Application path

[221003] Logistics process analysis of e-commerce from a metaverse articulated approach.

Juan Esteban Aranguren Roa[a, c], Juan Sebastián Murcia Rincón[a, c],

Jean Paul Palacios Pardo[a, c], Nicolás Poveda Bustos[a, c],

Alexander Cárdenas Ramos[b, c], Wilson Hernández Martínez[b, c]

[a] *Industrial Engineering Student*
[b] *Professor, Research Project Director, Industrial Engineering Department*
[c] *Pontificia Universidad Javeriana, Bogotá, Colombia*

Abstract

The digitization of stores within a three-dimensional virtual world will be the technological and socio economic future, which will bring challenges to logistics around the relationship between the digital world and the real world. As of the date of this work, all the refinements and investments of large companies around the emerging metaverses can be identified, with the main objective of being part of the daily future of society. Based on this, both large companies and small businesses have already begun to enter the virtual world, either creating their metaverses or buying parcels of land within existing metaverses. To the date of this work, there is no evidence of any Colombian business or trade within what is considered the probable future, for which it is of most importance to begin to have knowledge and applications of businesses within the metaverse and the implications that this entails.

For this reason, it is seeking to propose the methodology in which Colombian e-commerce can enter the three- dimensional virtual space, by designing a 100% virtual space in the multiplatform graphic engine "Unity" that allows the experience of physical commerce, within a metaverse in which the user can interact in many ways. Finally, it is expected that all customer actions within the metaverse will have direct repercussions with the real world, in such a way that said interactions and/or purchases that are made will be evidenced through the shipping and logistics of the product. electronic invoices sent via email, marketing of the products selected and added to the shopping cart, or other actions that may take place in the virtual environment.

Key Words: Digitalization, E-commerce, Metaverse, Logistic, Virtual Reality

1. Justification And Problem Statement

A supply chain can be defined as three or more organizations linked by one or more products, services, finance, or information fluxes from a source to a client (Mentzer, 2001). The management efficiency of the supply chain depends on its approach, which allows the manufacturers, wholesalers, and distributors to optimize their activities. "When a management strategy is proposed for the supply chain for B2B and B2C businesses, one can follow three different approaches: reduce costs, reduce capital, or improve the service." (Calle, 2020).

In addition, the e-commerce supply chain is different, as data is managed in real-time, and the limitations in inventory are lowered. For this reason, Peerbit's research "How retail and E-Commerce can scale fast using Logistics Optimization" explains that, when businesses implement e-commerce in the supply chain, these would obtain benefits in distribution costs, order fulfillment, inventory matching based on SKU location and shipping time. Additionally, 42% of B2B buyers prefer online channels, as they offer a better overview of

the inventory available and delivery details. "By optimizing the delivery, on average, 60% of customers are retained, and 40% of them could be defenders of the business" (Peerbits, 2021).

Now, e-commerce Logistics and their impact on the supply chain represent different challenges derived from the accelerated growth of new technologies and the next internet generation. Different alternatives have been presented, which modify processes and necessities within the supply chain, where different opportunities are generated, which develop by the hand of virtual reality and diverse emergent metaverses. In this new reality, users will have new experiences, and the supply chain management will need to construct an infrastructure that supports the impact of the virtual worlds.

Returning to the article "E-commerce Logistics in Supply Chain Management: Practice Perspective", the orders placed in electronic business are usually rather small, but the product delivery is complex, therefore the reach that the logistics role has, must be much wider. In addition to this, the supply chain presents technological challenges that require the use of information system management that allows taking a step towards new modules that satisfy the requirements of the times (Yu, Wang, Zhong & Huang, 2022).

However, the e-commerce in Colombia has been affected by the contingencies derived from the pandemic. According to the Colombian Chamber of E-commerce (CCCE) digital sales in 2019 represented 21,8 billion COP, while in 2020, around the start of the pandemic, digital sales represented 28.4 billion COP, which means a 30.2% growth, and a rise in digital transactions by 79.4% (Ramírez, 2021). Therefore, "e-commerce has maintained the trend observed in 2020, during the third quarter of 2021, online sales had values close to 10 billion pesos, that is, 79.6% more than sales in the same quarter of 2019" (Ramirez, 2021). Because of this, it's expected that in 2022, the sales generated by e-commerce will increase 33% (Semana, 2021), and that, 5 years from now, they will have a growth up to 74% (Pastrán, 2021).

Nonetheless, Colombia has digital gaps that could harden the adoption of the metaverse, where there is a socioeconomic difference between communities that have access to ICTs and those that do not. This is the case of Colombian companies that, because of the pandemic, increased their investments in digital technologies by 60%, as it is the case of Carulla, which breaks into the business with smart stores, where they designed and built the "Fruver Scan". It is a technology in which the customer places the article on the scanner, and through machine learning, recognizes exactly what it is. Additionally, Smile ID, it's a functionality implemented by Carulla that allows the customer to pay for their products through facial recognition, which significantly reduces the payment time. Therefore, leading companies such as Carulla in the mass consumption and retail e-commerce sector such as Éxito, Alkosto, D1, Mercado Libre, Falabella; can venture into this type of technology due to their financial base and a significant market size.

Keeping in mind the constant growth of ecommerce and the emergent technologies, it is especially important to highlight the importance of the commercialization of assets in metaverses, mainly the high demand for intangible terrains. "The Sandbox" and "Decentraland" are the most popular in this regard, having generated the most terrain sales as NFTs (Pérez, 2021). It's calculated that property sales within the metaverse will reach USD 1000 million by 2022 (RT, 2022), and those industries developed within metaverses will have a 56% growth by 2026, reaching USD 372 billion (Hudson, 2021).

Therefore, new purchasing ways can be generated in e-commerce, as Shopify's director, one of the biggest businesses for creating sales websites explains, with the growth in metaverses, decentralization of e-commerce will be promoted. This allows brands the possibility of not having to align to the uniformity of market formality to virtualize the purchasing experience, bringing the experience of shopping at home or in a store even closer. Consequently, instead of using advertisements to reach potential buyers, sellers can take advantage of streams, content, stories, podcasts, and audio streaming. "I believe that a more direct trade on social media and fewer advertisements would make the internet better" (Indig, 2021).

In January 2022, H&M was the first clothing brand to build their shop in the metaverse via Ceek (Rocha, 2022), which is a platform that created a virtual city and uses its cryptocurrency, with which all purchases are made. One of the reasons for the company to join the metaverse was taking into consideration the already mentioned inevitable growth of new technologies, which can duplicate inversions by 2022 to 100 million USD, as it seeks to significantly increase sales by 2030 (Rocha,2022).

Considering what has been said so far about the industry, innovation, and infrastructure, it is crucial to

guarantee elements that allow the potentiation of supply chains by recognizing the metaverse as a result of the innovation processes worldwide. In the same way, the metaverse can be a platform that boosts businesses' growth and sustainability, which manages their supply chain through e-commerce.

Returning to what has been said so far about this growing kind of commerce , this research project will aim to answer the following questions: How will Colombian businesses begin to transform their supply chains to adapt to the growing incursion of metaverses? How can a diagnosis be made that allows drawing up a roadmap, so that companies can adjust or define their logistics strategy according to the implementation or incursion of a metaverse?

2.   Background

During the state-of-art construction, it's necessary to identify the dynamics surrounding the understanding, implementation, and globalization of the metaverse. As a first step, an investigation through researching scientific papers, union studies, and applied business cases that synthesize relevant concepts for the correct comprehension of elements that allow identifying a methodological step-by-step line to address this research project (Table 1).

The digital transformation that has been occurring since the 20th century has had an enormous impact on the supply chain, as well as the emerging logistics 4.0 that has brought immeasurable challenges and opportunities for organizations all over the world (Wamba, Queiroz, 2022). This represents a key factor for countries on their way to the Fourth Industrial Revolution. The supply chain is made up of information fluxes, products and/or services (in which providers of raw materials take part), the business in charge of entry logistics, and the provision of the service to finally take care of outbound coordination, which is hand in hand with the distribution channels of the product or service, such as wholesalers or retailers.

Retail sales are one of the multiple scenarios for goods and services commerce . Traditional retail is one in which consumers could evaluate the products' attributes, such as color, texture, and taste, among others, and attracts a public mainly based on people of an older generation, with lower exposure to technology. On the other hand, electronic retail expects to attract a more young public, that searches for commerce by convenience, which represents different logistic approaches; while traditional retail is fundamental to hiring collaborators, and making sure there is a physical shop, electronic retail is much more relevant the correct implantation of information technologies that allow the supply chain to have its usual fluxes, to improve the processing of information, and that manages an easy relationship with the customers, while interconnectivity is promoted (Bourkalis, 2009).

The evolution of retail sales has been guided by emerging technologies, especially the internet. The first prominent digital transformation was framed by the appearance of e-retail, which derives from e-commerce, and now, from these new virtual environments, Meta-retail emerges. This new way of commerce intends to put all retail sales in a three-dimensional environment, in which new space is generated for both retailers and consumers, who, more than just consuming a good or service, are seeking to interact with this new space, while business is shifting to giving the customer a better experience in these virtual environments, with a special focus on the e-commerce models. (Bourkalis, 2009).

