Augmented Reality: An analysis and framework for business, marketing, and UX teams.

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ABSTRACT
Augmented Reality (AR) is an emerging technology that has the potential to change customer-brand relationships, and drive long-term marketing strategy [2,9]. To successfully implement this new technology, businesses must first understand the five components of an AR experience (Content, Users, Bystanders, Targets, and Background), and the different types of experiences (Active/Print Packaging, Bogus Window, Geo-Layer, and Magic Mirror) that teams can create [10]. Proper utilization of these components and types of experiences can lead to multiple benefits for users, including improvements in decision making, time savings, inspiration, sense of self, sociability, fun and entertainment, physical and mental health, education, and additional context around traditionally static environments.

However, AR technology does not come without challenges around proper implementation. The benefits of AR can be negated by specific risks around breaking this new bond between users and brands, and concerns around both privacy and physical safety. This makes it important to keep the specific usability principles of AR in mind, as they often differ from more traditional UX usability principles. Aligning business teams also poses a challenge, requiring teams to accept risks and plan strategically. This will allow companies to create new strategies that can maximize the technology's potential and drive engagement with the product and brand [10].

To help guide teams, this research has been used to create a framework around the successful adoption and implementation of AR technology into both businesses and marketing plans, as well as their users' lives.

KEYWORDS
Computer graphics, Graphics systems and interfaces, Mixed / augmented reality

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INTRODUCTION
A shift in marketing philosophy towards omnichannel marketing has resulted in a new, long-term consumer/brand relationship that allows people and brands to interact in a much more intimate way [13]. This has resulted in a need for creating new channels to engage users.

One of these emerging technologies is Augmented Reality (AR). AR uses a device to render digital objects and information into the real-world environment in real-time [1,10]. AR works to enhance the lives of users by providing digital information that is not readily available to a user's physical environment [1]. While predominantly seen as a visual medium, AR can also include elements of other senses, including smell, touch, and hearing [1]. AR has the potential to drive new marketing campaigns by offering unique benefits not seen in other technologies, for example, by allowing users to see how virtual products would work in their personal environments [10].

However, the success of these technologies is not solely reliant on the technology itself, but on the strategy surrounding the creation, adoption, and refinement of the technology deployed [14]. Companies need to understand the challenges and obstacles around building and managing an AR platform so they can create strong, lasting relationships that drive product and brand engagement [14].

This paper will examine the components, types, benefits, risks, usability principles, and business cases for AR through a literature review, and provide a framework around implementing AR in an organization based on these findings.

ASPECTS OF AN AR EXPERIENCE
The first part of understanding AR is understanding the five different aspects of an AR experience. These are Content, Users, Bystanders, Targets, and Backgrounds [10].

Content
Content is the virtual information that a user sees [10]. Content can come in multiple formats, including text, photos, videos, and animations [10]. All the AR content makes up the "AR Layer," or the general experience of the whole application [10].

User
The user is the person who is interacting with the AR application [10]. Users can interact with an AR experience on both private (ex - mobile phone) and public devices (ex - magic mirrors), or in both private (ex - a user's own home) or public (ex - a store) settings [10].

Bystanders
Bystanders are the other people who may be around the user's AR experience or receive artifacts from an experience, but do not directly use the product [10]. Bystanders are an important part of the AR experience because they directly affect both how the user experiences and uses the product by being indirectly involved [10].

Targets
Targets are the objects and people in that are augmented with new information [10].

Background
The background is the objects in the frame that surround the targets, but are not augmented [10]. Though the use varies from application to application, the background is important in capturing the context of the physical environment [10].

TYPES OF AR EXPERIENCES
With an understanding of the elements at play in an AR experience, designers can apply this knowledge to building a product. While there are many different use cases for AR experiences, AR can be defined through four main types of experience; Active Print Packaging, Bogus Window, Geo-Layer, and Magic Mirror [10].

