Functional Decomposition Diagram of Amazon

Data Requirements Specifications (DRS)

Customer View: Product

The products listed on the website can be added to the carts. Then, create orders based on the products. The data stored are product_id, product_name, product_description, product_thumbnail (URL), standard price in dollars, brand, dimension in inches, created_at, and modified_at. Each product is identified by product_id.

Customer View: User

Before purchasing any product from Amazon, the website visitors must create an account to become a user. The data stored on the user includes user_id, first_name, last_name, is_prime_member(boolean), email, password, created_at (register date), modified_at, pin (for some programs on Amazon), currency, and birthdate. The user_id is used to identify the user account.

Customer View: User Address

Customer might have multiple addresses and can be shared with people who live in the same place. An address includes user_address_id, first name, last name, street, city, zip code, country, mobile phone, and user id. The first name and last name don't need to be associated with the first name and last name of the User. The identifier of this table is user_address_id.

Customer View: Order Item

Order items are the products that are ordered. This entity will be generated when a user order a product. It includes order_item_id, quantity, and price of each product, created at and modified at. Each order item is identified by order_item_id.

Customer View: Order Detail

Order detail contains many order items. It includes order_detail_id, transaction status (completed, ongoing, failed), created at, modified at, payment date, estimated delivery date, receive date, comment, shipping fee, tax rate, user id and payment_method_id. The identifier of order detail is order_detail_id.

Customer View: Product Vendor

When a customer goes to the detail page of a product, the customer can see who is selling the product. The data stored includes vendor_id as a primary key, vendor name, vendor description, business domain, email, password thumbnail profile, and is_verified. However, email and password are inaccessible by the customers or product vendors that are not the account owner.

Customer View: Vendor Address

A customer can view the vendor's business address to contact them. The data stored in vendor_address includes first name, last name, street, city, zipcode, country, home phone (business phone), and vendor_id.

Customer View: Product Vendor Map

A customer can see the list of products by multiple vendors. The data stored in the product vendor map includes product_id, vendor_id, list_date, price, and discount_price.

Customer View: Payment Method

There are several payment methods that the customers can use (Credit Card, Debit Card, Paypal, Venmo). The data stored include payment_method_id as an identifier, payment_method_name, credit card number, and user_id.

Customer View: Review

After a customer has purchased the product, the customer can create a review on that product. Each review includes review_id as an identifier, rating star, comment, review date, helpful rate count, product id, and user id.

Customer View: Review Image

Each review can have many review images. This table is for listing the review images for each review, which includes review_id and review_image as a composite key.

Customer View: Cart

Each user has a cart. Each cart includes cart_id as a primary key, modified at, and user_id.

Customer View: Product Cart Map

This table maps the carts with products, which include product_id and cart_id as a composite key, and quantity.

Customer View: Product Department

Currently, there are 5 product departments: appliances, tv audio & cameras, bags & luggage, men's clothing, home & kitchen. The data stored on the pro department includes department_id, department_name, and created at.

Customer View: Product Department Map

This table is just for mapping products with product departments because one product can be included in many departments. The data stored in the product department map are product_id and department_id which are the composite key.

Customer View: Product Sub-Category

Product sub-category is a small group of product departments. Similarly, a product can be included in many product subcategories. The data stored in product subcategories includes sub_category_id as a primary key, sub_category_name, sub_category_description, created at , modified at, and department_id.

Customer View: Product Sub-Category Map

This table has the same function as a product department map. The data stored is only a composite key of product_id and sub_cateogry_id.

Customer View: Order

This table contains the associations of other tables to the Order Item table. The data stored includes order_item_id as a primary key, order_detail_idt, user_address_id, product_id, user_id, and vendor_id.

Product Vendor View: Product

A product can be sold by many product vendors and the product vendors can edit or delete their own products. The data stored are product_id, product_name, product_description, product_thumbnail (URL), standard price in dollars, brand, dimension in inches, created_at, and modified_at. Each product is identified by product_id.

Product Vendor View: Product Vendor

A user can register and log in as a product vendor to sell items on Amazon. The vendor must be verified before Amazon allows sellers to sell on the platform. The data stored includes vendor_id as a primary key, vendor name, vendor description, business domain, email, password thumbnail profile, and is_verified.

Product Vendor View: Vendor Address

A product vendor can set up their own business address for the customers to get in touch with them. The data stored in vendor_address includes first name, last name, street, city, zipcode, country, home phone (business phone), and vendor_id.

Product Vendor View: User

A product vendor can view some information about the users. The data stored on the user includes user_id, first_name, last_name, is_prime_member(boolean), email, password, created_at (register date), modified_at, pin (for some programs on Amazon), currency, and birthdate.

Product Vendor View: User Address

Product vendors can see the address of the users who order with them. The data stored on User Address includes user_address_id, first name, last name, street, city, zipcode, country, mobile phone, user_id. The first name and last name don't need to be associated with the first name and last name of User. The identifier of this table is user_address_id.

Product Vendor View: Order item

Product vendors can see the order_item that the customer ordered. This table needs to be joined in order to determine the data associated with this table. The data stored includes order_item_id, quantity, and price of each product, created at and modified at. Each order item is identified by order_item_id.

Product Vendor View: Order

The associations among order items are defined in this table. The data stored includes order_item_id as a primary key, order_detail_id, user_address_id, product_id, user_id, and vendor_id.

Product Vendor View: Review

Product vendors can see the review from the customers on their products. The data stored includes review_id as an identifier, rating star, comment, review date, helpful rate count, product id, and user id.

Product Vendor View: Review Image

Each review can have many review images. This table is for listing the review images for each review, which includes review_id and review_image as a composite key.

Product Vendor View: Product Department

Currently, there are 5 product departments: appliances, tv audio & cameras, bags & luggage, men's clothing, home & kitchen. The data stored on the product department includes department_id, department_name, and created at.

Product Vendor View: Product Department Map

This table is just for mapping products with product departments because one product can be included in many departments. The data stored in the product department map are product_id and department_id which are the composite key.

Product Vendor View: Product Sub Category

Product sub-category is a small group of product departments. Similarly, a product can be included in many product subcategories. The data stored in product subcategories includes sub_category_id as a primary key, sub_category_name, sub_category_description, created at, modified at, and department_id.

Product Vendor View: Product Sub-Category Map

This table has the same function as a product department map. The data stored is only a composite key of product_id and sub_category_id.

Staff View: Product

Staff is the one who manages the database, so staff can insert, update, and delete the product data. The data stored are product_id, product_name, product_description, product_thumbnail (URL), standard_price in dollars, brand, dimension in inches, created_at, and modified_at. Each product is identified by product_id.

Staff View: Product Vendor

Staff can delete the product vendor if that product vendor violates the terms and conditions of the platform. The data stored includes vendor_id as a primary key, vendor name, vendor description, business domain, email, password thumbnail profile, and is_verified. However, email and password are inaccessible by the customers or product vendors that are not the account owner.

Staff View: Product Vendor Map

After removing the product vendor, the staff needs to also remove the product listed by the product vendor. The data stored includes product_id, vendor_id, list_date, price, and discount_price.

Staff View: Review

Staff can recheck the informed reviews reported by the vendor in case that the review is unfair and should be deleted. The data stored includes review_id, rating_star, comment, review_date, helpful_rate_count, product_id, and user_id. If the review_id record has been deleted from the Review table, it has to be removed from the Review_image table as well.

Staff View: Review Images

This table stores the review images that reference the review, one review can have multiple review images, therefore both review_id and review_image are composite primary keys to ensure the integrity of the records.

