

Centralized Service Platform for Warehousing

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Abstract - The purpose of this study is to analyze how moving to a centralized online platform like Swiggy, Zomato, Oyo, etc. has helped expand businesses of restaurants and hotels, and how adopting a similar model to the warehouse industry will help promote and expand the business to a wider customer base. Analyzing the growth before and after moving to a centralized online platform helps give insight on how adopting a similar model to warehousing will affect the growth and operations of the warehousing industry. This paper also looks into the traditional approach and proposed approach of utilizing a warehouse and provides an account of the benefits and drawbacks each approach may have.

Keywords - warehouse, storage, property, centralized platform

1. INTRODUCTION

The subject of this project is to create a unified platform for owners or organizations that own warehouses (hereafter referred to as "Providers") and individuals or ventures that require the use of warehouses (hereafter referred to as "Clients") to interact with one another in a standardized, simplified, user-friendly and organized system. This proposed platform is designed to benefit both clients and providers by implementing a system that invokes consistency, predictability, uniformity, and in a way, the flexibility of operations. Other advantages include cost reduction, the ability to scale, better brand equity, quality control, wider customer reach, and innovation that will gradually improve over time. In short, by providing a unified platform like "Book My Space", providers will not only realize higher efficiency and productivity but will also enable clients more varied and informed choices.

1.1. Problem Definition

In the current business landscape, there are no services that provide a unified platform for warehouses and potential clients to interact with each other in a simplified and standardized manner. Currently, individual warehouses providers make use of discrete platforms to interact with clients. This fragments the marketplace and makes it difficult for clients to compare services provided by different warehouse providers. This existing fragmentation also inhibits providers from reaching a wider client base and expanding their business.

The established business model provides clients the option to either purchase an existing warehouse or take part

in a contractual agreement for a long term lease of the required space. This alienates clients that require a short term or limited storage requirements and diminish potential business that providers would otherwise gain. The current model places the burden of advertising and management entirely on the providers, this favors providers that have the financial resources to utilize platforms and services that are otherwise out of reach of a small scale or inadequately financed provider.

By providing a unified platform that benefits both providers and clients in various ways, the proposed platform that is the subject of this project will establish a standardized and organized model that enables providers to reach a wider client base and clients to have access to diverse and better-informed choices.

1.2. Objectives

Some of the objectives of this project are to provide a unified platform that provides the following benefits as mentioned below:

1) Ease of Use

The platform should be easy to use and offers high convenience with time and effort saving for the clients and providers. The UI/UX of the platform, along with the ease of navigability and efficient search options enhances convenience.

2) Always Available for Reservations

The platform enables businesses to be open 24 hours a day, 7 days a week. In other words, clients can make a reservation whenever it fits into their schedule, and additionally, studies have shown that immediate availability when looking for products or services dramatically increases the number of purchases or appointments which benefit the providers.

3) Reduce No-Shows

Clients who made a financial commitment when booking their reservations are more likely to show up, resulting in significantly fewer no-shows. In the event a client does need to cancel, their spot automatically becomes available again so someone else can book it.

4) Flexible Payments

The platform will offer flexible payment options for the clients to be able to pay using various modes of payments, best suitable for them. The integration of various popular payment gateways offers flexibility and cashless transactions to the customers, thus encouraging them to use the platform.

5) Reduced Errors

A centralized platform leverages technology to connect the provider's ecosystem into a single source of truth, which reduces errors, costs and improves the provider business's operational efficiency. Moreover, it helps providers predict potential errors and deal with them in advance.

6) Automated Business Processes

Rather than spend time managing manual and time-consuming business processes, a centralized platform will enable providers to automatically handle critical business processes.

7) Security

Having information about clients and customers is important, but ensuring that private information remains secure might be just as vital to the health of a business. Many providers are not well prepared for the tricks that hackers use to extract data from their information systems or to deal with the fallout from such an occurrence. By providing robust security of information on the platform, providers can concentrate on their business, and clients can be assured their information is secured.

8) Real-time Tracking

The platform will be equipped with real-time tracking systems, such that the clients and providers can track the term of bookings, along with an easy renewal of bookings.