In 2020, the digital world experimented with 2 years' worth of growth in the span of 90 days. The Covid-19 pandemic modified consumption habits in such a way that it is expected that around 100.000 physical shops close during the next 5 years (Boudreau, 2021), due to the emergent evolution of virtual worlds, online experiences that transform the consumption process, and the personalization of shopping prospects. Gen Z enjoys a more digitized life since it's considered that they met 80% of their friends through the online world. These drastic changes in the consumers' behavior also create an impulse for a new range of virtual experiences. Taking into account that 3% is the average conversion rate of e-commerce sales in the retail sector and that the remaining part of the traffic, 97% of visitors do not buy on e-commerce platforms, it is important to guarantee a sustainable digital future (Boudreau, 2021), which also ensures a transition process from live shops to e-commerce that allows effective and safe digital development.

Author	Title	Classification	Metaverse	Digital architecture	Virtual reality	Cybersecurity	Supply chain	Virtual manufacturing	Retailer	E-Commerce
Hyunsoo Lee	A self-configurable large-scale virtual manufacturing environment for collaborative designers	Scientific paper		✓	✓			✓		
Stephen Davidson	An immersive Perspective on the second life virtual world	Scientific paper		✓		✓				
Craig W.	Modeling Healthcare logistics in a virtual world	Scientific paper		✓	✓					
Gurgaon	What is in store for DevOps and DEvSecops in 2022	Applied cases	✓							
Heejeong	An Innovate e-commerce platform incorporating metaverse to live commerce	Scientific paper	✓		✓			✓		✓
Diana Hassoncgh	Retailing In social Virtual Worlds: Developing A Typology of Virtual Store Atmospherics	Scientific paper	✓		✓				✓	
Harrison, Bourdreau	Going above and beyond ecommerce in the future highly virtualized world and increasingly digital ecosystem	Scientific paper	✓		✓				✓	✓
Michael Bourlakis.	Retail spatial evolution: paving the way from traditional to metaverse retailing	Scientific paper	✓						✓	✓
Jon M. Garon	Legal Implications of a Ubiquitous Metaverse and a Web3 Future	Scientific paper	✓			✓				
Francis Chang, C. Mic Bowman.	XPU: A Distributed Architecture for Metaverses	Technical report	✓	✓						

Table 1. Literature review. self-authorship

Recently, live commerce, which is a type of commerce that presents products via chat with the customers has been gaining popularity within e-commerce (Jeong, 2021). Live e-commerce and different virtual environments have a complementary relationship. If a product sells only through live channels, it is difficult to completely resolve customers' questions through comment communication. On the other hand, the metaverse has a limitation, in the sense that information or pictures of the real form of the product cannot be obtained. Therefore, combining the two modalities would allow us to fill in each other's gaps, to create a shopping space that has both online and offline advantages (Jeong, 2021).

Now, the Metaverse is a compound word that unites "meta" and "universe" and refers to a three-dimensional world where virtualization from reality and an intangible space coexist (Jeong, 2021). The "metaverse" concept was mentioned for the first time in 1992, in Neal Stephenson's novel "Snow Crash", in an interview for Vanity Fair in 2017, the author confirmed that his work wasn't based on any scientific research and was only a product of his creativity and projection knowledge (Tones, 2021). In a first approach to the metaverse, multiple descriptions and applications for the concept have emerged. In 2018, director Steven Spielberg gave a brief idea of the illusory reality with his film "Ready Player One", an adaptation of a book by Ernest Cline published in 2011 (Iberdrola, 2022). By 2022, this concept is no longer seen as an idea, but as a near future.

Returning to the above. The metaverse will be related to all the stages and steps of the supply chain (DHL, 2022), from storage to shipping and delivery. Also, it will serve to anticipate information all the time and at any place, which will allow to speed up processes and optimize costs, as well as make shipping and delivery more secure (Gómez, 2022). According to the "Augmented reality of logistics" study from DHL, 20% of all logistics costs correspond to storage operations, such as location, colocation, and extraction of merchandise, which would affect their reception and delivery.

For this reason, its application and development within the virtual world will be useful to speed up the product organization and maximum optimization of available space (Gómez, 2022). Experts on the subject calculate that dispatchers use between 60 and 40% of their working hours to search for packages instead of transporting the products. For this reason, the metaverse is not only going to establish a more detailed simulation of processes, but it will also promote the implementation of immersive virtual environments, to facilitate organizing processes in warehouses and production centers (Mecalux, 2022).

In terms of transport, the metaverse would facilitate product code bar scanning, as well as organization, optimization of space, and offer updated information about damages to the merchandise. This new reality could be applied from the register to traceability of products, which implies significant cost savings in time and management (Gómez, 2022). According to the above, in the matter of production and logistics, there are different programs that design work fluxes, detect inefficiencies, and increase productivity (Mecalux, 2022). For example, the Nvidia Omniverse is software implemented in BMW. As Nvidia's CEO Jensen Huang mentioned in an interview for CNBC, "The metaverse helps companies reduce the costs of organization's operatives.

The digital world allows the creation of different scenarios, in which companies from different sectors can incorporate, and construct an infinity of applications. Recently, different businesses have been debuting in the virtual spaces of the metaverse, such as H&M, Samsung, Walmart, IKEA, Apple, Nike, Victoria's Secret, among others. These companies now have the advantage of allowing customers to create their own content, far more from just the limitations of the physical world, and letting them to experiment virtually what, until now, was only available offline.

In addition to this, video games also have had proximity to the metaverse. This is the case of video games such as Fortnite, a program developed by Epic Games that utilizes the virtual world to allow players to create an online community while they enjoy playing a battle-royal game. In April of 2021, famous rapper Travis Scott presented a virtual concert, offered to all the public inside the game. Around 27.7 million users attended the concert and generated 10 times the income of a regular offline concert. (Jeong, 2022). Another aspect of video games in the metaverse is virtual reality, which is starting to have a direct link with the metaverse in all types of fields.

On February the 7th, 2022, an Indian couple got married inside the metaverse during which they didn't have to worry about Covid-19, or sanitary recommendations (Cal, 2022). The celebration was carried out during the afternoon, and guests accessed through access codes previously given to them, and just like that, they appeared in J.K. Rowling's "Harry Potter". Once in Hogwarts, they could walk around the castle, give out their gifts to the wedding couple, and celebrate with their love in the company of friends and family. This approach gives us the opportunity to build ideas with immeasurable possibilities during the next few years.

Therefore, when talking about virtual reality, we refer to the representation of scenes or object images produced by an informatic system, which gives off the sensation of its real existence (RAE, 2022). Also, for the correct implementation of virtual reality, it is necessary to keep in mind the simulation, interaction, and perception of users (Vera, Ortega, Burgos, 2003). The simulation can be represented as a system that mimics reality, with the purpose of convincing the user that their experience constitutes one of the real realms. Interaction is defined as a capacity to have control over the created system, so that the users' actions produce changes in the artificial world. Finally, perception, the most relevant factor, currently seeks that Virtual Reality systems aim mainly the sight, hearing and touch through external elements such as visualization HMD helmets, and data gloves (Verá, Ortega, Burgos, 2003).

On October the 28th, 2021, during the "*Connect*" conference, Mark Zuckerberg announced that his company Facebook, now named Meta, will now be focused on recreating life within the metaverse, helping people connect through communities with similar interests, have a unique lifestyle, and mainly, trade and invest in a world where non-renewable resources don't exist. "The metaverse will be a social, 3D virtual space, in which you will be able to share intricate experiences with other people, even when it is not possible to be together physically and doing activities together wouldn't be possible in the real world" (Zuckerberg, 2022).

Therefore, to reach the metaverse, a building or construction process needs to be made, in which the following steps are imperative: 1) Identification of the virtual components that derive from the real world; 2) choose a metaverse platform. It's possible to choose from the metaverse platforms already launched in the market, like Facebook Meta or you can build your metaverse platform from scratch; 3) Design the metaspace; 4) Build an interaction layer, so your user can interact within the metaspace you have designed. The interaction layer defines the user controls, access criteria, navigation controls, and communication protocols between the users. It also defines the integrations with third-party tools and software needed to support the functioning of the metaspace; 5) Build an interoperability layer. Interoperability standards enable the operational processes to support the exchange and sharing of information between different systems. (Rahul, 2022) As a complement to this, it is important to keep in mind other factors, such as privacy, and security, which must be a priority of metaverse construction from day one (Zuckenberg, 2022).

As current internet businesses, each service provider will have continuous obligations to protect clients' privacy and information security, making compliance with applicable privacy and security laws making compliance with applicable privacy and security laws an essential component of every company's metaverse strategy. This is because, one of the main threats in the metaverse is violations of cyberattack security, corporate espionage, ransomware attacks, and piracy. The responsibility of supervising and acting against all threats mentioned will be at the hands of directors and workers of the providing companies (Garon Jhon, 2022).