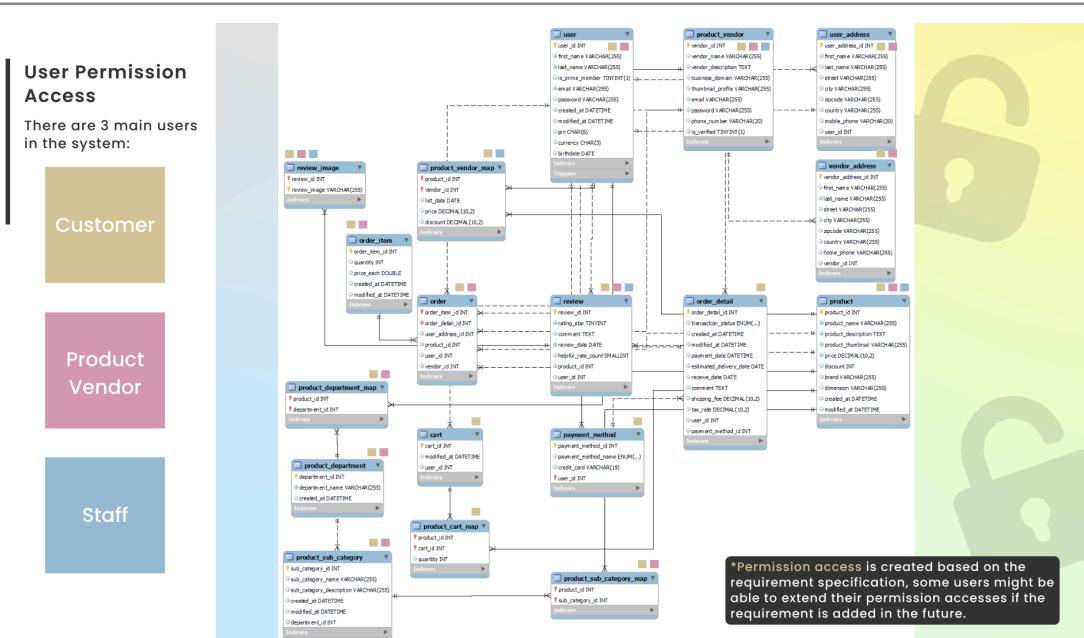


Figure 2: User Permission Access

Dataset Summary

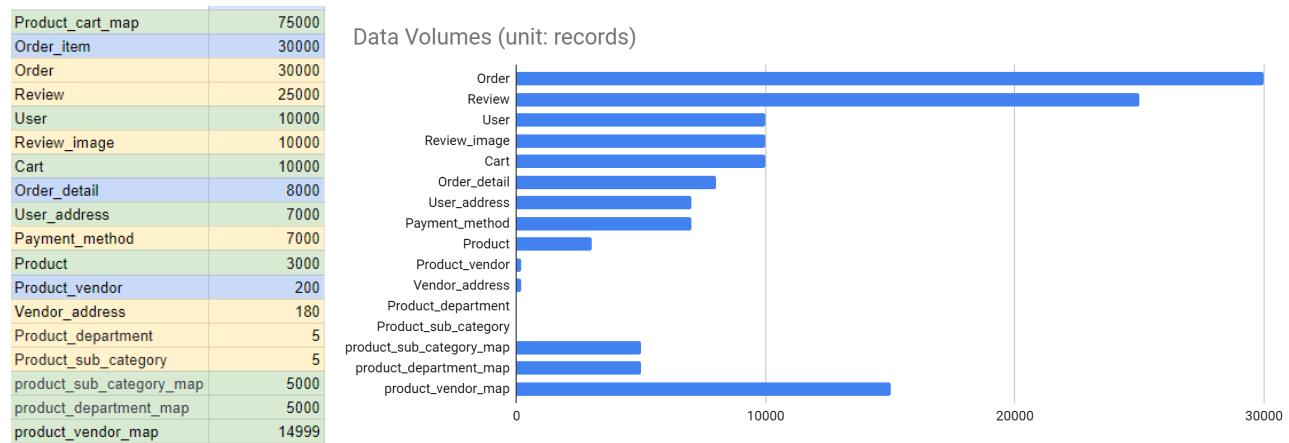


Figure 3, 4: Data Volumes

Product Reference: <https://www.kaggle.com/datasets/lokeshparab/amazon-products-dataset>

The left image is the table, and the right image is the horizontal bar chart that shows table names with their volumes. We expect people are keeping the products in their cart, so product_cart_map will be the table that contains the most data followed by Order_item and Order. In the new schema, we combined Order_item and Order and we choose to keep the Order_item table because it is the table before we normalize it. For User and User_address, the user_address can be shared with other users, so it is possible to have more User than User_address. On Review and Review_image tables, a review doesn't need to have the image(s), so the total amount of data in the Review table is more than in Review_image. In addition, a product vendor can sell many products, so 200 vendors should be able to list those products on the platform. There are only 5 product departments, and product subcategories because 1 product subcategory usually contains many products, and product departments are the bigger scope of the product subcategories. However, the data that we derived from contains 1 main category and 1 subcategory for each product, so we follow that and use the distinct values to create departments and subcategories.

Transaction Requirements Specifications (TRS)

Regarding the functional requirements on the Functional Decomposition Diagram, there are 9 processes included in the Amazon. In this section, it will describe in more detail each process.

Functional Req	1.1 Show the lists of products with their details
Description	This process shows the list of products regarding the given input from the customer on the search field. For instance, if the customer input “Dog food” it should return all of the dog food products that Amazon provides.
Input	Query from the customer
Output	List of products
Actors	Staff and Customer
Data queries <i>*Some users cannot access some data, so it will have a role separation in some requirements*</i>	Both Actors <ul style="list-style-type: none"> 1.1.1 Show the list of products and their details whose product name includes the word “Panasonic”. 1.1.2 Continue from 1.1.1, Show the rating score and helpful_rate_count of those products and sorted by weighting rating score and helpful_rate_count in descending order. HINT: To weight the rating score, rating_star * helpful_rate_count 1.1.3 Show the list of products where the product brand is equal to “LG” or “Blue Star” and the sub category is "Air Conditioners" 1.1.4 Show the list of Samsung products where the discount price is between 100 and 300 (Note that the discount price can be calculated by the price minus the discount column) and sorted the discount price by ascending order 1.1.5 Show the product name and their details where their created and modified date is within the year 2022.
Precondition	The customer needs to enter the Amazon website.
Postcondition	List of products is returned regarding the given query.
Scenario (Typical Flows of Events)	<ol style="list-style-type: none"> 1. The customer fills in the query information (such as product name, product vendor, and product category) on the search field. 2. System will check the received query with the database whether there is data on these products or not. 3. The system returns the list of products that match the received query.
Exceptions	<ol style="list-style-type: none"> 1. If the customer does not input any query on the search field, it will just display the home page as the same. 2. If there is no matching query with the database, it will return the empty tables (do not have any results) from the database.

	<p>3. When it has no matching query with the database, it will receive the 2. Statement and return the message showing “We haven’t provided this product, please try again” to the customer.</p>
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Functional Req	1.2 Create/Edit/Delete the products
Description	This process shows the action of creating, editing, and deleting the product which will be published on the Amazon website.
Input	Query string
Output	Created product, Edited product, Deleted product
Actors	Vendors
Data queries <i>*Some users cannot access some data, so it will have a role separation in some requirements*</i>	<p>Vendors</p> <p>1.2.1 Create/Insert new product with the following details (other columns just leave it blank for now)</p> <ul style="list-style-type: none"> Product name: Elephant Stuffed Animal Toy Plushie Product description: Fluffy toy Product_thumbnail: <p>https://m.media-amazon.com/images/I/41lrtqXPiWL._AC_UL399_.jpg</p> <ul style="list-style-type: none"> Price: 23.50 Brand: Lambs & Ivy <p>1.2.2 Edit the brand name of all records where the brand is equal to “TOSHIBA” to “Toshiba”.</p> <p>1.2.3 Create the function to delete the product by passing the “product_id” on the parameter</p> <p>Note that: You need to delete all of the product_id that has been deleted in other tables too.</p> <p>*Note that: Only the product vendor that is the owner of its brand will be able to Create/Edit/Delete the products on the following queries. For instance, if the product owner's name is “AplhaTech” and it's the owner of the product name “Samsung”, then it will be allowed (show the button), otherwise they will be allowed to view products only. - Assume that this authentication is performed in advance</p>
Precondition	Vendors need to log in to the Amazon website and it needs to perform authentication to verify if the product vendor is the owner of this product.
Postcondition	Product has been written/edited/deleted, and it will show the status regarding the performed action.
Scenario (Typical Flows of Events)	<ol style="list-style-type: none"> 1. If the vendor wants to create the product, they can create it by clicking on ‘Add product’. 2. If the vendor wants to update the product, the vendor has to go

	<p>to the last row and select ‘Edit’ to edit the product's details.</p> <ol style="list-style-type: none"> 3. If the vendor wants to delete the product, the vendor has to go to the managed inventory page and click ‘Delete products and listing’. 4. The system will return created, modified, and deleted products.
Exceptions	<ol style="list-style-type: none"> 1. Vendors may not be able to edit or delete a product if it has pending orders, as this can affect customers who have already made purchases. 2. The product information provided by the vendor must be accurate and comply with Amazon's policies and guidelines. 3. Vendors cannot create duplicate listings for the same product, as this can create confusion for customers and harm the vendor's reputation.