9) Analytics

The platform will implement a dashboard of analytics that helps clients and providers quickly view all relevant data. As an example, with at-a-glance data that is simple to understand, clients can better track all bookings they are currently engaged in and providers can focus on creating offers customers want the most and grow their business by doing so.

10) Ratings & Reviews

The ability to Review is changing the way consumers interact with businesses. As such, it becomes important for providers to embrace

reviews and meet their customer's expectations. Moreover, clients can have a more realistic expectation of service from the provider based on the reviews.

11) Effective Customer Support

With 24/7 customer support facilities, the platform can offer the best customer support that individual providers may not be capable of on their own. Answering client queries and assisting them in any need or complaints is important for any successful business. Customer support will also provide clients with the opportunity to raise queries whenever it suits them and providers can better answer queries in an organized and timely manner.

2. LITERATURE SURVEY

The goal of this literature survey is to review existing platforms that provide similar business models as what is needed to be implemented by the proposed platform. The insight provided by this survey will enable a better understanding of the existing platforms and their mode of operation. This literature survey will also enable designing and structuring a viable business model that will ensure a better chance of success for the proposed platform.

2.1. Overview

This section provides a brief overview of the platforms that are the subject of this study. It provides details to understand the targeted user base of the various platforms and their business models.

2.1.1. Zomato

Zomato has proven to be a phenomenal foodie platform, providing a convenient way to review restaurants, feedback, listings in (now) over 24 different countries. The platform is even capable of giving insightful analytics for the restaurant to help route their business to exponential growth. The platform is ideal for both food lovers and restaurant owners. Users can also view pictures and menus for restaurants that do not have a website of their own. The platform allows restaurant owners to increase their restaurant business visibility through listing advertisements and special promotional menus through the Zomato platform.

2.1.2. Swiggy

A squad of 3 friends, Nandan Reddy, Rahul Jaimini, and Sriharsha Majety, came up with their amazing all-new Swiggy app! An on-demand food ordering and delivery platform where you can order your favorite food from your favorite restaurant(s), and get it delivered within 30 minutes. You can also track your order to know how long it will take to get delivered. The business model canvas of Swiggy is based on a hyperlocal on-demand food delivery business operation. Working as a bridge between restaurants and customers, Swiggy utilizes an innovative

technology platform that works as a single point of contact. Their app allows urban foodies to order food from nearby restaurants and get it delivered at their doorstep. Apart from accumulating restaurants, Swiggy also has its own fleet of delivery partners. Because Swiggy operates as a dual-partnership model, it also benefits restaurants that can receive more orders from customers using their own Swiggy app. Once the order is placed, they will know the order details, prepare the order and deliver it to Swiggy drivers. This way, restaurants don't need to use their own delivery personnel, saving costs and efforts.

2.1.3. Oyo Rooms

Oyo Rooms is an Indian hotel chain. It is the world's third-largest and fastest-growing hospitality chain of leased and franchised hotels, homes and living spaces. Founded in 2013 by Ritesh Agarwal, OYO initially consisted mainly of budget hotels. What started from a single hotel service in India, Oyo has now turned out as one of the world's largest hotel network brands. It has stretched out its roots to 230 cities with over 8500 hotels. Through its app-based booking facility, Oyo allows customers to book rooms within a few seconds. Oyo delivers a similar awesome experience across all of its rooms with its excellent room services and amenities. Oyo started as a hotel aggregator and used to lease some rooms and sell them under its brand name. However, it changed its business model from the aggregator to the franchise model. It involved partnering with hotels, asking them to operate as a franchise, and selling their rooms to customers at competitive prices. Oyo does not own hotel properties that are listed on their website. Oyo renovates the hotels according to its checklist of standard services, and makes the hotel property a part of its "standardized budget hotel chain" with Oyo's branding. To become Oyo's partners, every hotel has to meet a set of guidelines for services, pricing, staff quality, features of rooms, security, etc.