Because of this, many companies have begun making patents in the virtual environment, which is the case of Victoria's Secret. The beauty and underwear American company, famous for its marketing and high

visibility, started taking its first steps towards the metaverse and NFT's (Ipropoup, 2022). The company presented four requests for digital collectibles and media development through blockchain, as well as clothing for its use in virtual worlds (Kondoudis, 2020). This process of registration is of great importance, since it allows third parties to be unable to use the brand legally in the multiverse, without authorization from the original company (Iproup, 2022).

In an equivalent way, since 2017 Walmart has been incorporating elements related to the metaverse, with a video that shows how their stores would look in the metaverse, therefore, their plans involve creating their own crypto currency, and a collection of NFT's (Thomas, 2022). According to the patents and brands office in the US, it stands out that Walmart presented several requests on the 30th of December 2021. In this statement, they confirm that Walmart shows a lot of background planification surrounding their cryptocurrency, their approach to the metaverse, and the virtual world that seems to arrive or that it is already here (Gerben, 2022).

Another particularly attractive case is one developed by the Korean multinational Samsung, which in the year 2022 presented their project "Samsung 837X", defined as an experience in an immersive world, where their clients could experience in the metaverse the launching of their products, get NFT's, and buy or sell items. All this, under the use of blockchain technology, through "Decentraland" infrastructure, where users could interact with products of the company, and personalize their avatars. In addition to this, Samsung proposes different spaces focused on the interactions in the metaverse, where initiatives such as "Connectivity Theater", "Custom Stage", and "Sustainability Forests" can be found. These spaces in the metaverse would have the goal to share the company's initiatives.

However, it's impressive to know and visualize all advances and achievements of the companies and cases previously presented, but the question is, how did they create a VR space in the metaverse? Which programs and codification language did they use? According to the director of Open Computing Ltd Josip Almasi, in order to build a metaverse, there are some factors to have in mind. On the one hand, let's start with the VR and 3D content needed. It's necessary to enable the VR browsers that can already be supported by web browsers, which already support video and audio streaming (WebRTC), VR and AR (WebXR). Second, the 3D content is better to manage in an open-source standard gIFT format; like it's provided by the leading platform for 3D and AR "*Sketchfab*", which is supported by several companies and has more than five hundred thousands of hosts. After these two principal factors, tell us the importance between being in VR or interacting in the metaverse with VR: "*In VR, arrange windows wherever you look. That's better than any number of screens. And once that happens, you'll be able to talk metaverse for real*" (Almasi, 2022). On the other hand, the most complex factor is to include a personalized avatar into the metaverse, as the different structure of code related it with the human composition of bones that each avatar could have, "*Then, must-have features that are supposed to be trivial, like holding something in your virtual hand, become extremely complicated*" (Almasi, 2022). Based on that, it's better to use default avatars, and in this way, not to venture into these complications. At last but not least, Almasi recommends, as the best way to load and build 3D scenarios is Babylon.js, "*an open source JavaScript WebGL library to load glTF content and render with WebGL*" (Almasi, 2022), which is the best way and codification language of the VRSpace.

Finally, there have been significant advances in relation to the conception of the metaverse, which has been evidenced by the massification of applied cases such as the ones seen on Victoria's Secret, Fortnite, Walmart, Samsung, and Hogwarts wedding. Thus, the applied research associated with virtual reality, e-commerce, the construction of the metaverse, and cybersecurity, is important to strengthen schemes that allow companies to adopt the metaverse within their logistics strategies, therefore, this will be the object of this project.

3.   Objectives

General Objective:
- Design a method that allows the integration of the metaverse and the value chain of Colombian e-commerce logistics processes.

Specific Objectives:
- Establish the features of Colombian e-commerces through an integrated approach that keeps into account its logistics operations.
- Develop an architecture for the integration of e-commerce processes with the metaverse.
- Implement a controlled test of the integration method and logistics processes.
- Build a metric scheme for the performance of the integration between the metaverse and the business physical environment.

4.   Characteristics and logistical operations of e-commerce / Peculiarities of logistical operations of e-commerce / Description of logistical operations of e-commerce

4.1.   Methodology

To characterize the processes that are part of electronic commerce, a search of the operation of electronic commerce will be carried out, which will be constituted by primary and secondary sources of some of the greatest exponents of e-commerce (Amazon, Linio and Mercado libre), where papers were reviewed, interviews were conducted, and outstanding documents were sought to obtain information that complements the research carried out. This is with the purpose of identifying the qualitative variables and logistical processes that allow for identifying the performance of these businesses.

Initially, employing a flowchart, the purchase process will be represented, from the moment the client enters the digital platform, until his order is received at his home. Likewise, to map the logistics processes, the thread chart tool of the supply chain operations reference framework "SCOR" will be used, commonly used to represent, analyze and manage the supply chain, since that allows to visualize the activities required within the logistics to be able to effectively satisfy the demand of the clients. Once the model has been proposed, performance indicators can be identified that allow logistics operations to be monitored at the logistics level.

4.2.   Analysis of results

Electronic commerce is a distribution, marketing, and sales channel for both products and services that have been strengthened since the beginning of the pandemic in 2019, in which all citizens of the world entered a state of quarantine, for which they increased online orders without the need to leave home. Given the above, it is necessary to understand the present roles, related to the logistics processes that pluralize in functions of provisioning, storage, distribution, and both physical and information flows.

The development of electronic commerce B2B, B2C, C2C, and C2B, among others, starts from the user interface that the different platforms such as Amazon, Mercadolibre, or eBay offer. In the first place, it will be called "Process A" for that process in which each electronic commerce is responsible for its products in its storage centers, for which the expenses, income, and related logistics fall on them. Secondly, for "Process B", electronic commerce is a facilitator of the physical space for the storage of third-party products, whether natural or legal persons, but logistics and customer service are managed by electronic commerce from reception in the warehouse until the products are delivered or returned by customers. In the third and last place, there is a "Process C", where electronic commerce acts as a digital showcase through its platform so that third parties, whether natural or legal persons, market their products, being in charge of logistics without nexus and collaboration of the trade. electronics.

Now, going into detail to understand other variables that constitute the agile and correct functioning of electronic commerce, begins with the activities carried out by the sellers; One of these is the "product listing" on the platform for their categorization, where the platform automatically generates a particular "SKU" code for each item listed, with which it is identified both in the physical inventory and in the databases. e-commerce data. Likewise, when listing the product on the digital platform, the "distribution strategy" must be defined to determine the type of logistics and customer service that will be handled, taking into account the processes "A", " B" and "C" mentioned

above.

Other actors that comprise the flow of information for independent electronic commerce are the "providers or platforms" where electronic commerce can be positioned, since each platform, such as Shopify, Wix, Opencart, and PrestaShop among others; contains different operating characteristics. Likewise, e-commerce uses different payment platforms, for example, Mercado Libre together with Mercado Pago, the services offered by Amazon Web Services, or others such as Pay U or Wompi that may be associated with the previously mentioned e-commerce.

Once the most significant and representative variables were identified, first-hand sources were taken into account as well as sellers of "Process B" and frequent buyers within the platforms of Amazon, Mercado Libre, and independent electronic stores.

As an e-commerce seller, "Sebastián González Duarte" was interviewed, currently "Commercial VP of Asylum Marketing" with more than 7 years of experience in digital strategy and more than 4 years working with Amazon accounts, as a seller of the most popular marketplace largest in the world, adopted the Amazon FBA (Fulfillment By Amazon) model, which refers to the previously explained "Process B". Sebastián began by mentioning the importance of creating a "Private Label" as the goal to be achieved as a seller within the Amazon platform, to generate value in the product through experience, visual and written content, and most importantly, a brand that contains all these differentiating factors from other products, niches, categories, and shopping experiences.

Sebastian shared that the first thing to do is to verify if the country in which it is located is suitable to be a seller, given the case that the country qualifies among those authorized, an Amazon account is opened as a seller "Amazon Seller", where in the "Seller Central" you can manage everything around the creation and listing of products, number of sales, returns, and highly important quantitative indicators. Likewise, if you are in the USA and have the company registered with an LLC, you can verify this with Amazon and obtain many more benefits over the others.

At the moment in which the product is decided, several factors are taken into account, to begin the understanding of the Amazon algorithm. Those who have entered the platform, identify that the products are organized by categories and subcategories, therefore, it is necessary to create and list the product to be sold within the "Seller Central"; identify the category in which it belongs, put the name with which it will be searched (take into account the search keywords), create the "bullet points", its description and the images with the parameters determined by Amazon. Now, going back to Amazon's algorithm, the better the product is listed with all this information, the LQS (Listing Quality Score) will be higher, and it will tend to be shown to a greater extent on the first page at the time the search is made.

Following the listing and creation of the digital showcase, the product must be delivered to the Amazon warehouses, for which the flow of information regarding the dimensions, weight, quantities, and content of the boxes or packaging of the products is of the utmost importance. products, so that Amazon assigns an "ASIN number" (Own code for the traceability of the product within Amazon), labels, and determines the warehouses to which the merchandise will arrive, be located, and distributed in the different states of the USA.