Active Print / Packaging
Active Print / Packaging is AR that uses advertisements, print packages, catalogs, and other physically printed materials to display augmented content [10]. With this experience, AR content is "virtually displayed over standard real-world print ads," creating a combined experience of traditional print media and digital technology [13]. With Active Print / Packaging experiences, users typically use their own device, with ads being available in the user's environment [10]. An example of Active Print / Packaging AR is using a print package as a vehicle to start a brand-based game, or using a QR code on an ad to get more information on a product [10].

Bogus Widow
Bogus Window is AR that uses a screen disguised as a glass window to create a digital experience [10]. In this type of AR, users are typically not part of the augmentation because the Bogus Window augments things behind the window, which the user is usually standing in front of [10]. Similar to Active Print / Packaging, this type of AR is often part of a more traditional marketing campaign. An example of this is an advertisement for the show The Walking Dead that used a TV screen to augment a bus stop to make it appear that zombies were approaching [10].

Geo-Layer
Geo-layer is arguably the most common AR experience. This AR experience relies on a user's own device to augment the environment around them [10]. This can include elements of geolocation, but is not dependent on geolocation to complete the AR experience [10]. Some examples of Geo-Layer include Ikea's mobile app that allows users to place furniture into their own homes, historical tours that allow users to gain more information by pointing their phones at specific locations, surgical assistance by using a device to provide additional help and context during surgical procedures, and Pokémon Go, a popular game based on the anime series where users catch AR Pokémon in their real environment [1,4,8,10].

Magic Mirrors
Magic Mirror is another common AR experience. Magic Mirror uses stationary devices (ex - tv screens) or the user's mobile device to augment both the elements around the user, and the user themselves [10]. Magic Mirror differs from Geo-Layer because, in most instances, the user is part of the experience [10]. Some examples of Magic Mirror Sephora's makeup application that allows users to apply AR makeup to their real-world face using their personal mobile device, or Cisco's retail mirror that allows users to "try on" clothes though an AR-enabled screen that functions like a real-world mirror. [1,10,11].

USE CASES AND BENEFITS OF AR
The application of AR leads to several benefits for both individual users and business teams. These benefits are dependent on the use cases, settings, and types of experiences. In this section, we examine the different use cases and benefits of AR in both consumer and private sector use.

Improved Decision Making
AR provides a unique opportunity to add additional, virtual information to a real-world setting [5]. AR helps provide context to important situations, becoming part of a person's information processing and helping to better digest their surroundings through AR content [2]. This allows customers to feel like they are experiencing authentic situations. By providing a way for users to feel like they are actually trying out a product, AR helps make them more comfortable with a decision and provides a "utilitarian and hedonic value in online service experiences" [2].

Time Savings
AR applications allow users to alter details faster and more efficiently than physically trying out different products, creating a more customized shopping experience that allows users to make faster and easier decisions [1,6]. Time savings is also applicable to Active Print / Packaging, allowing users to see more content that is initially printed, which saves time and effort when researching a product by providing "the ability to explore beyond what is printed on the traditional ad" [13]. Studies have shown that the "intrinsic benefits, such as a more entertaining or visually appealing shopping, were...valued much less than the

extrinsic benefit of shopping efficiency" [11]. Providing a more efficient experience leads to a stronger feeling of satisfaction, which can drive brand engagement.

Inspiration

Inspiration can be defined as a "motivational state that brings ideas to fruition" [9]. AR experiences help to create a feeling of joy, which helps to drive personal inspiration [9]. In return, this inspiration drives opinions on brands "through the quality and integration of virtual content onto the consumer's perception of the real-world," which can reflect both positively and negatively on the brand itself [9]. This means that a positive experience with a branded AR app can directly influence the public reception of a brand. It is important to note this is even the case with larger brands, for example, Ikea, that has seen increases in brand image through positively leveraging technology, even though previous research has indicated that shifts in brand perception are often difficult to achieve for these larger, more established brands [9].

Sense of Self

AR apps, specifically used on personal devices in a private setting, allow users to bring a brand into their personal space during personal time ("me time" where users do what they want) [11]. This creates greater engagement with the brand that differs from traditional schools of thought that focus on public use [11]. In a personal setting, users "develop relationships with the brand that are decidedly less transactional and more focused on leisure behaviors," allowing users to experiment and feel empowered, which enhances their sense of self through the lens of trying new things [11].