2.1.4. AirBnB

Airbnb is a private, global company that offers an online marketplace platform for hospitality services. Airbnb is accessible through its official website or by an app. Members of Airbnb can use the platform to arrange or offer to lodge for homestays or tourism experiences. Airbnb's platform is designed for individuals that are private owners of any listed properties within the 191 countries that it caters. The platform works through a total of 4 million Airbnb listings over 191 countries, and over 2 million individuals use Airbnb to gain access to leasing, rental property insights. The Airbnb platform allows individuals such as "host members" to host any events as well. Airbnb's majority of revenue is generated from Host members. Host members are responsible for posting and providing properties/events with specifications. The traveler would be able to utilize the Airbnb platform to view the vast house listings. Majority of the members can book a trip to almost anywhere around the world. There are approx. 650,000

hosts on Airbnb. According to Priceonomics, Airbnb hosts make an average of \$924 per month and in some cases as high as \$10,000 a month. Airbnb makes a commission from every booking that is completed. There are approx. 28,571,438 bookings a year, which is approx. 23,810 bookings per month.

2.1.5. Flipkart

Flipkart e-Commerce Company was first idealized by Sachin and Binny Bansal in 2007. Both brothers are former Amazon executives. The Bansal brothers were able to successfully design a business module based on their experience and expertise. Their business scheme stood promising that led to the initial funding process from external sources. Initially, the Bansal brothers invested in a total of \$5,600 towards developing an ideal online book store website. 2 years after the initial launch, Flipkart platform stood potential enough to raise \$1M from Accel India. They later formed alliances with Tiger Global, raising in a total of \$10M in 2010 and \$20M in 2011. Flipkart had also reported that they have completed the 4th round of funding phase from MIH, a subdivision of Naspers Group and ICONIQ Capital. These funding were harvested for the very reason to further explore new business opportunities and venture to new business endeavors that would further improve and grow Flipkart as a company.

2.2. Customer Segments

This section provides a description of the user base targeted by the various platforms that are the subject of this study.

2.2.1. Zomato

Zomato platform is explicitly designed for users to find and locate restaurants in a range of various cuisines. Zomato is perfectly geared for customers who prefer home delivery. The platform further stands significant for restaurants who want to promote the business or restaurant name to help reach the target audience. There are active reviewers, who add reviews and photos of local restaurants or businesses on Zomato platform.

2.2.2. Swiggy

The customer segments of Swiggy include those people who do not wish to go out to restaurants and eateries to buy food. People who want to order food online and want to get it delivered at their doorsteps are the principal customers of Swiggy. After its recent business expansion, people who want to buy and get other products delivered from nearby shops and stores of groceries, pharmacies, electronics, flower shops and gift shops in the city are also Swiggy's customers.

2.2.3. Oyo Rooms

The customer segments of Oyo include a variety of different travelers. Adventure Travelers, All those travelers who want to explore different destinations independently (in the low budget) or in a small group. Also known as backpack

travelers. Leisure travelers, Travelers who want to take a vacation from everyday busy life. Family travelers, Those who travel in large groups and look for a spacious and comfortable stay, where they can also arrange parties, family events, weddings etc. Business travelers, Oyo also has commercial places on its platform where customers can book office spaces and conference rooms for their business purposes.

2.2.4. AirBnB

The customer segments at Airbnb are wide and categorized in the following types. Hosts, Property owners who offer accommodation and welcome the guest on their property and Guests, Travelers who are looking for lodging and a great experience while traveling.

2.2.5. Flipkart

Flipkart offers a Massive Urban Market of users who prefers to buy online. Flipkart has grown into an enormous platform for a vast marketplace in India for the time being. Currently, Flipkart marketplace is only open and available for deliveries to be made anywhere within India. Flipkart offers its loyal and new customers promotional offers & special pricing during the holidays. They also provide branded products at reasonable prices. Flipkart products are easily accessible through their official website. Flipkart products can be accessed through Flipkart's software applications programs. Flipkart's most success is driven by the smart analytics that are evaluated for the market places. Its social media platforms are another set of sources that help the analyst identify what consumers are into nowadays, and what is the recent trend. Flipkart targets those products that are in high demand to potentially make a sale.

2.3. Key Activities

This section covers the necessary activities required for the platform that is the subject of this study to maintain a successful operation.