Now, when the product is already in the warehouse, you can start selling using one of the two possible methods. The first is through paid advertising with search keywords, so that the seller's product appears first, or through the Amazon algorithm, there is a score that is given to each of the products listed on the platform with the name or identification of "Rank". This rating is given for each of the categories, from number 1 to the number of products that are being sold or listed for this particular category. Once this is understood, the closer that rating is to 0, it means that this product is being sold and shown much more than all the others. It is granted automatically through the analysis of several factors, including the aforementioned LQS, the number of sales over the number of visits (flow of conversions over time), the relationship between demand and the existence of stock in the warehouses, the number, and the score of reviews.

Finally, when a customer places an order, it is identified with the ASIN number and the Amazon information systems that indicate where it is located within the warehouses and which state is closest to the location of the order. client. This information is delivered to an employee or to robots that carry the product from the racks to the point of packaging, labeling, and dispatch registration; to finally be delivered to the means of transport determined

by Amazon, so that it reaches the customer as soon as possible, where, from then on, Amazon customer service will communicate with the buyers. Therefore, according to Sebastian, the FBA seller must be in charge of managing the availability of the product (stock) and focus on getting closer to 0 in the Rank by raising or lowering prices, putting discount coupons, and improving the quality of images and descriptions.

In the development of electronic commerce activities, there are different inputs and outputs of financial resources that allow the generation of supply, generation of value, and sustainability of electronic commerce. Electronic commerce platforms deploy different business models that demand capital according to their needs. for its implementation and seeking to make said investment profitable; The most common way in which e-commerce generates income is through digital sales of products or services, which, for example, in the case of Amazon in 2019, represented more than 50% of its income (Ang, 2020), but it is not they remain only in sales since the income of electronic businesses is very diverse, it is possible to find tickets for the sale of services to third parties, either by commissions, fees per store, databases, documents, and other particular services depending on the type of business electronic.

Some platforms collect money through subscriptions to their clients, such as Amazon Prime, which allows free shipping on eligible products or premium accounts to access different tools such as LinkedIn. Electronic stores, commonly used as a digital showcase, allow their users to highlight their ads by charging them an advertising space within the same platform, income is also generated by charging commissions for sales or transactions carried out on the platform, usually, sales commissions or transactions are a percentage of the price that the client is paying but it is not always like that, for example, in payments made with cryptocurrencies there may be an additional fee that will depend on the flow of purchases made with the currency at the time of making the transaction as it is the case of the Open Sea platform that will make a standard charge for the transaction but that due to the use of blockchains will have to pay the network service, and finally another way in which electronic businesses can generate income is through donations, However, this business model is rare.

As a counterpart, electronic businesses have different associated expenses given their operation, it is important to mention that there may be expenses related to payroll depending on the size of the company, taxes, and payments related to commercial activity, among other expenses that are not directly related to e-commerce. Some expenses that electronic commerce can generate is the same infrastructure where the electronic commerce is set up, whether it is own or that of third parties, for example, Amazon develops its infrastructure and is also an infrastructure provider for other companies through its affiliate AWS. Another important expense of an electronic business is the logistics of shipments and storage, the business will have unit costs per volume stored in warehouses owned by the business or renting spaces to natural or legal persons as the case may be, now for the shipments that it makes under its logistics or logistics outsourcing with legal entities (FedEx, Ups, DHL, etc.) or with natural persons (Amazon Flex, etc.). Trade generates other costs; e-commerce platforms have expenses related to marketing that they make from market segmentation, these expenses can be linked to advertising campaign services that contain user information such as Google Ads or they can be additional tools to the costs related to marketing.

To manage the flows of information and e-commerce, it is necessary to implement a CMS according to the characteristics and functionalities of the CMS that is used, which can cause different expenses, for example, the services provided by Shopify or PrestaShops that are paid or Woocommerce that is free but requires a WordPress infrastructure. E-commerce must also pay for the domain and hosting of the business. Finally, the last cost that will be incurred will be the payment platform which may depend on sales forecasts or buyer behavior, some well-known payment platforms are Paypal, Mercadopago, PayU, virtual POS, or Stripe, which charge a commission for purchase amounts or according to the associated banking entities (Gamella, 2022).

Now, the logistics and supply chain of a company can be represented through the flowchart below, where two stages are identified, the first, the purchase process, and the second, the state of the order after executing the order process. purchase, in addition, the different actors that make up the processes stand out, which are the clients, the e-commerce, and external sellers that make use of the e-commerce digital platform for the commercialization of products.
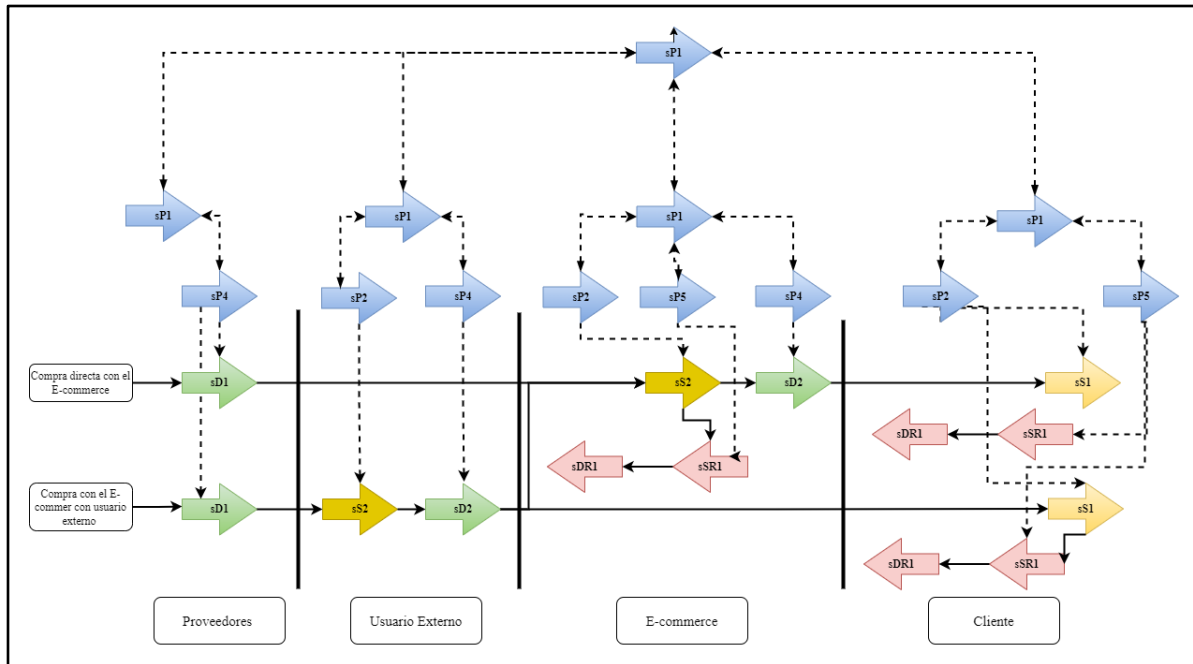
Diagram 1. Logistics process Scor. Self-authorship

The description of the processes in Diagram 1 is shown below:

Process	Nomenclature	Involved	Description
Delivery	sD1	Providers	It is the process carried out by the suppliers who send the finished products to the e-commerce and to the external user. Type 1 is established since the supplier is expected to have the products available at all times
	sD2	Ecommerce and external user	The process carried out by the e-commerce and the external user is type 2 since they are sent only in response to specific customer orders.
Supply	sS1	Clustomers	The products have availability to supply and make a sufficient rotation of the same inventory. It is also type 1 because customers leave it as their stock.
	sS2	Ecommerce and external users	By not having as much stock space in the e-commerce and the user, this is done in type 2, since it is by customer request.
	sP1	Providers,External users, Ecommerce and customers.	By having to coordinate the supply chain of how to supply, or how to make the products, we have the sP1 since with this it is planned in a general way.

	sP2	External users, Ecommerce and customers.	The receipt plan for the finished product.
Planing	sP4	Providers, External users and Ecommerce.	Action plan made for the delivery of the products, you can see the planning of the suppliers where they send the products to the ecommerce and to the external user.
	sP5	E-commerce and customers.	Action plan for the return of products in the supply chain.
Returns	sSR1	E-commerce and customers.	Upon encountering a defective product, it must be returned to the sender.
	sDR1	E-commerce and customers.	Proceso en el cual los involucrados devuelven el producto defectuoso al eslabón corresponde

Table 2. Description of Scor. Self-authorship

Once the logistics process has been identified, the process management variables can be identified, which allows evaluating the behaviors and performance of the processes, to take corrective actions as appropriate. Given the accelerated growth of electronic commerce, it is necessary to promote the best results depending on a strategic commitment, that is why the main indicator that must be taken is the Order Fill Rate (OFR), which is a measure of the number of orders that managed to fulfill completely without any backorders or stockouts. It is a good reflection of your ability to meet customer demand and the overall effectiveness of your e-commerce operations, the way to calculate this indicator is through the following equation:

$$OFR = (\frac{Total\ de\ pedidos\ que\ ha\ podido\ satisfacer\ de\ una\ sola\ vez}{Total\ de\ pedidos\ recibidos}) * 100$$