Functional Req	1.3 Write/Edit/Delete the review description and images of each product
Description	This process shows the action of creating, editing, and deleting the review description and images of each product of customer and staff which will be published on the Amazon website at the review product part. It allows customers to manage their product reviews.
Input	Review description and images (optional) of the product
Output	Written review, Edited review, Deleted review
Actors	Customer
Data queries <i>*Some users cannot access some data, so it will have a role separation in some requirements*</i>	<p>Customer</p> <p>1.3.1 User id 10 want to create the review to product id 430 with this following details Rating star: 5 Comment: Good! Must have item Review date: 2023-05-12</p> <p>1.3.2 Edit the 1.3.1 comment by updating the comment Comment: Good! Must-have item. I have used it since I was a high school student, currently, I am working, I still use it.</p> <p>1.3.3 Delete the Review 1.3.1</p>
Precondition	Customers have to log in to the Amazon website and buy the product that they will review.
Postcondition	Review has been written/edited/deleted, and it will show the status regarding the performed action.
Scenario (Typical Flows of Events)	<ol style="list-style-type: none"> 1. If the customer wants to create the product, they can create it by clicking on ‘Write a customer review’. 2. If the customer wants to edit the review, the customer has to go

	<p>to ellipsis and select ‘Edit review’.</p> <ol style="list-style-type: none"> 3. If the customer wants to delete the review, the customer has to go to ellipsis and select ‘Delete review’. 4. The system will return written, edited, and deleted.
Exceptions	<ol style="list-style-type: none"> 1. Reviews and images must be relevant to the product being reviewed and cannot contain offensive or inappropriate content. Due to Amazon policies and guidelines. 2. Customers may not be able to leave a review for a product they did not purchase or receive as a gift, as this can affect the integrity of the review system. 3. Reviews and images cannot be used to promote or advertise other products or services, as this can violate Amazon's policies and guidelines.

Functional Req	1.4 Delete the product
Description	This process shows the action of deleting the products by staff. Staff will verify which product can be published on the Amazon website. If it has a product that cannot be published on the Amazon website, staff will delete that product.
Input	Click on the deleted product
Output	Deleted product
Actors	Staff
Data queries <i>*Some users cannot access some data, so it will have a role separation in some requirements*</i>	Staff 1.4.1 Assuming that the product vendor “OceanOasis” (or vendor id 85) violates the set regulations of the company by selling the prohibited products. With this action, all of his product vendor information and any information related to him will be deleted. *Note that: Make sure you delete all of the information linking/mapping to this vendor since he has no permission in selling the products.
Precondition	Staff has to log in to the Amazon website and verify that the product cannot be published on the Amazon website.
Postcondition	The product has been deleted and the status is shown that “The product was deleted”.
Scenario (Typical Flows of Events)	<ol style="list-style-type: none"> 1. A staff receives a report from a customer or another seller indicating that the vendor is selling a product that is illegal to

	<p>sell on Amazon, such as a controlled substance or a product that violates environmental or safety regulations.</p> <ol style="list-style-type: none"> 2. The staff member investigates the product listing and confirms that the vendor is indeed selling a prohibited item. 3. The staff member contacts the vendor and informs them that their product violates Amazon's policies and must be removed immediately. 4. If the vendor does not edit or delete the product, the staff will delete the product from Amazon and suspend the vendor's account.
Exceptions	<ol style="list-style-type: none"> 1. Before a staff deletes a product, they will notify the vendor and provide them with an opportunity to correct any issues or address any policy violations. 2. If a vendor has a history of policy violations, Amazon may choose to permanently suspend their account and remove all of their products from the platform.

Functional Req	1.5 Delete the review
Description	This process shows the action of deleting the review by staff. Staff will recheck which review is not true that the vendor informed to staff.
Input	Click on the deleted review
Output	Deleted review
Actors	Staff
Data queries <i>*Some users cannot access some data, so it will have a role separation in some requirements*</i>	Staff <p>1.5.1 Assuming that comment that review id 1 has a rude word on the comment and should be deleted. Therefore, you need to delete all of the reviews where it references to review id 1 to make the website cleaner.</p>
Precondition	Vendor must inform the staff of the unfair review by giving the evidence.
Postcondition	The review has been deleted and the status is shown that “The review was deleted”.
Scenario (Typical Flows	<ol style="list-style-type: none"> 1. The staff has to check the evidence that the customer gave a fake review to attack the vendor or not.

of Events)	2. If the result shows that the customer gave a fake review, the staff can delete the review from the reviewed product.
Exceptions	<ol style="list-style-type: none"> 1. The staff will only delete a review if it violates Amazon's policies or guidelines. 2. The staff member will not delete a review without notifying the reviewer and providing them with an opportunity to respond. This ensures that the reviewer's rights and interests are protected and that Amazon is acting fairly and transparently.

Functional Req	2.1 Register
Description	This process of registration on the Amazon website involves creating an account that allows customers to access services offered by Amazon including online shopping, selling products, and managing their account information.
Input	Name, Email, Password, Password Confirmation
Output	Created account
Actors	Customer and Vendor
Data queries <i>*Some users cannot access some data, so it will have a role separation in some requirements*</i>	<p>Customer</p> <p>2.1.1 Assuming that Kulawut is a new user, and he wants to register for an account with the following details.</p> <p>Firstname: Kulawut Lastname: Makkamoltham Email: kulawut.mak@gmail.com Password: EaFgHyWbv</p> <p>Vendor</p> <p>2.1.2 Assuming that Nearlyded is a new product vendor, and he wants to register for an account with the following details.</p> <p>Vendor name: Nearlyded Email: nearlyded@hotmail.com Password: AfdFDrrE</p>
Precondition	The customer needs to enter the registration page.
Postcondition	The customer can register for the new account and the message status reported that “The customer has been created successfully”.
Scenario (Typical Flows of Events)	<ol style="list-style-type: none"> 1. Search on Google ‘Amazon create account’ then click Amazon registration to navigate to the Amazon registration website. 2. Input all information that Amazon asks the user to provide including name, email, password, and password confirmation.

Exceptions	<ol style="list-style-type: none"> 1. The user must be of a minimum age required by Amazon policies to register. If the customer is below the minimum age limit, they will not be able to register on Amazon. 2. The user must agree to Amazon's terms and conditions, privacy policy, and other policies and guidelines that govern the use of Amazon's platform. If the customer does not agree to these terms and conditions, they will not be able to register on Amazon. 3. If the user has a history of violating Amazon's policies or guidelines, their registration may be rejected or their account may be suspended or terminated.
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Functional Req	2.2 Login
Description	This is the process to authenticate the customer to the platform. Each customer role has different access to the services. Customers can access online shopping, amazon prime (not included in the project), etc. While product_vendor can access the selling platform.
Input	Email, Password
Output	Authentication and Authorization
Actors	Customer and Vendor
Data queries <i>*Some users cannot access some data, so it will have a role separation in some requirements*</i>	<p>Customer</p> <p>2.2.1 Assuming that you are Kulawut, and he wants to log in to his new account with the following details. Please show all of his information.</p> <p>Vendor</p> <p>2.2.2 Assuming that you are Nearlyded, and he wants to log in to his new account with the following details. Please show all of his information.</p>
Precondition	The customer needs to have an Amazon account.
Postcondition	The customer can log in to the system/website successfully.
Scenario (Typical Flows of Events)	<ol style="list-style-type: none"> 1. A user goes to the Amazon website. 2. Click on the 'Sign in' button. 3. Enter your registered email address and password and click the 'Sign in' button. 4. After successfully logging in, the user will be directed to their Amazon account dashboard.
Exceptions	<ol style="list-style-type: none"> 1. If the user meets any issues logging in, they can contact Amazon's customer service for assistance or use the "forgot

	password" feature to reset their password.
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Functional Req	2.3 See the order history of each customer
Description	This process of letting vendors and customers see the history of a customer about purchases and transactions.
Input	The customer ID of the customer that needed to be queried/found.
Output	List of order history
Actors	Vendor and Customer
Data queries <i>*Some users cannot access some data, so it will have a role separation in some requirements*</i>	<p>Customer</p> <p>2.3.1 Assuming that you logged in as “Tina Walker”, and you want to see the number of transaction statuses (Completed, Ongoing, Failed) sorted by the highest count. For instance, Completed 10 orders, Ongoing 3 orders, and Failed 2 orders.</p> <p>Vendor</p> <p>2.3.2 List all of the order history where the transaction status is equal to “Failed”.</p> <p>Note that: Order status can be viewed on <i>transaction_status</i> on the Order_detail table.</p>
Precondition	The customer must have an active and verified Amazon account. Customers can only view the history order of themselves only.
Postcondition	The order history of each customer is shown.
Scenario (Typical Flows of Events)	<ol style="list-style-type: none"> 1. The customer navigates to the customer's profile page by searching for their name or clicking on their customer name or profile picture. 2. The customer clicks on the ‘Order History’ section of the customer's profile page. 3. The customer selects the specific order or orders they want to view from the list of past orders displayed on the page. 4. The customer can view details about the selected order or orders.
Exceptions	<ol style="list-style-type: none"> 1. If the customer has decided to keep their order history private, the vendor will not be able to view their past orders. 2. If the customer does not have permission or access to view the order history of the customer, they will not be able to view it.