2.3.1. Zomato

- Manage Network effects
- Manage and Utilize Advertising
- Drive Customer Experience Initiatives
- Enhancing Brand Image
- Online food delivery and subscription
- Consultancy to Restaurant Owners

2.3.2. Swiggy

- Building partnerships with eateries and retail shops
- Hiring delivery providers and suppliers
- Acquiring customers and managing their orders
- Managing delivery and payment process

- Managing technical operations
- Updating system and building IT infrastructure
- Handling queries and concerns of customers and partners

2.3.3. Oyo Rooms

- Platform
- Partnership
- Customer experience
- Sales & Marketing
- Recruitment
- Business growth
- Communication

2.3.4. AirBnB

- Platform development
- Sales and marketing
- Managing bad behaviors and risks
- Protect sensitive information of their members
- Maintain Customer Service
- Develop a strategic partnership
- Manage Agreements

2.3.5. Flipkart

- Manage the supply chain
- Product catalog
- Build and manage sellers network
- Establish a partnership with distributors and other manufacturers
- Marketing & Sales promotion
- Secure payment portal

2.4. Key Resources

This section covers the resources employed by the various platforms in this study to run a successful operation.

2.4.1. Zomato

Zomato has a massive database on restaurants, café, and similar business places across cities in 24 countries. Zomato aims to build new alliances and capture the global market.

- High-Quality Database
- Employees
- Zomato Platform
- Content Contributors

- Zomato brand reputation
- Funding Partners

2.4.2. Swiggy

As it has partnerships with local restaurants and shops, its main resources are local partners. Other key resources are delivery providers and its own human resources to manage administrative and technical operations. Technology is another resource it uses to operate its apps.

2.4.3. Oyo Rooms

The key resources of Oyo include:

- Hi-tech app architecture
- 458,000 fully leased and franchised hotel properties.
- Customer Database
- Employees with technical knowledge like programming, development, and maintenance, and other staff for business management.
- Venture Funding

2.4.4. AirBnB

The following are the essential resources that helped to formulate and actualize the platform to what it is today:

- Airbnb platform and mobile App
- Software engineers, analytic and data scientists
- Millions of properties listed on their platform
- User-generated content on the web pages including reviews
- Captured data and algorithmic systems
- Access to venture capital to keep the business excelling and growing

2.4.5. Flipkart

Initial resources that makeup Flipkart, consists of a group of multiple investors that help fund the structure of Flipkart operations and for further development.

- Huge Traffic Flow
- Payment System
- Bank's Internet Banking feature
- Flipkart SmartBuy
- Flipkart Technological Aspects

2.5. Channels

This section provides details on the different means the various platforms use to interact with their customers.

2.5.1. Zomato

Zomato offers its platform accessible through multiple access points Application (smartphone or tablet) and Zomato Official Website

2.5.2. Swiggy

The channels of Swiggy are mobile app, websites, and digital marketing. Its mobile app is available on both Android and iOS.

2.5.3. Oyo Rooms

The channels of Oyo are Website and mobile application, Blogs, Social media networks like Twitter, Facebook, and Instagram, Neighborhood hotels, Student organizations

2.5.4. AirBnB

Airbnb platform (website and app) is the primary channel through which Airbnb delivers its services to its members. Platforms like content marketing, media coverage, digital ad campaigns all help to drive the force of interested hosts and travelers alike to Airbnb platforms.

2.5.5. Flipkart

One of the most significant reasons for Flipkart success is the powerful combination of Flipkart revenue model and other digital marketing schemes that spread like wildfire across the internet, creating its online presence, awareness and helping to further channel Flipkart for opportunities. The website alone provides additional features, promotional deals and other exclusives that help it landing pages convert. Additional accessible platforms like Flipkart software applications help potential customers to process other potential orders.

2.6. Revenue Streams

This section covers the means by which the platforms in the study generate revenue.

2.6.1. Zomato

Zomato's revenue similarly increased in FY19 compared to FY18. In FY19, Zomato's revenue is \$206 M, a total of three times more than FY18 (which was \$68 M)

- Delivery
- Dining Out
- Ticket Sales
- Consultation Services
- Sustainability

2.6.2. Swiggy

As it's expanding its business strategy and operations day by day, the revenue streams of Swiggy are also considerably increasing. There are mainly 6 revenue

streams at present through which Swiggy makes money:-
Delivery charges

- Commissions
- Advertising
- Banner Promotions
- Priority listing of restaurants
- Affiliate Income

2.6.3. Oyo Rooms

As of Dec 2018, Oyo has annual revenue of \$1.8 Billion. In 2019, OYO reported 3.5x growth in revenue in FY 2017-18.