Equation 1. Order fill rate

On Time Delivery (OTD) is a key performance indicator (KPI) and allows e-commerce and other delivery companies to use it to assess their ability to fulfill a customer's order on the promised delivery date. This measure can reveal inefficiencies or bottlenecks in the fulfillment or delivery processes. If you notice that your on-time delivery performance is starting to slip, it is often a symptom of other problems that your business needs to address. Calculate the OTD rate by the following equation:

$$OTD = (\frac{Number\ of\ items\ delivered\ on\ time}{Total\ number\ of\ deliveries.}) * 100$$

Equation 2. On time delivery

Once the product has been delivered, we have to evaluate the quality, which is why the next indicator is the Quality of delivery. That means the proportion of the number of items that customers received and don't have any problems on receipt with respect to the total number of items that were shipped. The calculation of this indicator can be made by employing the following equation:

$$QOD = (\frac{Number\ of\ items\ delivered\ without\ complaint}{Total\ number\ of\ deliveries.}) * 100$$

Equation 3. Quality of delivery

Finally, there are key factors that will determine the success or failure of our first contact with the customer. One of these determining factors is Response Time, which is the average time that takes a salesperson to respond to the first contact with a potential customer. This metric is more important when the average time is calculated by segmenting leads by their source. That means, by where those leads have contacted us. The response time will vary depending on whether the contact was made, by sending a WhatsApp, an email, or filling out a form. To calculate it, you should refer to the following formula:

$$RT = \frac{\sum \quad (Date\ of\ the\ first\ contact - Date\ of\ tracking)}{Total\ of\ customers}$$

Equation 4. Response Time

5. Integration of the necessary processes in favor of the metaverse architecture

5.1. Methodology

For this objective, it is necessary to understand the design and construction of a virtual space that allows immersion in e-commerce through virtual reality. Where different functions will be established, to enable a user to interact with their virtual environment and with the operating characteristics of e-commerce. For this purpose, a search and documentation of the required hardware and software systems to work and enter the metaverse will be carried out.

In the same way, those indispensable variables of virtual environments will be identified, from a logistic perspective. As the flows of the supply chain, and the variables of the physical spaces. To be able to relate them to each other, to establish a step by step articulation of the logistics and implications of these variables in both spaces combined, the physical and virtual.

5.2. Analysis of results

For the construction of the metaverse, it is necessary to start with the recognition of elements and functionalities that allow users to make use of it. As well as to identify the requirements that electronic commerce will demand to be able to establish itself in the metaverse. From the above, it is sought to establish a graphic engine that allows the construction of the virtual environment considering that it can generate multiplatform programs and optimal use of hardware and software resources ensuring the smooth execution of the program. Likewise, it is free of software errors commonly known as "bugs", for which, it is established as a multiplatform development tool "Unity" that will allow the construction of the entire architecture and interactive virtual environment.

Subsequently, 5 base elements are determined on which the proposal is developed. These elements are the environment or scenario that refers to the architectural "virtual space" where e-commerce will be established in the metaverse. The "objects", are the physical and tangible products or bodies represented virtually with aesthetic components to resemble the real behavior of an object. The "direct interaction" and manipulation of the mentioned bodies through their physical behavior, in such a way that it is not only a three-dimensional virtual representation but also tangible by being manipulable and as realistic as possible, to achieve a much more immersive experience than traditional e-commerce. The "Avatar" will be the virtual representation of the user within the store and will be under the user's control. Finally, "The Head Up Display" (HUD), is constituted by the information that appears on the screen for the user to initiate events or have, for example, information about the items with which he/she interacts in the e-commerce within the metaverse.

Additionally, AR Cloud technology should be considered, which allows layers of information to be added to the real world and stored in the cloud. In the metaverse, this means that if an object is added to the virtual reality, it will be stored in layers of fast memory storage where it has been placed, even if the metaverse is left for a while.

There is a requirement for specialized hardware to enter the virtual spaces designed in the metaverse, these

elements are viewers and controls. However, it is possible to access through a monitor, mouse, and keyboard, sacrificing the virtual reality experience, understanding that specialized elements can be expensive and are not so popular; in the same way that happened with the Internet in its origins. However, as it becomes more popular and more people are interested in accessing this technology, a much wider offer will be generated to make these accessories more accessible, there will be a greater investment in the improvement of hardware and software products, as well as other adaptive processes that society will undergo in search of a shared virtual and sensory experience. This adaptation can be evidenced by Augmented World Expo, which mentions how these technologies are becoming more and more accessible. Today, there are already powerful simulators of sensory stimuli such as Var's VR (vision simulator), HaptX (tactile), and OVR (odor).

However, the metaverse is not limited to simulating sensory stimuli. Its purpose is to allow people to live in a virtual reality alternative to the real world. Each individual becomes an avatar and can interact, build things and, in theory, carry out any action that can be carried out in reality, as well as those that are not allowed. To achieve this, we start with some necessary protocols to develop the general component of meta-commerce. Which is divided into two main factors: The Entornogram and what refers to the articulation of both, software and hardware.

To begin with, once the "Unity" tool is installed, a "main camera" must be created within a "scene". The "main camera" refers to the user's movements and first-person view, who will move through the spaces he/she wants, and will be able to visualize everything he/she wants within the virtual space developed. This space is defined according to the objective of the developers. In this case, it was sought to create a car dealership, so in a space of large dimensions, an area was delimited where the products will be displayed. For this, there are two options, one is to design the space, object or product. As a second option, there is the possibility of adding "Assets" by downloading objects of free use or buying objects designed by third parties that offer their work and designs through platforms such as Unity Asset Store or Sketchfab that function as a marketplace of assets.

Once the space is available, it is necessary to have the products, which, as well as the environment, can be designed or acquired. Then they can be loaded into the program and located in the virtual environment designed. Furthermore, it is of utmost importance that the user can interact with the environment, and not just stay in a three-dimensional display. That is why the main camera is integrated with an interaction protocol (a "hand"), which is encoded and has added features with which you can grab and manipulate certain objects in the environment.

In the same way, the objects that can be interacted are coded and made available to the user, to generate the immersive experience that differentiates it from any other e-commerce or virtual experience. For this, several protocols are taken into account, such as the movement of the object, the possibility of opening and closing the door, seeing the product inside, and moving around in it.

Having these factors clear, it is important to establish the necessary protocols to identify e-commerce, to integrate them within the metaverse. This is why we start from the marketplace protocols, which at a high level was previously mentioned, the main camera, the interactive virtual space, and the products that constitute and define the marketplace protocol within the metaverse. Furthermore, the functionality protocol can generate the purchase of a product or service and the desired quantity according to the user. For this, it is necessary to establish a conversation with the user through text and response options so that the customer can make the desired decisions. Likewise, a protocol for updating inventory and logistics information related to the supply chain is necessary. This requires a database in "Unity" that is updated according to the user's decisions, or an integration with a spreadsheet between the cloud and unity that is updated simultaneously. In the same way, as we have a database with inventories, we manage one with budgets and accounting that is updated in the same way.

Finally, it is important to mention that from the user's position, it is necessary to have a computer with a minimum RAM of 8 GB that can support the file without connection or memory problems. This is because as a user, you can enter the metaverse without accessing the virtual reality, only with the computer keys, trackpad, or mouse. However, if you are looking for a one hundred percent immersive experience, it is required to have "HTC or Oculus Rift" VR technology, to have full control and interaction with space and objects. To adapt this technology, the developer has to install a tool to the program that allows virtual reality interaction, which is free of charge. However, the cost of the visors and controllers is around 700 USD per unit.

That is why as a developer, on one hand you need a computer with 8 GB or more of RAM. On the other hand, you need the previously stated variables of the protocols, plus several lines of code and knowledge of the Unity tool that can be acquired. Either through courses or empirically, and autonomously with the information found for

free on the internet. It is worth mentioning that as it is a current topic, there are still few manuals, tutorials, guides and references to support the subject, which is evident in the elements set out in the justification, which support the development of this degree work.

6. Control test of the applied methodologies

6.1. Methodology

This objective will focus on defining the factors to be included in the virtual space according to the logistic processes currently used in e-commerce. For example, inventory management must be taken into account in the virtual space, since this allows a more coherent flow of information to reality. Following this, a survey of available hardware and software will be carried out to perform the controlled test, which consists of understanding the tools available and how to implement them in this construction.

Once all the understanding part is done, we proceed to build the virtual environment. For this, we must start with the physical construction of the place, that is to say, how it will look and what elements will be found in this environment. Thus, having the virtual space designed, it will be necessary to implement all the variables that articulate this model, including the available inventory, product information, and even customer information, since this should be close to reality.

Finally, the output variables of the virtual environment must be linked to the logistics processes, since if the customer buys a product, it must arrive in perfect condition and have all the correct information regarding the customer and the product. Likewise, key information must be extracted, To support management factors in the virtual environment.