Functional Req	3.1 Add product to the cart
Description	Cart feature in Amazon will help customers to check out all order items at once.
Input	A product
Output	List of products in the cart
Actors	Customer
Data queries <i>*Some users cannot access some data, so it will have a role separation in some requirements*</i>	Customer 3.1.1 Assuming that you logged in as “Lori Hunt”, and you want to add product id 95 or “Hitachi SPLIT AC - 1.0 Ton HITACHI SHIZEN 3100S INVERTER - R32 - RAPG312HFE0Z1 (Gold)” to his cart for 99 items.
Precondition	Customers need to enter the Amazon website.
Postcondition	The item is added to the cart
Scenario (Typical Flows of Events)	<ol style="list-style-type: none"> 1. A customer enters a website. 2. The customer browses the website to find a specific item. 3. The customer clicks Add to Cart button on the right-hand side of the screen
Exceptions	<ol style="list-style-type: none"> 1. If the product is out of stock or unavailable, the customer will not be able to add it to their cart. 2. If the customer's Amazon account has been suspended, deactivated, or restricted, they may not be able to add products to their cart. 3. If the customer's payment method is declined or invalid, they may not be able to add products to their cart or complete the checkout process.

Functional Req	3.2 Process the payment
Description	This payment process includes validating the payment information and confirming the order details before processing the payment.
Input	Payment information
Output	Payment confirmation

Actors	Customer
Data queries <i>*Some users cannot access some data, so it will have a role separation in some requirements*</i>	<p>Customer</p> <p>3.2.1 Assuming that you logged in as “Lori Hunt” (or user id 492), and you want to process the payment of all products in his cart. Note that the result should show the product_name, quantity ordered, and price (each).</p> <p>3.2.2 Continue from 3.2.1., in this query return the summation of the price he needs to pay in total (Hint: Summation of 3.2.1.)</p>
Precondition	The customer must validate the payment information.
Postcondition	customers can complete their payment successfully, and it shows that the “Payment is completed”.
Scenario (Typical Flows of Events)	<ol style="list-style-type: none"> 1. The customer adds one or more products to their shopping cart and proceeds to checkout. 2. The customer enters their shipping address, billing address, and payment information. 3. Amazon confirms the order details with the customer. 4. The customer confirms the order and clicks the "Place Your Order" button. 5. Amazon processes the payment and sends a confirmation email to the customer.
Exceptions	<ol style="list-style-type: none"> 1. If the customer's payment method is declined, the transaction may not be processed, and the customer will need to choose a different payment method or update their payment information. 2. If the customer's Amazon account has been suspended, deactivated, or restricted, they may not be able to process payments or complete the checkout process. 3. If the customer encounters technical issues or errors while attempting to process a payment, the customer can use Amazon customer service for assistance.

System Requirements Specifications (SRS)

ID	Requirement Description	Priority	Functional Requirements	Non-Functional Requirements
1	This process shows the list of products regarding the given input from the customer on the search field. For instance, if the customer input “Dog food” it should return all of the dog food products that Amazon provides.	High	1.1 Show the lists of products with their details	<ul style="list-style-type: none"> - Intuitive: System should show the products that are easy to read including the font size, color, and theme should be consistent with the website. - Response time: The product list should load quickly and efficiently in a range between 200 milliseconds and 1 second. - Search and filter options: The product list should have search and filter options that allow customers to find the products they are looking for quickly and easily. - Error handling: System should validate the inputs and provide clear error messages in case of any mistakes or errors to prevent data entry mistakes and ensure that the system operates smoothly.
2	This process shows the action of create, edit, delete of the product which will be published on the Amazon website.	High	1.2 Create/Edit/Delete the products	<ul style="list-style-type: none"> - Security: System must allow only the customers and roles who have permission on each part to secure the system. - Accuracy: System should display the information that is accurate, up-to-date, and relevant that allows the customers to make informed decisions. - Versioning and tracking: System should keep track of changes made to products, and allows customers to revert back to previous versions if needed. - Error handling: System should validate the inputs and provide clear error messages in case of any mistakes or errors to prevent data entry mistakes and

ID	Requirement Description	Priority	Functional Requirements	Non-Functional Requirements
				ensure that the system operates smoothly.
3	This process shows the action of create, edit, delete of the review description and images of each product of customer and staff which will be published on the Amazon website at the review product part. It allows customers to manage their product's review.	High	1.3 Write/Edit/Delete the review description and images of each product	<ul style="list-style-type: none"> - Security: System must allow only the customers and roles who have permission on each part to secure the system. - Accuracy: System should display the information that is accurate, up-to-date, and relevant that allows the customers to make informed decisions. - Versioning and tracking: System should keep track of changes made to products, and allows customers to revert back to previous versions if needed. - Error handling: System should validate the inputs and provide clear error messages in case of any mistakes or errors to prevent data entry mistakes and ensure that the system operates smoothly.
4	This process shows the action of deleting the products by staff. Staff will verify which product can be published on the Amazon website. If it has a product that cannot be published on the Amazon website, staff will delete that product.	High	1.4 Delete the product	<ul style="list-style-type: none"> - Security: System must allow only the customers and roles who have permission on each part to secure the system. - Accuracy: System should display the information that is accurate, up-to-date, and relevant that allows the customers to make informed decisions. - Versioning and tracking: System should keep track of changes made to products, and allows customers to revert back to previous versions if needed. - Error handling: System should validate the inputs and provide clear error messages in case of any mistakes or errors to prevent data entry mistakes and ensure that the system operates smoothly.

ID	Requirement Description	Priority	Functional Requirements	Non-Functional Requirements
				ensure that the system operates smoothly.
5	This process shows the action of deleting the review by staff. Staff will recheck which review is not true that the vendor informed to staff.	Medium	1.5 Delete the review	<ul style="list-style-type: none"> - Security: System must allow only the customers and roles who have permission on each part to secure the system. - Accuracy: System should display the information that is accurate, up-to-date, and relevant that allows the customers to make informed decisions. - Versioning and tracking: System should keep track of changes made to products, and allows customers to revert back to previous versions if needed. - Error handling: System should validate the inputs and provide clear error messages in case of any mistakes or errors to prevent data entry mistakes and ensure that the system operates smoothly.
6	This process of registration on the Amazon website involves creating an account that allows customers to access services offered by Amazon including online shopping, selling products, and managing their account information.	High	2.1 Register	<ul style="list-style-type: none"> - Security: System must implement secure authentication mechanisms. - Password Security: System should have strong password policies such as requiring a minimum length, a mix of uppercase and lowercase letters, numbers, and special characters. - Error handling: System should validate the inputs and provide clear error messages in case of any mistakes or errors to prevent data entry mistakes and ensure that the system operates smoothly.
7	This is the process to authenticate the customer to the platform. Each	High	2.2 Login	<ul style="list-style-type: none"> - Security: System must implement secure authentication mechanisms and provide 2FA