An AR experience can put the user in the foreground of the brand, focusing more on their physical existence and what they are doing, and less on the product itself [11]. While the ideas of play and experimentation are prioritized over the brand, this interaction still results in a partnership/relationship between the person and the brand [11]. This creates a stronger relationship based on personal space, while removing distinct lines between customer and brand, and driving brand engagement [11].

Sociability

AR applications and campaigns present new ways for customers and brands to interact [13]. AR inserts "branded content within consumers' social and physical environments," providing marketers with new ways to insert themselves into both physical and digital conversations [10]. This more frequent involvement in a user's life, especially when the application provides avenues that facilitate self-presentation, leads to higher instances of sharing content through both social media and traditional word of mouth [5,10].

This provides more opportunities for the brand to be shared through both general comments and artifacts (recorded aspects of an AR experience, for example, images, or social media posts) from the AR experience, resulting in more engagement for both the brand and initial users, as well as potential users who see the experiences and artifacts established users are sharing [10]. This keeps current users engaged, while facilitating new engagement for potential users, both of which help to grow the brand. The overarching result is a larger and stronger brand community created by using this technology to bring people and brands together [10].

Fun and Entertainment

AR can provide a unique experience around user enjoyment when focusing on elements of both entertainment and humor [9,13]. This can include games (for example PokémonGo), or more direct aspects of self-augmentation (for example Sephora's makeup app or Facebook's AR video features) [4,10]. These experiences lead to higher levels of user satisfaction and inspiration, improving brand relationships, and a user's openness to making purchases [5,9].

Physical and Mental Health

AR can be used to improve both physical and mental health by facilitating exercise and personal engagement [4]. For example, PokémonGo users "reported a statistically significant increase in time spent walking, running, biking, and skating after they started playing compared to before they started playing" [4]. This increased time spent being active also led to increased social interactions by playing the game with other people, and a reduction in anxiety by providing an easy way to meet new people and explore new locations [4].

AR has also been applied to treating other psychological disorders, for example using AR bugs to eliminate phobias in a realistic, but "safe" setting [1]. These use cases illustrate new applications for AR outside of the marketing sphere, though some might be more intentional than others. For example, PokémonGo was initially a marketing and sales effort that was shown to have additional values surrounding physical and mental health benefits, where the treatment of psychological disorders is more altruistic in nature. In either case, it is important to consider both the intended and intended benefits of technology.

Education

One of the most important benefits of AR is providing information, which can be applied in various ways to help educate users on products and brands [13]. This allows "more efficient communication with the user through multimedia presentations," the main benefit being that users "more willingly listen, watch and/or read about information that they can acquire by simply pointing at an object using their phone rather than have to look it up in a guide." [1]

This can be applied to multiple AR experience types and use cases, for example, geo-local experiences can provide additional information on specific locations, AR print ads can show additional information that could not fit in a more traditional print ad, and games can use AR to help teach users the rules of a game [1,13]. The educational aspect of AR helps users to become "smarter and more aware" as users receive additional information about the objects in their relative surroundings [6].

Additional Context

AR experiences can provide additional context around tasks that have limitations in what the user can see or experience. This is largely seen in the medical field, where AR tools are used to help "augment the physician's view inside the human body during surgery" [1]. "Recent breakthroughs have enabled the expansion of clinician as-user applications, where adoption has been historically limited by the ability of the technology to achieve a sufficient quality of experience" [12]. These breakthroughs have provided additional information through the use of advanced tools and imaging to help enhance the surgeon's abilities, leading to more possibilities around medical training, image interpretation, procedures, and therapy [1,12].

RISKS

While the benefits of AR are ample, adopting this technology does not come without potential risks for the consumer, brand, and business. These risks are important to consider when creating and facilitating a positive AR experience.