- Commissions
- Room Reservation Fee
- Membership fees
- Advertising
- Sponsors and Partnerships
- Consulting Services

2.6.4. AirBnB

The revenue of Airbnb come from two main sources they are:

- Host Fee (Ranges from 3-5%)
- Travelers Fees (Ranges from 0-20%)
- Reservation fees (per room charges)
- Cleaning fees
- Service Fees
- Occupancy
- Extra guest fees
- Currency exchange fees
- VAT / Local Taxes and more

2.6.5. Flipkart

Flipkart makes a percentage cut whenever someone sells their product to a customer. Commissions are usually deducted from the original transaction value prior to paying out the seller who sold the item. The commission structures vary from item to item, they are categorized in the following:

- Low Margin branded categories: 2-5%
- High Margin branded categories: 10-25%
- Shopping fees (Flipkart Assured Program)
- Own Shipping Services – Ekart

2.7. Inference

Based on the previous sections in this chapter we can infer a few details about the various platforms.

2.7.1. Zomato

Zomato happens to be one of the most successful platforms that was originally launched in India. Today it's serving platforms and operations have extended to over 21 countries and are determined to continue to grow its customer base. Zomato is working on many new business endeavors. However, this doesn't limit Zomato from further implementation and improvement to their existing platforms and software applications.

2.7.2. Swiggy

Swiggy has undoubtedly become a leading online food ordering and delivery company. Having changed the entire landscape of how India eats, its innovative business model has made the life of every foodie easier, tastier, and more fun. With its fast deliveries, live order tracking, and no restrictions on order amount, Swiggy is not far from taking a huge chunk of India's food-tech market. It has been demonstrated through Swiggy's business model.

2.7.3. Oyo Rooms

Oyo has truly revolutionized the hotel industry with its efficient use of technology. It has redefined living spaces and taken the user experiences to the next level. With its quick booking facility, hassle-free rental experience, and convenient pricing, it has transformed the way people stay away from homes. Its growth is unstoppable with its continual expansions to newer markets while it has strongly built its brand name as the most prominent hotel network with both high quality and affordability.

2.7.4. AirBnB

According to multiple resources, Airbnb is expected to list in 2019 IPO's. Airbnb is determined to grow exponentially in the 2019 year. One of the most crucial tactics for Airbnb's success rate is its ability to provide home listings at a global scale, capturing populations from over 191 countries. To conclude, Airbnb is one of the most successful platforms for hosting opportunities, in the same aspect, it provides high-quality listings of locations and events for those who are looking to book a getaway.

2.7.5. Flipkart

The success of Flipkart may not be very much dependent on the fact that it operates similarly to Amazon, instead because of the market trend and scope in India. Although there are Amazon facilities designated in India, Flipkart online platform offers similar brands and products, only this time Flipkart doesn't charge additional international shipping charges and therefore delivery is much cheaper as compared to what Amazon charges.

Because of the demand and scope in India, the success of Flipkart was made possible.

3. TOOL DESCRIPTION

The web is an incredible platform. Its mix of ubiquity across devices and operating systems, its user-centered security model, and the fact that neither its specification nor its implementation is controlled by a single company makes the web a unique platform to develop software on. Combined with its inherent linkability, it's possible to search it and share what you've found with anyone, anywhere. Whenever you go to a website, it's up-to-date, and your experience with that site can be as ephemeral or as permanent as you'd like. Web applications can reach anyone, anywhere, on any device with a single codebase.

Native applications are known for being incredibly rich and reliable. They're ever-present, on home screens, docks, and taskbars. They work regardless of network connection. They launch in their own standalone experience. They can read and write files from the local file system, access hardware connected via USB, serial or bluetooth, and even interact with data stored on your device, like contacts and calendar events. In native applications, you can do things like take pictures, see playing songs listed on the home screen, or control song playback while in another app. Native applications feel like part of the device they run on.