ID	Requirement Description	Priority	Functional Requirements	Non-Functional Requirements
	customer role has different access to the services. Customers can access online shopping, amazon prime (not included in the project), etc. While product_vendor can access the selling platform.			(Two-factor authentication) for logging into the account. <ul style="list-style-type: none"> - Error handling: System should validate the inputs and provide clear error messages in case of any mistakes or errors to prevent data entry mistakes and ensure that the system operates smoothly. - Forget password functionality: Provide a way for customers to reset their password if they forget it. - ..
8	This process of letting vendors and customers see the history of a customer about purchases and transactions.	Medium	2.3 See the order history of each customer	<ul style="list-style-type: none"> - Clear and Concise information: The order history for each customer should display clear and concise information about each order, including order date, order number, product name, quantity, price, and others. - Filter and sorting options: System should provide filtering and sorting options that allows customers to find specific orders quickly and easily. - Print and export functionality: System should provide the ability to print or export the order history, which can be useful for record-keeping or accounting purposes. For instance, managers can and use this report to make informed decisions.
9	Cart feature in Amazon will help customers to check out all order items at once.	High	3.1 Add product to the cart	<ul style="list-style-type: none"> - Cart summary: After adding a product to the cart, the customer should be able to see a summary of their cart contents that includes the product name, price, quantity, and a subtotal for each item. - Save cart for later: Customers should have the option to save their cart in case they leave the

ID	Requirement Description	Priority	Functional Requirements	Non-Functional Requirements
				<p>website or app before completing their purchase. This will help the customer return to complete their purchase later.</p> <ul style="list-style-type: none"> - Cross-sell and upsell: After adding a product to their cart, the customer may be interested in related or complementary products. Therefore, the system suggest related products or offer discounts for purchasing additional items.
10	This payment process includes validating the payment information and confirming the order details before processing the payment.	High	3.2 Process the payment	<ul style="list-style-type: none"> - Security: System should ensure that all payment information is encrypted and stored securely, and that all transactions are processed securely to help prevent data breaches and protect sensitive customer information. - Confirmation: System should provide a clear information message or receipt after the payment has been processed to provide customers with a record of their purchases. - Payment methods: System offers multiple payment methods such as credit cards, debit cards, PayPal, Apple Pay, and other popular payment options to accommodate the preferences of different customers and increase conversion. - “Buy Now” button: Each product listing should include a visible “Buy Now” button so that customers can proceed to their payment immediately without entering the cart which consumes time rather than implementing this button.

Final Entity-Relationship Diagram (ERD)

Regarding *Phase 1 ER Diagram*, there are 17 tables in total, however, there are 10 selected tables as shown below. We decided to select the tables based on the setting requirement specifications and these tables will be transformed into the final relational schema in the next later step.

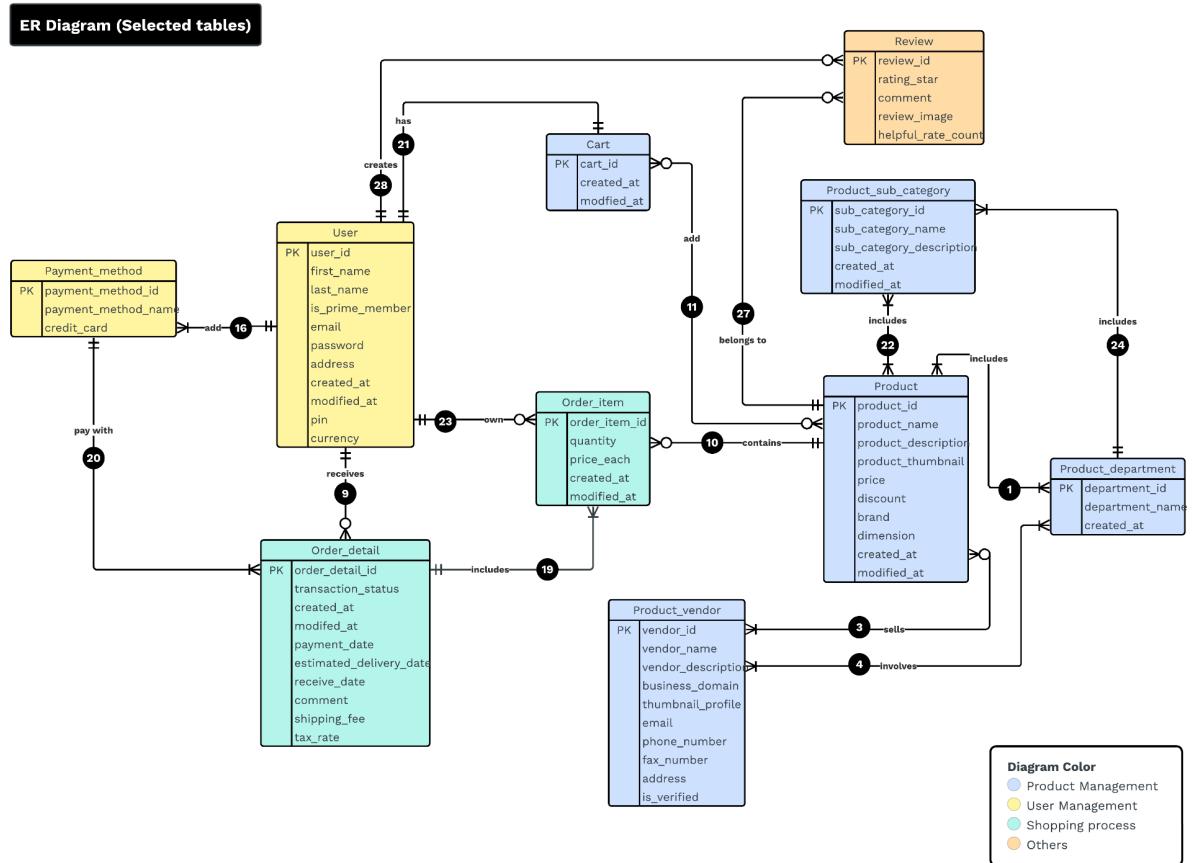


Figure 5: Final Entity-Relationship Diagram (ERD)

Ready-to-Implement Relational Database Schema and Constraints

After transforming ER Diagram into Relational Schema, this final relational schema will be used in the analysis. (Transformation steps mentioned in *ERD/EERD Transformation* in Phase 1)