Creating a Bad Experience

Arguably the biggest risk when creating an AR experience is in the experience itself. This risk presents in two ways; the quality of the experience and the quality of the information presented [6]. The quality of the experience focuses on standard usability. The app should be built with a focus on usability, being user-friendly, and not overwhelming in terms of content display or additional cognitive needs [3,6,11]. However, these apps do not need to be perfect; users will forgive minor usability problems in the app, as long as the experience is meaningful and focused on the user [11]. Additionally, the app itself needs to present a "high-quality output that displays reliable and trustworthy information and images" as a way to drive user engagement [6]. A poor experience prevents users from forming bonds with both the app and brand, which, in return, decreases brand engagement [11].

Breaking the User/Brand Bond

The user/brand relationship formed during an AR experience only works when the brand falls into the background [11]. The more forward and obvious the brand is, the more it takes customers out of this new relationship because it brings the transactional nature of the relationship into focus [11]. However, things like glitches do not completely break down that relationship, largely because users project problems with AR away from the brand by attributing it to problems with new technology, though this opinion may be fleeting as this technology becomes more commonplace [11]. In the end, "if the brand's economic and commercial interests come to the fore, or if the AR content is perceived as a wholly artificial layer that does not correspond to one's real face, the consumer does not incorporate the AR content into their self" [11].

Sabotage/Misuse

In some cases, implementing an AR experience can negatively affect a brand through sabotage and misuse of both the experience and the brand itself [10]. An example of this would be a competitor product positioning itself in an experience, though it was not the intended use case (i.e. - Coke products showing up in an AR Pepsi ad) [10]. This requires marketers to understand the risks in terms of both app creation and placement, while also highlighting the need for content curation to help moderate the digital experience [10].

Privacy

Users are less likely to support an AR application when questions of privacy are called into concern [2,6]. This idea of privacy differs from other technologies in that it is not as focused on requested personal information (like providing an email or address to sign up for a service), but rather focused on the imagery that is collected [6]. Many AR experiences do not tell users what will be done with the images collected after the experience, resulting in privacy concerns for both users and bystanders, especially as technology increases its capabilities around recognizing and tagging people [1,6]. This causes additional concerns when moving away from entertainment, and into more advanced use cases, for example when dealing with medical applications and HIPAA violations [1].

Injury

The engaging, social, and exploratory use case of AR (Ex - PokémonGo, Virtual Tours) can be distracting, especially in outdoor situations and when involving younger people [8]. For example, in the first three weeks of the release for PokémonGo, there were "a multitude of incidents involving users playing the game; including several fractures, soft tissue injuries, armed robberies, sexual assaults, traffic accidents, traffic violations, and even a report of 2 men falling off of a 60-foot cliff" [8]. AR experiences can lead to inherent dangers when distracted, resulting in the need to consider ethical concerns when creating AR experiences [6,8].

Addiction/Overuse

As users, especially kids, blend screen time with the real world, their use of these devices increases [8]. In some cases, this leads to a new challenge surrounding balancing activity and screen time because the two are so closely related [8]. While relatively unexplored, the growth of this technology will require the creation of new guidelines to help prevent addiction and overuse [8].

Social Acceptance

"Augmented Reality systems implemented in mobile applications need to be subtle, discrete and unobtrusive, so to not disrupt the user if s/he is under a high load of work and the disruption is not of priority level." [1]. This includes elements of both ease of use, and public acceptance. If a device is either awkward to use or aesthetically unpleasant, people will be hesitant to use the device in a public setting [1]. This means that developers creating non-phone-based, mobile AR applications need to consider both usability and fashion when creating devices for people to wear in social settings [1].

USABILITY PRINCIPLES

When creating an AR experience, there are specific, AR usability principles to keep in mind. While it is important to focus on traditional usability principles, there are some additional aspects of usability to consider when building an AR experience.

Consumer-Driven, Not Technology Driven

AR experiences are about connecting the consumer and the brand. With that in mind, the consumer needs to be the focus of this product, and not the technology behind it [10]. Teams should focus on using user insights and needs to frame the technology; "these insights should then shape where such an experience should occur, how it could ideally be triggered, and what content it should feature" [10]. If teams fail to focus on the user, and instead focus on the technology, they face the potential problem of creating something overly flashy or gimmicky that completely misses the focus on the customer [10]. This is key in building that relationship between the consumer and the brand, and, in return, the success of the campaign.