6.2. Analysis of results

For the building of the virtual space, certain protocols must be carried out to accomplish the minimum standards required for its design. The first and most important protocol is the establishment of the virtual environment: This is based on defining what objects you want to have and how the meta-commerce architecture will be visualized. There are two ways to build the environment: on one hand, the first option is to build the objects in an alternative software to "Unity", such as "Autocad", in which the store environment is built according to the needs of the store. However, this requires more work and time, not to mention knowledge and skills in other specialized software. On the other hand, is to import objects from the "Unity" store (Unity Asset Store) or other electronic stores such as Sketchfab in which there is a variety of objects, designs, and other resources that can be used for free or paid use. In this way, once the model is chosen, we proceed with the import of the selected objects to "Unity" to finally place them in the virtual space. If you want to know how to import this to unity, you can go to annexes.

After the environment is designed, you must create a player, which can have different forms, established according to the designer's preference; For example, it can be a human, a cube, an android, or even a science fiction character. The Skin has to be imported into "Unity" in the same way as the objects were imported. Additionally, the player will have movement options, to have the possibility of controlling the virtual environment by implementing different codes according to the functionalities of movement or interaction with objects and the environment. This is from the development of scripts in C# (C Sharp) in the Microsoft Visual Studio tool that integrates particular functionalities for Unity from code libraries, in this case, you can see a code fragment in *Table 3*.

Script	Explanation

float mouseX = Input.GetAxis("Mouse X");
float mouseY = Input.GetAxis("Mouse Y");
transform.Rotate(new Vector3(0,mouseX,0) * speedCam * Time.deltaTime);
	In this part of the code, you can see how the camera rotation and the character movement within the virtual space are defined. The way the camera rotates is the

camRotation -= mouseY * speedCam * Time.deltaTime;
camRotation = Mathf.Clamp(camRotation, -90 , 90);
cam.localRotation = Quaternion.Euler(new Vector3(camRotation,0,0));
horizontalMove = Input.GetAxis("Horizontal");
verticalMove = Input.GetAxis("Vertical");
Vector3 movement = (transform.right*horizontalMove + transform.forward * verticalMove) * playerSpeed * Time.deltaTime;
player.Move(movement);
player.Move(newVector3(0,gravityMove,0)*Time.delta;
	simulation of what the client will see, this is defined in the variable "CamRotation". As for the character move in the axes, the variables "vertical move" and "horizontal move" are defined for each axis. That is to say, the character will move according to the player's orders. There are two ways to move, one is with the keyboard arrows and the other is with the "Steam VR" controls. (if you want to consult this script, you can see more detail in annexes).

Table 3. Movement script . Self-authorship

Additionally, interaction with the product to be marketed is of utmost importance, so the aim is to provide the consumer with an experience that is able to break the traditional schemes of e-commerce, thus offering a different experience to the one they are used to by such traditional means. In this case, by means of tools such as "Unity Store" it is important to create an account in "Unity" since it has the facility to directly import the file where you are working, as can be seen in the *Image 1*.
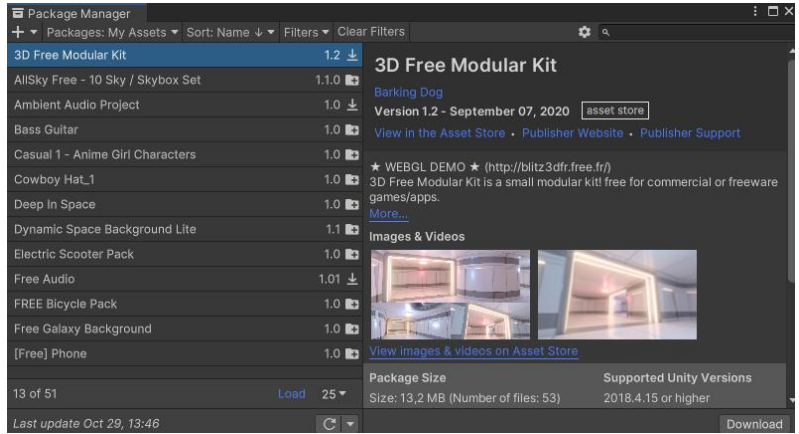

Image 1. Package Manager Unity. Self-authorship

In the case of using "Sketchfab" , download and unzip the folder of the 3D resource you want to use. Then in the folder where the file is located copy and paste the "Asset" to add it manually in Unity. As can be seen in the *Image 2*, in which a folder called assets are created, in which all the 3D resources to be implemented in the virtual environment are stored.
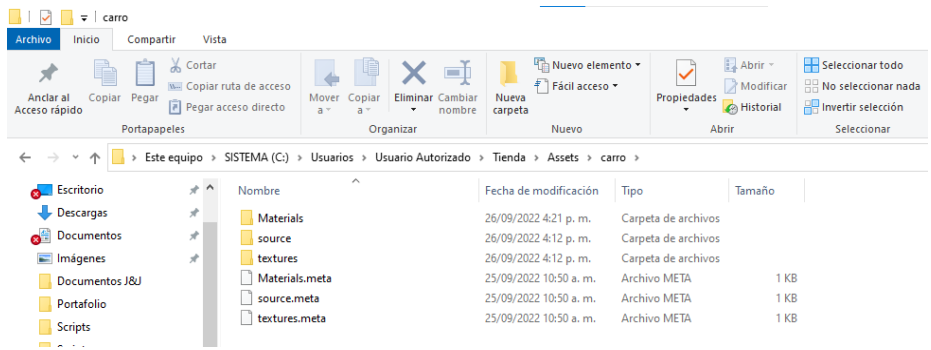

Image 2. Sketchfab Downloaded. Self-authorship

Now, for the objects it is important to create an "empty object" and use the Unity function called "Box Collider", which allows the creation of an "invisible field" that surrounds the object and makes possible the interaction with it. Next, you can see how a Boolean variable is activated when the character enters the field. Then a conditional is created. That performs a scene change when it presses the "E" key where the character appears inside the car.

Script	Explanation
| ```
public bool active;
void Update()
{
    if (active == true)
    {
      if (Input.GetKeyDown(KeyCode.E))
      {
        SceneManager.LoadScene("Dodge");
      }
    }
}
``` | In the code, there is a Boolean variable that allows the activation of the commands, this variable is activated when the player is near an object, so the interaction with that object can be guaranteed. Once the variable is activated, we proceed to perform a command given by the player, in this case, the command is with the "E" key, which will allow us to change the scene. That is, in this case, where you will enter the car by changing the scene (if you want to consult this script, you can see more detail in annexes). |

Table 4. Change Scene script . Self-authorship

The next protocol is to simulate the virtual store, the purchase of items, and inventory. This process is the most robust because it has the combination of different scripts, which together result in the interface of a store. To begin with, the way to create the store is by employing a "Canvas", which is the visual construction of the store, this is composed of text boxes that appear in the virtual space. For example, the store with the available objects, the quantity you want to purchase, the corresponding price, confirmation of the purchase, and the option to select more than one object. These are the text spaces that we can build in the canvas since this is the choice of each user. As for the scripts we have defined the following:

- ShopManager
- NPC Tienda
- ItemTienda
- Database
- Confirm purchase
- Buy More Items

These scripts are the ones that make up the store, without one of them the store would not work properly, so they must all be implemented, then, key aspects of the scripts will be explained (if you want to see more detail of these scripts, you can consult in annexes).

So, The first script is Database, the objective is to build the database of the store, that is to say, the objects that will be commercialized in the virtual store. It is necessary to define the variables that are considered, in the case of the present work of degree, the following variables are taken into account:

Script	Explanation
| ```
public string name;
public int ID;
public Sprite icon;
public int price;
public Clase clase;
public Tipo type;
public bool accumulate;
public string description;
``` | In the script, these variables are defined, which will be carried with the store's database. The name variable is defined because it is the field with which the product is distinguished, just like the ID. However, the ID has a unique factor, as this is how we distinguish between SKUs. Furthermore, in terms of visualization, the icon variable is defined, in which we can put a picture of the product. As for the class, type and cumulative are internal variables for the operation of the code. Finally, the price and description are variables that are displayed when the user interacts. (if you want to consult this script, you can see more detail in annexes). |

Table 5. Database script . Self-authorship

In the case of the NPC store script, it allows us to activate the store. So the user will be able to activate it with the letter "E". This is implemented in any object, which you have the opportunity to open. For example, this can be put on a cashier in which approaching activates the interface. In the *Image 3* we can see how this interface is activated at the moment of generating this action:

Script	Explanation

void Update()
{
    if (show){
       TiendaUI.SetActive(true);}
    else{
       TiendaUI.SetActive(false);}
  }
	The most important part of the script is the boolean variable, which allows showing the canvas, this is in the variable Show. This variable becomes true when the E key is pressed and false when it is pressed again. When the variable is True, the canvas is activated, which means that it will appear on the screen. (if you want to consult this script, you can see more detail in annexes).

Table 6. NPC script. Self-authorship

Image 3. Shop interface. Self-authorship

Once the store is opened, as shown in the image. The store items were listed through the Store Item script, which is responsible for linking the data from the Database and the store canvas, which allows displaying the items with their respective price and description. This is done thanks to the ID since in both cases it is the same.