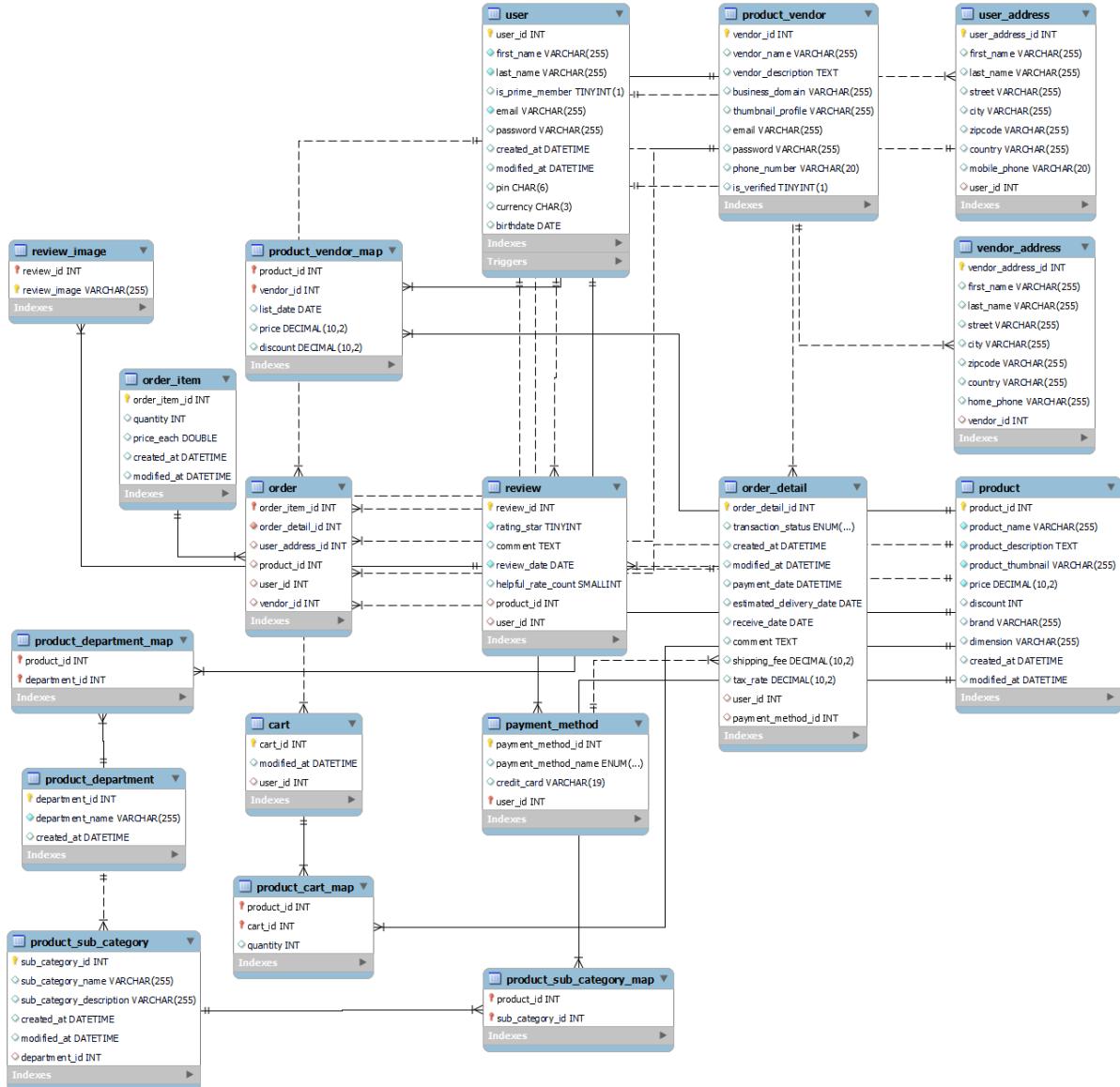


Figure 6: Denormalized Relational Schema

Results of Analysis

Transaction/ Relation	1.1				1.2				1.3				1.4				1.5				2.1			
	I	R	U	D	I	R	U	D	I	R	U	D	I	R	U	D	I	R	U	D	I	R	U	D
Product		X				X	X	X																
Product_vendor		X																	X					
Vendor_address																								
Product_vendor_map		X																						
User																						X	X	
User_address																								
Payment_method																								
Order_detail																								
Order_item																								
Review		X								X												X		
Review_image																								
Cart																								
Product_cart_map																								
Product_departmn et																								
Product_departme nt_map																								
Product_sub_categ ory																								
Product_sub_categ ory_map																								

Transaction/ Relation	2.2				2.3				3.1				3.2				-				-				
	I	R	U	D	I	R	U	D	I	R	U	D	I	R	U	D	I	R	U	D	I	R	U	D	
Product													X												
Product_vendor		X																							
Vendor_address																									
Product_vendor_map																									
User		X																							
User_address																									
Payment_method						X																			
Order_detail							X																		
Order_item								X																	
Review																									
Review_image																									
Cart									X																
Product_cart_map															X										
Product_departmn et																									
Product_departme nt_map																									
Product_sub_categ ory																									

Queries or Transactions (at least 2)

*Assuming that there are 10,000 active users (U), and the average number of times the query is executed per user per day is 2 queries (F) in the morning (8.00-11.00) and night (20.00-23.00). For the peak rate assuming that it is roughly 5 times of the average.

Transaction: 1.1 Show the lists of products with their details

1.1.1 Show the list of products and their details whose product name includes the word "Panasonic".

Transaction Volume

Average: $(U * F) / 24 = (10,000 * 2) / 24 = 208.33 \approx 209$ times/per hour

Peak: $209 * 5 = 1,045$ times/per hour (between 17.00 and 20.00 Saturday-Sunday)

```
SELECT
    product_name,
    product_description,
    product_thumbnail,
    pv.vendor_name,
    pvm.price,
    pvm.discount_price,
    100-ROUND(discount_price/price*100, 2)
    AS discount_percentage
FROM product p
JOIN product_vendor_map pvm ON
    pvm.product_id = p.product_id
JOIN product_vendor pv ON
    pvm.vendor_id = pv.vendor_id
WHERE MATCH(product_name) AGAINST
    ("Panasonic");
```

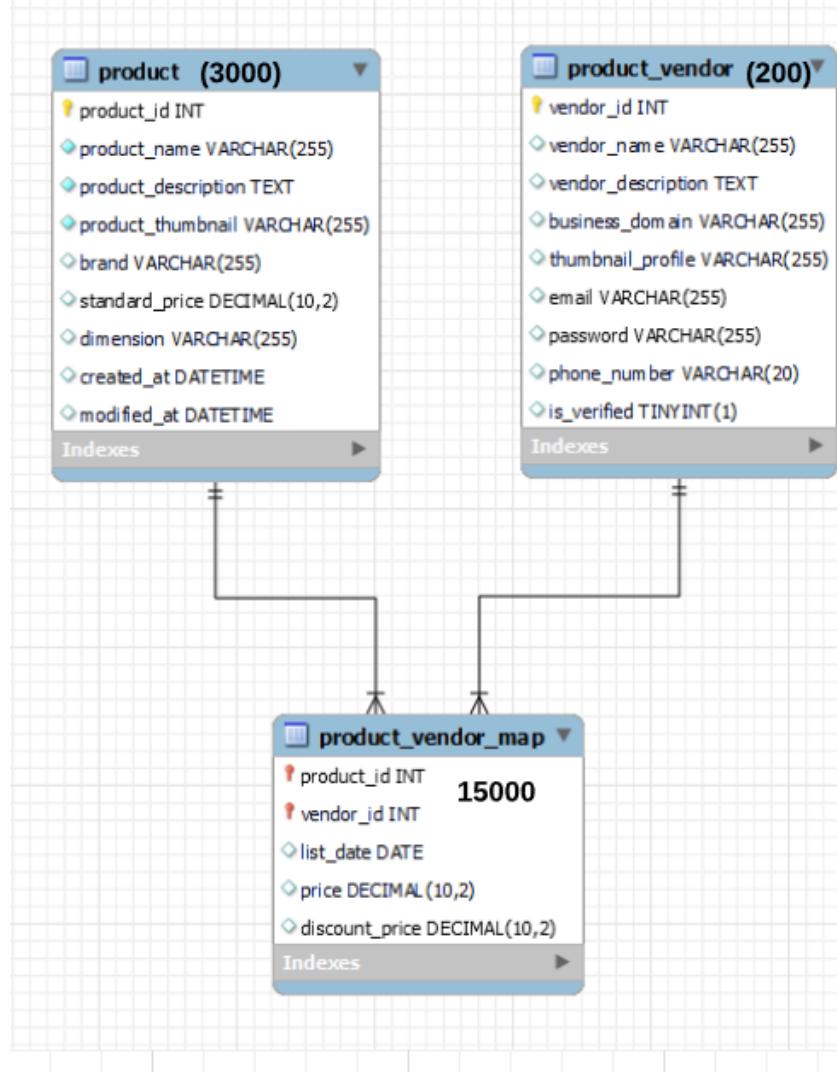
Predicate: MATCH(product_name)
AGAINST ("Panasonic");

Join attributes: pvm.product_id = p.product_id,
pvm.vendor_id = pv.vendor_id

Ordering attribute: none

Built-in functions: none

Attributes updated: none



Access	Entity	Type of Access	No. of References		
			Per Transaction	Avg Per Hour	Peak Per Hour
1	product(entry)	R	3,000	$3,000 * 209 = 627,000$	$3,000 * 1,045 = 3,135,000$
2	product_vendor_map	R	15,000	$15,000 * 209 = 3,135,000$	$15,000 * 1,045 = 15,675,000$
3	product_vendor	R	200	$200 * 209 = 41,800$	$200 * 1,045 = 209,000$
Total References				3,803,800	19,019,000

*Assuming that there are 10,000 active users (U), and the average number of times the query is executed per user per day is 1 query (F) in every morning. For the peak rate assuming that it is roughly 2 times of the average if it has any problems on the order.

Transaction: 2.3 See the order history of each customer

2.3.1 Assuming that you logged in as “Tina Walker”, and you want to see the number of transaction statuses (Completed, Ongoing, Failed) sorted by the highest count. For instance, Completed 10 orders, Ongoing 3 orders, and Failed 2 orders.