If you think about native apps and web apps in terms of capabilities and reach, native apps represent the best of capabilities whereas web apps represent the best of reach. So where do Progressive Web Apps fit in?

Progressive Web Apps (PWA) are built and enhanced with modern APIs to deliver native-like capabilities, reliability, and installability while reaching anyone, anywhere, on any device with a single codebase.

3.1. PWA Description

A Progressive Web App (PWA) is an app that uses modern Web capabilities to offer users a very similar (if not better) experience to a native app.

Unlike traditional apps, progressive web apps are a hybrid between regular web pages and mobile applications. The term "progressive" refers to the fact that they introduce new features and, from the user experience's point of view, they are initially perceived as normal websites but progressively behave more like mobile apps, among other things multiplatform.

Progressive Web Applications are viable alternatives for native or hybrid apps for most business and enterprise applications. These applications are rarely hardware intensive and are often budget conscious. In these cases, focusing efforts on building a single PWA instead of supporting multiple native platforms can help save development time and cost.

In general, it is worth evaluating first if an application can be built as a PWA before deciding to build a native application. The web platform is adding capabilities at a fast pace, allowing you to do anything from 3D acceleration to hardware access.

3.2. Key Features of PWA

Progressive Web Apps are web applications that have been designed so they are capable, reliable, and installable. These three pillars transform them into an experience that feels like a native application.

3.2.1. Capable

The web is quite capable in its own right today. For example, you can build a hyper-local video chat app using WebRTC, geolocation, and push notifications. You can make that app installable and take those conversations virtual with WebGL and WebVR. With the introduction of Web Assembly, developers can tap into other ecosystems, like C, C++, and Rust, and bring decades of work and capabilities to the web too.

Until recently, only native apps could really lay claim to these capabilities. While some capabilities are still out of the web's reach, new and upcoming APIs are looking to change that, expanding what the web can do with features like file system access, media controls, app badging, and full clipboard support. All of these capabilities are built with the web's secure, user-centric permission model, ensuring that going to a website is never a scary proposition for users.

Between modern APIs, Web Assembly, and new and upcoming APIs, web applications are more capable than ever, and those capabilities are only growing

3.2.2. Reliable

A reliable Progressive Web App feels fast and dependable regardless of the network.

Speed is critical for getting users to use your experience. In fact, as page load times go from 1 second to ten seconds, the probability of a user bouncing increases by 123%. Performance doesn't stop after the onload event. Users should never wonder whether their interaction—for example, clicking a button—was registered or not. Scrolling and animation should feel smooth. Performance affects your entire experience, from how users perceive your application to how it actually performs.

Finally, reliable applications need to be usable regardless of network connection. Users expect apps to start up on slow or flaky network connections or even when offline. They expect the most recent content they've interacted with, like media tracks or tickets and itineraries, to be available and usable even if getting a request to your server is hard. When a request isn't possible, they expect to be told there's trouble instead of silently failing or crashing.

Users love apps that respond to interaction in the blink of an eye, and an experience they can depend on.

3.2.3. Installable

Installed Progressive Web Apps run in a standalone window instead of a browser tab. They're launchable from on the user's home screen, dock, taskbar, or shelf. It's possible to search for them on a device and jump between them with the app switcher, making them feel like part of the device they're installed on.

New capabilities open up after a web app is installed. Keyboard shortcuts usually reserved when running in the browser, become available. Progressive Web Apps can register to accept content from other applications, or to be the default application to handle different types of files.

When a Progressive Web App moves out of a tab and into a standalone app window, it transforms how users think about it and interact with it.

At their heart, Progressive Web Apps are just web applications. Using progressive enhancement, new capabilities are enabled in modern browsers. Using service workers and a web app manifest, your web application becomes reliable and installable. If the new capabilities aren't available, users still get the core experience.

Progressive Web Apps provide you with a unique opportunity to deliver a web experience your users will love. Using the latest web features to bring native-like capabilities and reliability, Progressive Web Apps allow what you build to be installed by anyone, anywhere, on any device with a single codebase.