Proper Use Case and Access

When creating an AR experience, it is important to understand where the application will be used. Earlier AR applications largely failed because they did not keep the use case in mind, which resulted in unusable experiences [13]. An example of this was seen in early QR code use, where companies did not think strategically about ad placement (for example putting a QR code on a billboard along a highway), which resulted in confusion and frustration around the product and experience, and eventual failure of the campaign [13]. Additionally, different environments lead to different challenges when using the app, and the advantages and disadvantages of creating an AR application around certain environments must be considered to help create a useful and engaging experience [1].

Augmentation and Interactivity Working Together

While the focus of the experience is on the augmentation that is occurring, it is the user interactions with this augmentation that complete the full experience [6]. Without the focus on user interaction, users will have nothing to engage with, preventing them from forming a user-brand relationship [6]. "Augmented reality with no interactivity component is similar to the obsolete technology that did not enable users to interact with it" [6].

Make AR Optional

Some users are more verbal than visual, so to provide the best experience, companies must cater to both kinds of customers - providing an option to use AR, but not forcing interaction with AR experiences [2]. In addition, other users may have a preference towards more traditional formats due to familiarity or ease of access, which requires marketers to take a "layered approach" where AR is used to enhance existing information, rather than be the basis of the experience [13]. This allows established AR users to take advantage of helpful features, while also allowing users who are curious about AR to try out the feature in a less high-stakes environment, and adverse users to avoid the feature entirely [13]. Allowing this flexibility in the use case provides both "time and cost savings to the marketer and consumer" [13].

Transparency in Use

As noted, privacy is a major concern for both direct users and bystanders of an AI product. To reduce the concern of privacy, AR apps and experiences should directly tell users how their information (personal information, photos, data, etc.) will be used [2]. This transparency will reduce concerns around adoption, and facilitate more frequent use.

BUSINESS IMPLEMENTATION

It is important to also look at AR, and adopting new technologies in general, from a more business-oriented perspective as a way to help make a case to management, and drive decision making. This section discusses navigating some of the internal roadblocks when making business decisions around implementing AR.

Internal Understanding

AR can be a marketing tool used to interact with multiple stakeholders and drive long-term marketing strategy, but there is often a lack of understanding from a business perspective that leads to a degree of hesitation when implementing new technology [2,9]. To successfully implement this new technology, management needs to understand how to implement AR technology into something that adds value to a brand by understanding the

customers, use cases, experiences, and end-results that AR can affect [2]. Organizations must also take into account how different departments, like UX, Marketing, and R&D, can all work together to determine if a project is feasible, and create a plan around definition, justification, and implementation [7]. The maturity of the technology also needs to be considered, which, in the case of AR, is relatively newer and may have more uncertainties than more established technologies [7].

Accepting Risk

When implementing new technologies, there is an inherent risk that a company faces, both internally and externally, around the success of adoption [14]. It is important to realize and accept that "technologies and customer behaviors are changing so fast, new initiatives are never finished but remain in a state of perpetual change," which requires firms to "be able to handle this level of uncertainty and be able to adapt quickly to new circumstances" [14]. There is always a risk of adopting new technology, especially early in that technology's life cycle, and businesses need to accept and work through that risk, rather than being stagnant with their development efforts [13,14]. There is always a negative connotation from early adoption, but AR is already nearing the point where it is becoming more refined and may not have this problem, showing more potential for future implementation [13].

Development Costs

The cost of building an AR application directly contributes to the idea of risk because of the uncertainties around development. Development cost comes down to three main areas - scope, timeline, and development team [15]. Scope involves the feature set companies are trying to achieve [15]. The type of AR experience, the number of features, and the number of advanced features all affect the time a product takes to build, which then costs more money [1,15]. Additionally, a tighter deadline generally requires more money to finish due to more people working [15]. Finally, the root of all costs depends on the cost of the dev team, which varies country by country [15].