Transaction Volume

Average: $(U * F) / 24 = (10,000 * 1) / 24 = 416.67 \approx 417$ times/per hour

Peak: $417 * 2 = 834$ times/per hour (between 11.00 and 14.00 Monday-Friday)

```
SELECT transaction_status,
       COUNT(order_detail_id) AS
       count_transaction_status
  FROM order_detail od
 WHERE user_id = 237
 GROUP BY transaction_status
 ORDER BY count_transaction_status
 DESC;
```

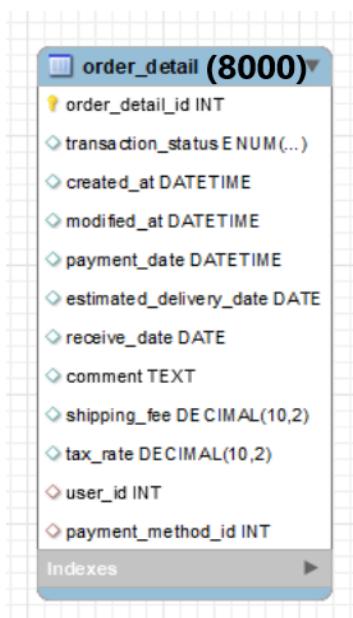
Predicate: user_id = 237

Join attributes: none

Ordering attribute: Yes (ORDER BY
count_transaction_status)

Built-in functions: none

Attributes updated: none



Access	Entity	Type of Access	No. of References		
			Per Transaction	Avg Per Hour	Peak Per Hour
1	order_detail (entry)	R	8,000	$8,000 * 417 = 3,336,000$	$8,000 * 834 = 6,672,000$
Total References			8,000	3,336,000	6,672,000

*Assuming that there are 10,000 active users (U), and the average number of times the query is executed per user per day is 20-30 query (F). For the peak rate assume that it is roughly 4 if it has promotions on that day e.g., 11/11, 12/12 on Shopee.

Transaction: 3.1 Add product to the cart

3.1.1 Assuming that you logged in as “Lori Hunt” (or user id 492), and you want to add product id 95 or “Hitachi SPLIT AC - 1.0 Ton HITACHI SHIZEN 3100S INVERTER - R32 - RAPG312HFE0Z1 (Gold)” to his cart for 99 items.

Transaction Volume

Average: $(U * F) / 24 = (10,000 * 4) / 24 = 1,666.67 \approx 1,667$ times/per hour

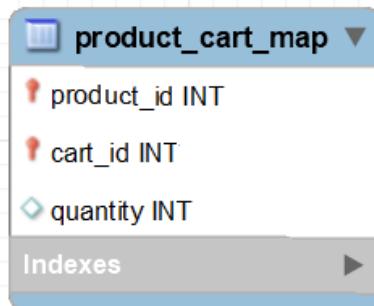
Peak: $1,667 * 4 = 6,668$ times/per hour

(between 12.00-14.00 and 16.00-20.00 Firday-Sunday, or promotion day like 11/11)

```
INSERT INTO product_cart_map
(product_id, cart_id, quantity)
VALUES(95, 492, 99);
```

Predicate: none
Join attributes: none
Ordering attribute: none
Built-in functions: none
Attributes updated: Yes (Inserted one record)

(50,000)



Assume that they already knew the product_id and cart_id, so they can directly insert to the product_cart_map table without finding on those tables.

Access	Entity	Type of Access	No. of References		
			Per Transaction	Avg Per Hour	Peak Per Hour
1	order_detail (entry)	R	50,000	$50,000 * 1,667 = 83,350,000$	$8,000 * 6,668 = 53,344,000$
Total References			50,000	83,350,000	53,344,000

Indexes

- After getting the index of each table, one transaction can have multiple query statements (and u can compute the cost it takes of each transaction) like **lecture 13_14**
- Product_department, product_sub_category, are small table, so we ignore them for further consideration.

Table	Transaction	Field	Frequency (Per day)
Product	1.1, 1.2	Predicate: product_name, product_description, brand, standard_price	200,000
	1.1, 1.2	Predicate: created_at, modified_at	40
	1.1	Join: Review on product_id	20,000
Product_vendor	1.4	Predicate: vendor_name	5
	1.4	Join: product_vendor_map	5
	2.2	Predicate: email, password	500
Review	1.5	Predicate: comment	2,000
users	2.2	Predicate: email, password	5,000
order	2.3	Join: order_detail on order_detail_id	1,000
	2.3	Join: user on user_id	1,000
	2.3	Predicate: first_name, last_name, transaction_status	1,000
	2.3	ordering: transaction_status	1,000
Product_cart_map	3.2	Join: Product on product_id	1,500
	3.2	Join: Cart on cart_id	1,500
	3.2	Join: User on user_id	1,500
	3.2	Predicate: user_id	1,500

Additional indexes to be created in MySQL based on the query transactions

Table	Index
Product	brand
	product_description
	product_name
	standard_price
Review	comment
User	email (unique)
Product_vendor	email, password

User Views (at least 2)

There are 3 main users performing in the system. Therefore, securing the system and limiting the access of each user need to be concerned. Moreover, since there are many users operating the system, breaking down this would help prevent the race condition that may occur when the process is synchronized.

- **Customer**

- 1.1.1 Show the list of products and their details whose product name includes the word "Panasonic". = **Product table**
- 1.1.2 Continue from 1.1.1, Show the rating score and helpful_rate_count of those products and sorted by weighting rating score and helpful_rate_count in descending order. HINT: To weight the rating score, rating_star * helpful_rate_count = **Product table**, **Review table**, and **Review_image table**
- 2.3.1 Assuming that you logged in as "Tina Sievewright", and you want to see the number of transaction statuses (Completed, Ongoing, Failed) sorted by the highest count. For instance, Completed 10 orders, Ongoing 3 orders, and Failed 2 orders. = **User table** and **Order_detail table**

- **Vendor**

- 2.2.2 Assuming that you are Nearlyded, and he wants to log in to his new account with the following details. Please show all of his information. = **Product_vendor table**
- 2.3.2 List all of the order history where the transaction status is equal to "Failed". = **Order_detail table** and **Payment_method table**

- **Staff**

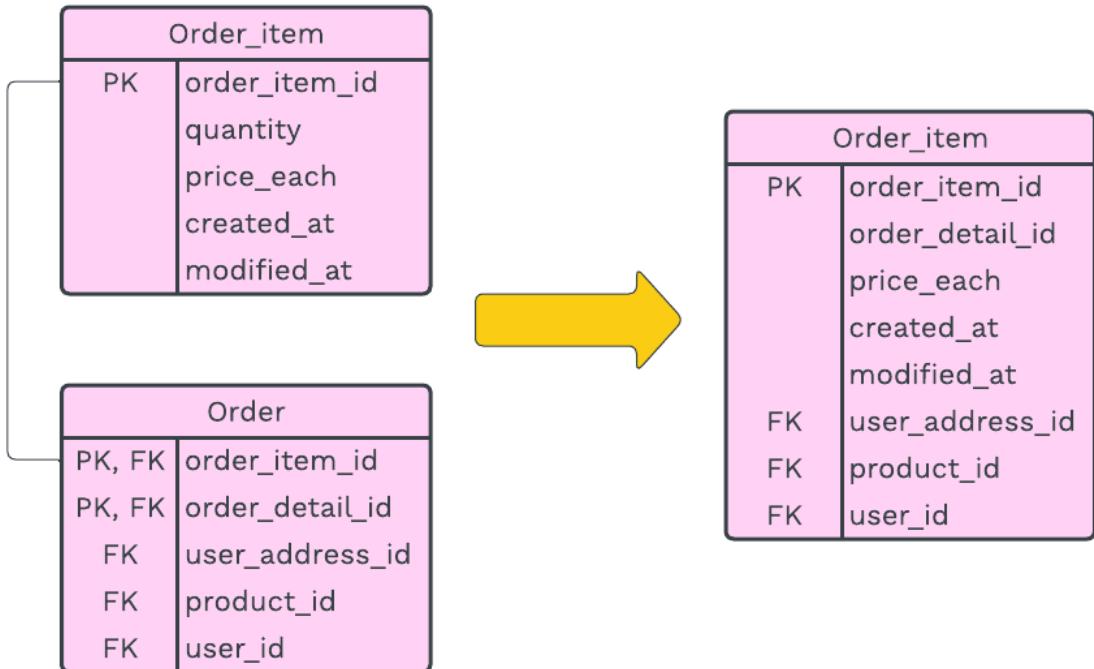
- 1.1.5 Show the product name and their details where their created and modified date is within the year 2022. = **Product table**