On the administration side of the store, that is, how many items are left and how much it costs if it has several products, the manager of this is the shop manager script, which is the manager of the store. Next, we see a small fragment of this code at the time of buying an item. First, it takes the user's money, because it must recognize if it is enough to buy the car. Second, it subtracts the user's money from this purchase price and finally subtracts in terms of inventory to know how much is left of the SKU.

Script	Explanation

public void ComprarItem(int ItemId, int cantidad)
{
    if (Player.GetComponent<Player>().Money >=
Itemcompra[ItemId].precio * cantidad) {
       Debug.Log("Item comprado");
       Player.GetComponent<Player>().Money -=
Itemcompra[ItemId].precio * cantidad;
       Itemcompra[ItemId].cantidad -= cantidad; }
    else{
       insuficientedinero.SetActive(true);}
}
	A function Buy Item is created, which first checks if the user has the necessary amount to buy the object, by means of an if. Where it takes into account the number of items and the price of each one, if the if is fulfilled, what it does is subtract the client's money and the amounts available. (if you want to consult this script, you can see more detail in annexes).

Table 7. Shop Manager script. Self-authorship

Once the desired item has been selected by the user, a sign will appear to decide the quantity of the item to be purchased, this sign can be seen in *Image 4*. Where the user can slide the Slider to the amount of desired items to buy, this is done through the script buy more items, you can see it in *Table 8*.

Script	Explanation
| ```
void Update()
{
    if (this.gameObject.activeInHierarchy){
        cantidadtext.text = slider.value.ToString();}
    if (compra){
        Texto.text = "¿cuanto deseas comprar?";}
    else{
        Texto.text = "vender";}
}
``` | What this code allows us to do is that when the customer is changing the Slider, the above number also changes. So he can know how much is the amount he wants. (if you want to consult this script, you can see more detail in annexes). |

Table 8. Buy more items script. Self-authorship

Image 4. Buy more interfaces. Self-authorship

Lastly, the confirm purchase sign is activated when the customer is in the last part of the process, where it is activated after accepting the desired amount, this can be seen in the *Image 5*. This poster shows the summary of the purchase, in which it says the amount selected by the customer and the total to be paid. This is done through the script confirm purchase, you can see it in *Table 9*.

Script	Explanation
| ```
void Update()
   {
     if (compra)
     {
         Texto.text = "¿Comprar " + cantidad + " " +
db.baseDatos[ID].nombre + " por un valor de " +
db.baseDatos[ID].precio * cantidad + "?";
     }
   }
``` | What this part of the code does is to be updating the text of the poster. That is to say, it updates it with the amount that the client is going to take and the total money to be paid. (if you want to consult this script, you can see more detail in annexes). |

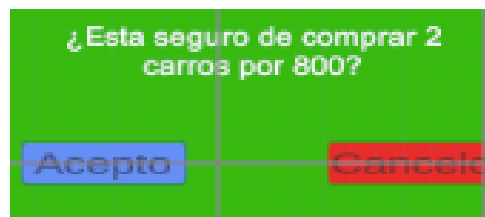*Table 9. Confirm Purchase script. Self-authorship*

Image 5. Confirm purchase interfaces. Self-authorship

Now, what has been done above is the basis of the Metaverse. However, the most important part is missing, which is the VR. So the next step is to make the connection with the virtual reality glasses, as this is the final factor for the customer to have the feeling of entering the store when in reality he is not. To be able to do this, you must have virtual reality glasses and controllers. In the case of this degree work, it was used the HTC Vive Pro Glasses.

Image 6.HTC Vive pro glasses. By Tech In

Once the appropriate equipment is obtained, the next step is to install the "Steam VR " software on the computer, this will synchronize the glasses and the controllers with the computer. The next step is to install the "Steam VR Plugin" in "Unity", this is done through the Assets, which were mentioned above. First, you must search in the Unity store for this add-on, then to install it, you must do the same process as the previous assets.
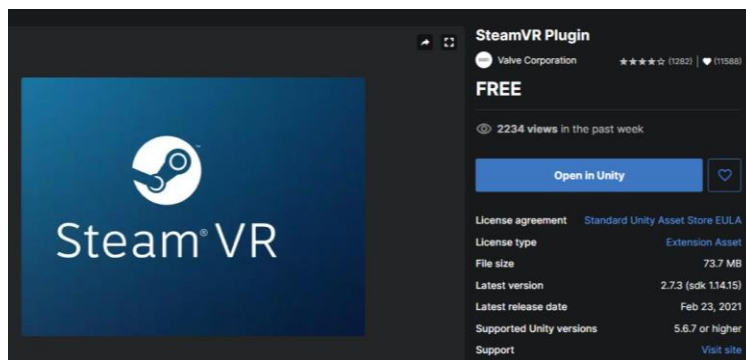
.

Image 7. Stream VR plugin. Self-authorship

Once the Plugin has been installed in Unity, it must be configured. To do this, go to Edit-Project Settings, where the window shown in image X will appear. The next thing to do is to configure the type of glasses you have, Unity allows you to have different types of glasses, such as Oculus or OpenVR. In the case of this degree work, the OpenVR option is selected, since the HTC glasses do not appear in Unity.
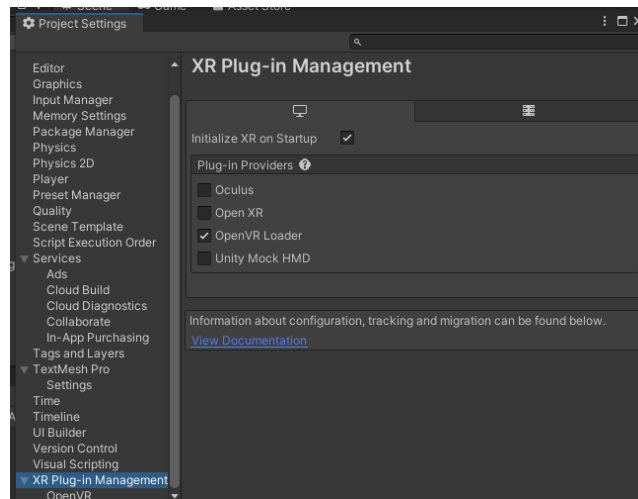

Image 8. XR Settings. Self-authorship

After this process, some Steam VR folders will appear, in which you can already find prefabricated elements and Scripts already made. In order to facilitate the connection with the glasses. The main thing to do is to change the player that was previously defined, for one that is already made in Steam VR. When the game is running, we will automatically see everything in the glasses.

Additionally, the XR interaction Toolkit Package must be installed, since, as with SteamVR, this will allow us to

generate interactions with the controllers and the glasses. To install it, go to the Window-Package Manager, and filter by the Unity Registry Packs.
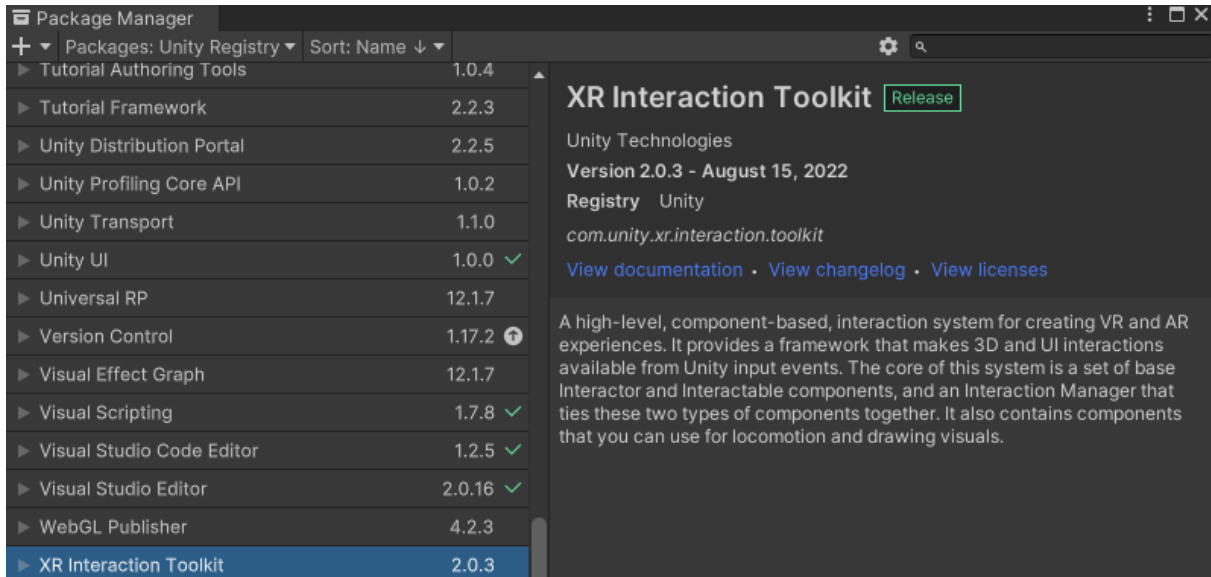

Image 9. XR Interaction Toolkit. Self-authorship

Once the package is installed, you have to proceed with the creation of an empty object as shown in *Image 10*. This will be composed of the main camera, the hand controls, and the interaction of the controllers. For each of the parts to work, you must put the scripts that were obtained from the XR interaction tool package, this will only be based on putting these scripts in the indicated objects. *Table 10* shows each object with its related script.