It is also important to consider post-development costs. More basic apps do less, but are more reliable, while more advanced apps do more, but are often unpredictable due to the highly custom nature of what is built [15]. This means that apps with more advanced functionality require more testing and monitoring, all of which add to the cost [15].

In terms of numbers, apps can take up to nine months to build, and cost anywhere from $5,000 to $300,000 or more, depending on the scope, timeline, and dev team [15]. There are also dev kits that can be used to save money, but these also come with risks around implementation [1]. That said, these numbers are estimates and do not factor in unknown problems, which can drive up the overall cost of production and maintenance [15].

Cost Savings / Increased Sales

While AR applications can have a large upfront cost, they can also result in cost savings and increased sales, depending on the use case. In terms of retail, AR applications can provide cheaper alternatives to traditional, trial-based services, eliminate the need for requesting samples and dealing with returns by providing an accurate service in a digital environment [2]. This applies in stores as well, with in-store AR experiences helping to engage customers into spending more time in stores and increasing sales [6]**.** Similar situations have been seen in the medical field, which has been able to offer virtual at-home services as a way to lower both costs and stress levels for patients [1]. Companies need to examine the potential for cost savings, and determine how that affects development and return on investment (ROI).

KPIs

It is important to set benchmarks for measuring the success of an application, but AR presents unique challenges because of the nature of both the app and the relationship to the brand that it can inspire [9]. While traditional KPIs around engagement may be useful at a base level, elements like star ratings may provide insight into attitudes around using an application, rather than the brand itself [9]. Given the new relationships that may be formed between brands and people, "assessing inspiration potential (e.g. through surveys or text mining user reviews) may lead to a better understanding of how an app will impact the brand" [9]. This means that when evaluating an AR experience, it is important to use both qualitative and quantitative measures to fully understand both how an application is being used and how that application is affecting user/brand relationships.

DISCUSSION

Creating an AR experience is a complex task that involves aligning users, teams, and businesses to create an experience that is beneficial for all parties. To create this experience, it is important to understand the technology itself, the mental model of the user, and the possible effects on business. Only in understanding how all of these aspects can come together are companies able to successfully create an engaging, helpful, and, most importantly, usable experience for consumers.

I created the following framework based on the findings from my literature review. The framework provided should be used as a guide to assess all of these aspects, and aid teams in making the right decisions as they implement AR technology into their businesses and marketing plans, as well as their users' lives, even as this technology continues to be refined.

FRAMEWORK FOR IMPLEMENTING

Base Level Understanding

Teams must understand the technical components and different types of AR experiences to help drive comprehension of the technology and initial ideation. They must also understand the use cases and benefits of AR, and how this technology can be applied to their organization in a way that facilitates user engagement, user/brand relationship, and/or profit.

Ideation

Teams must then identify use cases for the AR experience they want to build, and use that understanding to establish the audience, goals, settings, and platforms around that experience. In doing so, teams must assess risks around these use cases, and identify early-stage KPI's to properly evaluate success.

Internal Buy-In

When ideation is complete, teams must present ideas to high-level stakeholders, and address internal business hesitations surrounding creating an AR platform. At this point, it is also important to identify potential costs and cost savings. When internal buy-in is successful, internal teams must align on common goals, so everyone is working together on production and implementation.

Design

When creating designs and prototypes, teams must make sure to follow both AR and UX usability principles. To limit scope, teams must also create a list of features that take into account both necessity and cost of production.

Development

During development, teams must reconsider scope, and refine the existing feature set to keep with the budget. Teams must also consider the process they want to use. If using a framework, teams must vet this framework. If building from scratch, teams must assess the staff in terms of both roles and skillsets. If using external teams, a company needs to vet their history of successes and failures. Finally, teams must consider the timeline, knowing that faster turnaround times result in higher upfront and historical costs.

Launch and Maintenance

After a successful launch, teams must assess performance through qualitative and quantitative KPIs, and fix any initial bugs to improve the experience. Teams should also use existing backlogs and recent feedback to create a road map for improvements and implementing new features. Teams must also stay up to date on advancements in AR, frequently researching and assessing breakthroughs in technology and user research that may improve or change the experience.

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