Regarding the data and transaction requirement specifications (users' full permission on accessing the table is described in "Data requirement specifications"), there are many queries that we can use from each process, therefore we *select some important queries to create views as shown above*. Following an analysis of the data requirements for these user views, we used the centralized approach to merge the requirements for the user views as follows:

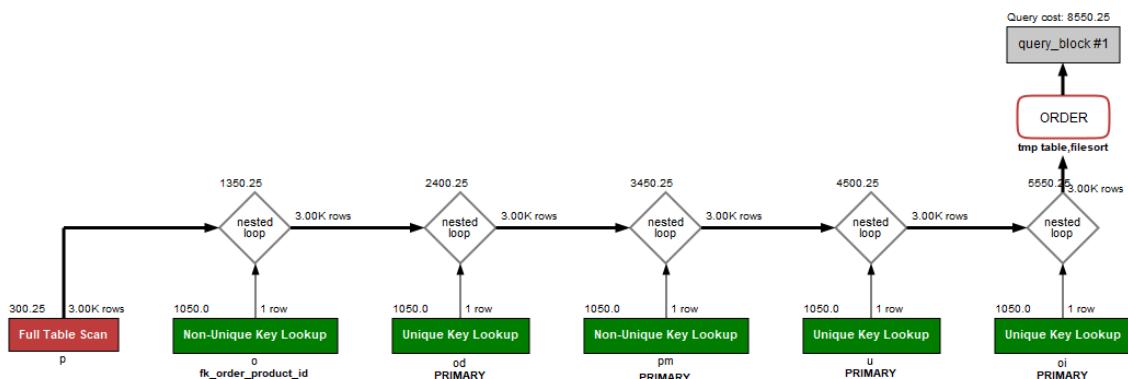
- **Product_list View:** **Product table**
 - Allowed to access: Customer, Vendor, and Staff
- **Review_list View:** **Review table** and **Review_image table**
 - Allowed to access: Customer and Staff
- **User_order View:** **User table**, **Order_detail table**, and **Payment_method table**
 - Allowed to access: User
- **Product_vendor_list View:** **Product_vendor table**, and **Vendor_address table**
 - Allowed to access: Vendor

Results of Fine-tuning Databases

1. Combining one-to-one (1:1) relationships



Order_item and Order are usually used together. For example, when a user wants to view the order history, the system must join order_item and order. However, joining these 2 tables for users doesn't have much effect on the performance since the users will run the WHERE clause with the user_id to filter the result first. The performance will increase a lot in case we need to retrieve a list order_item that must join with other tables such as order_detail and order_item.

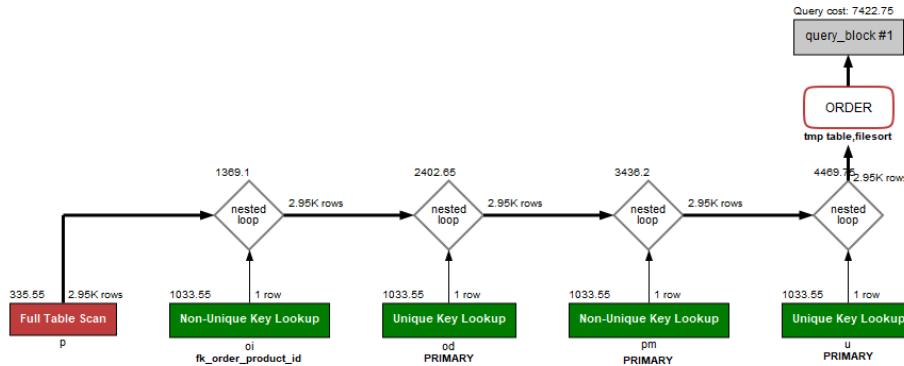


```

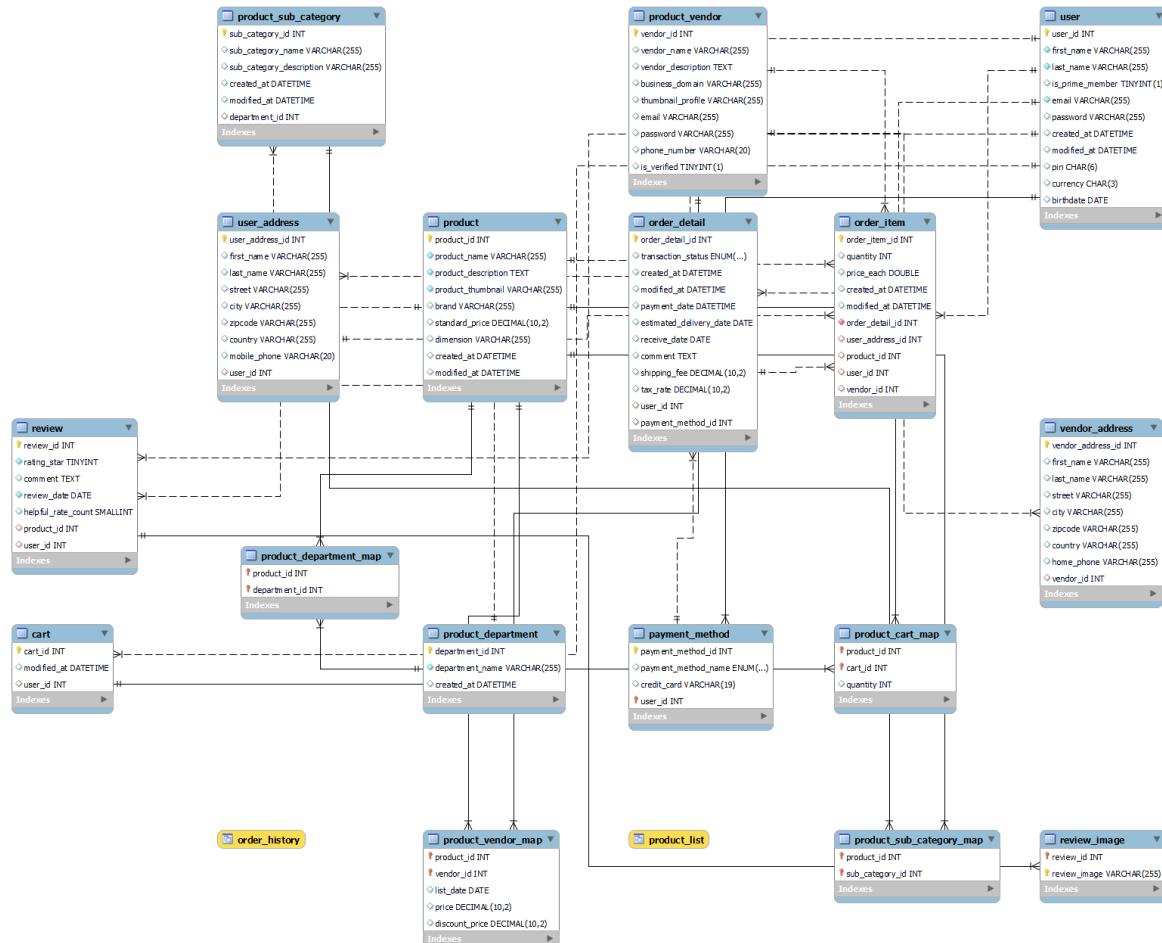
14 CREATE OR REPLACE VIEW `order_history` AS
15 SELECT p.product_name, oi.quantity, oi.price_each, od.order_detail_id, od.created_at AS `Ordered on`, payment_method_name, od.transaction_status
16 FROM order_detail od
17 JOIN `order` o ON o.order_detail_id = od.order_detail_id
18 JOIN order_item oi ON oi.order_item_id = o.order_item_id
19 JOIN product p ON p.product_id = o.product_id
20 JOIN `user` u ON u.user_id = o.user_id
21 JOIN payment_method pm ON od.payment_method_id = pm.payment_method_id
22 WHERE u.user_id = 1 OR u.user_id = 2 OR u.user_id = 10000
23 ORDER BY od.order_detail_id
24 LIMIT 10000;

```

With the combination of order_item and order, we can reduce the number of join of the order and order_item table, which contain a lot of data. As a result, it saves the time to join a table almost every time.



The diagram below is the result of Fine-tuning database.



Appendix

Link to Project Phase 1 (Final)

<  ITCS413_gr6_FinalReport_Phase1_ID030_040_133.pdf >

Link to GitHub

<https://github.com/Vvidsky/DBDesign_ProjectP2>

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