Image 10. XR Interaction Toolkit. Self-authorship

Object	Script
Main Camera	Tacker Pose Driver
XR origin	XR origin
Right Hand Controller And Left Hand Controller	XR Contoller (action-based), Hand complete, XR direct interaction
Right Ray Controller And Left Ray Controller	XR Contoller (action-based), XR Ray interactor, XR interactor Line Visual
Interactable Objects (Hats)	XR interaction Manager
Canvas	Tracked Device Graphic Raycaster
Event System	XRUI input Module

Table 10. Relation between object and script. Self-authorship

7.   Measuring the efficiency of integration

7.1.   Methodology

In order to establish a scheme to measure the performance between the integration of the metaverse and the physical environment, the next step is to determine those attributes that generate value in the proposed integration between the two environments and in the dynamics of e-commerce. From the previous identification of the proposed attributes, we continue with the establishment or creation of performance indicators related to these attributes through the use of tools that allow a correct treatment and analysis of the data obtained from the integration based on information obtained from the usability experience of users in the pilot of a meta-commerce.

Once the performance indicators have been established, in order to guarantee continuous control and evaluation during the execution of the sales processes and logistic processes of the e-commerce, the inspection information of the tests that will be carried out will be on display later, with the results obtained, a comparison will be made with the expected values of the indicators for the development of a plan.

7.2.   Analysis of results

In order to measure performance, the respective tests were carried out with volunteers from the Pontificia Universidad Javeriana, to test the Meta-commerce experience: Car dealership, where they could take a tour of the entire store, see the cars, get in some of them and see them from the inside to have the full experience. As a second factor, the entire purchase process, where the client can choose the number of units, the particular item they want to buy and the availability in stock. Around 15-20 volunteers lived the shopping experience, and a survey was carried out where several questions were asked from which various factors and indicators of analysis regarding the performance and usefulness of Meta-commerce can be evidenced.

Moreover, the results of the survey were used to be able to extract the greatest number of analysis variables regarding the interaction with the virtual space and the factors with the greatest influence on Meta-commerce such as space and place of purchase for increase in large quantities the percentage of conversions and billing by having a deeper approach with the company and the product. Based on this, two types of analysis variables were identified: those obtained during the Meta-commerce creation process with the direct responses of the volunteers in terms of their opinion of the experience and the possible opportunities for improvement identified both by the developers and volunteers when expressing their opinion, to determine the potential for growth and effectiveness for companies.

Based on the different assessments obtained from the immersion experience in the metaverse, those attributes that generate value from the integration between the virtual environment of meta-commerce and the physical environment were identified. Once the information is ordered and processed from the Google Studio dashboard, different attributes that make up the Net Promoter Score (NPS) are conglomerated. The NPS is an indicator of user retention to know which factors promote loyalty to the meta-commerce and what other factors of the user experience can be improved, to determine if the user would be a promoter and would recommend the use of meta-commerce. Considering the above, for this first indicator, the attributes of value creation and their weighting are presented below.

- Satisfaction level (25%)
- The originality of the proposal (15%)
- Comfort during the experience (15%)
- Ease of interaction (10%)
- Interaction practicality (10%)
- Purchase process in the metaverse (25%)

In the evaluation from the NPS, users can be categorized, where according to the score they can be promoters, indifferent, or detractors. Those who gave the best score are considered promoters, loyal customers who are related to the brand or company and recommend the product or service to their acquaintances continuously and voluntarily; they place total trust in the brand to the point of risking their reputation for it. The indifferent are the type of clients who valued the company at a neutral level, did not find it spectacular but did not find the product/service and attention received bad either, for which reason it does not have any positive or negative impact on the development or growth of the company. organization. As a last categorization, the detractors are those who were not satisfied with the brand or company in some way, either because they did not like the product/service, or the attention received, for which it is very unlikely that the client will do something again. conversion rate since it sees it as a risk due to lack of confidence in negative experimental facts that they are likely to share at will.

To assess whether the users of the pilot are promoters, detractors, or indifferent, an eligibility scale is established, where scores equal to or greater than 4.5 will be considered promoters, between 3.1 and 4.4 will be considered indifferent and between 0 and 3 points will be considered detractors. The NPS is an indicator that is not symmetrical, it ranges from -100% to 100%, therefore the scale considers only the highest scores to reduce biases that may occur at the time of conducting the survey, in this sense, it is Any value greater than 0% is considered a favorable value. To evaluate if a user became a promoter, he must obtain a score greater than or equal to 90%, where 6 promoters, 11 indifferent, and 0 detractors were obtained, which results in an NPS of 35.29%.

$$NPS = \frac{P - D}{n}$$

Equation 5. NPS

Where:
- P = Promoters
- D = Detractors
- N = Indifferent
- n = total respondents

$$NPS = \frac{P}{n} - \frac{D}{n}$$

$$NPS = \frac{6}{17} - \frac{0}{17} = 0.3529$$

Image 11. Equation NPS. Self-authorship

On the other hand, taking into account that the meta-commerce process carried out in this project was a pilot test, there are several factors and variables such as KPI's that are left out because they cannot be evaluated. This is due to two main reasons. The first is that there is no actual purchasing process and experience, and the customers are volunteers who have some kind of relationship with the researchers. Secondly, being too virgin about technology and innovation, only 52% of the world population has knowledge of what the metaverse is, which would be between 4 and 5 billion people who understand the concept of the metaverse, however, that does not imply that all those individuals use it. Likewise, virtual reality headsets are expensive and fewer individuals own the technology or even know how it works. According to the company and Statista page, "of the entire population worldwide, as of October 2022, only 0.195% have Virtual Reality headsets/glasses and it is estimated that by 2024 it will be 0.34 %" (Fernandez, 2022), therefore, being such a low percentage, it is not the time to mass market through the metaverse. How long did it take to start selling digitally since the existence of the internet? and How long will it take to be mass marketed within the metaverse with the use of VR headsets? Taking these two factors as a starting point, the analysis of the following KPIs turns out to be irrelevant both for the present investigation and for companies currently in which this document is being written:

- Visitor traffic: Number of visitors to the meta-commerce in a given period.

- Number of Sales: Sales made by customers in a given period.
- Conversion Rate: Percentage of customers who entered the meta-commerce and converted.
- Acceptance Rate: Percentage of invoiced sales.
- ROI: Return on Investment
- Customer Acquisition Cost (CAC): The cost of converting a visitor into a conversion lead or customer.
- Average Ticket: Average investment of customers in their orders.
- Customer Lifetime: Sales potential of a single customer.
- Rejection Rate: Percentage of visitors who do not convert or engage with the strategies.
- Exit Rate: Percentage of visitors who abandoned the cart or checked out.

However, in the future, these factors become extremely relevant, since the moment the individual begins to enter the metaverse, and a buying culture begins to be created, more advanced strategies, experiences and logistics can be established that work for a company in an automated way, which increases sales by being thoroughly optimized and developed in such a way that it is personalized for each of the users and clients, by being able to transport from one place to another in a matter of seconds, being and feeling inside a trade, without actually being there.

Image 12. Results Dashboard. Self-authorship

Benefits of the metaverse	Impact on the supply chain
Possibility of cross-selling	It generates the same benefit of a physical store, since being a virtual space, customers can have influence by buying more things from home, this will impact in generating higher sales.
Decrease of Backorders	By keeping information up to date, you avoid delays between suppliers, the company and customers.
Increased demand	It will generate a greater flow in the supply chain.
Elimination of physical store (Optional)	This eliminates a link in the chain, where delivery is immediate to the customer, i.e. from the warehouse to the customer, thus eliminating transportation costs between warehouses and stores.
Interconnection	Improved communication between links in the supply chain.
Improved Customer Service	By having a personalized system, where the IA can answer all questions and in a respectful manner. This will eliminate the number of dissatisfied customers that are generated in the stores.
Elimination of maximum customer capacity.	Unlimited capacity, meaning that we can host a number of clients in our business, since no conflict will be generated in the virtual space.

Table 11. Relation between benefits of the metaverse
with the supply chain. Self-authorship

8.   Annexes

The following are the annexes related to this degree project:
- E-commerce Scor Diagram (PDF)
- E-commerce Flowchart (PDF)
- Scene Change Script (Text)
- Script Buy more items (Text)
- Confirm Purchase Script (Text)
- Database Script (Text)
- Script item store (Text)
- Script Player (Text)
- Script Select (Text)
- Script Shop manager (Text)
- Script Npc store (Text)
- Results analysis Dashboard (Link) Dashboard
- Interview (Link) Test
- Shop (Link) Metaverse
- VR User Manual (Link) Explanation
- Survey (Link) Forms
- Methodology (PDF)

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