3.3. Reasons For PWA

When doing user research, we find some interesting patterns:

- Users hate delays and unreliability on mobile: the level of stress caused by mobile delays is comparable to watching a horror movie.
- Fifty percent of smartphone users are more likely to use a company's mobile site when browsing or shopping because they don't want to download an app.
- One of the top reasons for uninstalling an app is the limited storage (whereas an installed PWA usually takes less than 1MB).
- Smartphone users are more likely to purchase from mobile sites that offer relevant recommendations on products, and 85% of smartphone users say mobile notifications are useful.

According to those observations, we found out that customers prefer experiences that are fast, installable, reliable, and engaging.

PWAs provide a set of best practices and modern web APIs that are aimed at meeting your customers' needs by making your site fast, installable, reliable, and engaging.

For example, using a service worker to cache your resources and doing predictive prefetching makes your site faster, and more reliable. Making your site Installable provides an easy way for your customers to access it directly from their home screen or app launcher. And new APIs like Web Push Notifications make it easier to re-engage your users with personalized content to generate loyalty.

3.4. Business Impact

The business success definition can be a lot of things depending on your activity:

- Users spending more time on your service
- Reduced bounce rates for your leads
- Improved conversion rates
- More returning visitors

Most PWA projects result in a higher mobile conversion rate, and you can learn more from the numerous PWA case studies. Depending on your objectives, you may want to prioritize some aspects of PWA that make more sense for your business, and it's completely OK. PWA features can be cherry-picked and launched separately.

When a native app, installed from an app store, is launched, users expect it to open, regardless of whether they're connected to the internet. Progressive Web Apps should be no different.

At a minimum, a simple offline page that tells the user the app isn't available without a network connection should be served. Then, consider taking the experience a step further by providing some functionality that makes sense while offline. For example, you could provide access to tickets or boarding passes, offline wish lists, call center contact information, articles or recipes that the user has recently viewed, etc.

PWAs are modern websites that benefit from the massive reach of the web, combined with all the user-friendly features that users love in native apps. They leverage a set of best practices and modern web APIs, that can be implemented independently depending on your business specificities and priorities.

3.5. Basic Criteria

PWA are essentially fast, performance-focused web applications that are streamlined for mobile. They also can be saved to your smartphone's home screen and, from there, look and feel like a native app (including features like offline access and push notifications).

Three basic criteria to qualify your web app or website as a PWA:

- It must run under HTTPS.
- It must include a Web App Manifest.
- It must implement a service worker.

HTTPS:

By using secure connection such as Transport Layer Security or Secure Sockets Layer, the privacy and integrity of data are maintained and authentication of websites is also validated. HTTPS ensures data security over the network

Web-App Manifest:

A web manifest file provides meta data to the browser, telling it how to theme the add to home screen experience. The web manifest is a JSON file containing a series of properties used to describe the progressive web app to the platform. The platform knows how to find the manifest because it is referenced in the HEAD.

Service Worker:

A service worker is a script that your browser runs in the background, separate from a web page, opening the door to features that don't need a web page or user interaction.

Things to note about a service worker:

- It's a JavaScript Worker, so it can't access the DOM directly. Instead, a service worker can communicate with the pages it controls by responding to messages sent via the postMessage interface, and those pages can manipulate the DOM if needed.
- Service worker is a programmable network proxy, allowing you to control how network requests from your page are handled.
- It's terminated when not in use, and restarted when it's next needed, so you cannot rely on global state within a service worker's onfetch and onmessage handlers. If there is information that you need to persist and reuse across restarts, service workers do have access to the IndexedDB API.

A service worker is a script that is running separately from our website - in the background. Service workers are awesome, they can help us reach different things like caching pages, caching API calls, push notifications, background sync, and more.

- A service worker can cache network requests.
- A service worker can handle how network requests are done on your website.
- A service worker can make the use of the `_Background Sync API_` which allows you to defer actions until the user has stable connectivity.
- A service worker can't access/interact with the DOM directly.

- A service worker can cache your things from your website, like static assets.
- A service worker can receive push notifications when the app is not active.
- A service worker stays inactive when it's not in use. When it gets the "signal" to be used, it reactivates again.
- A service worker can be used to make your app work offline.

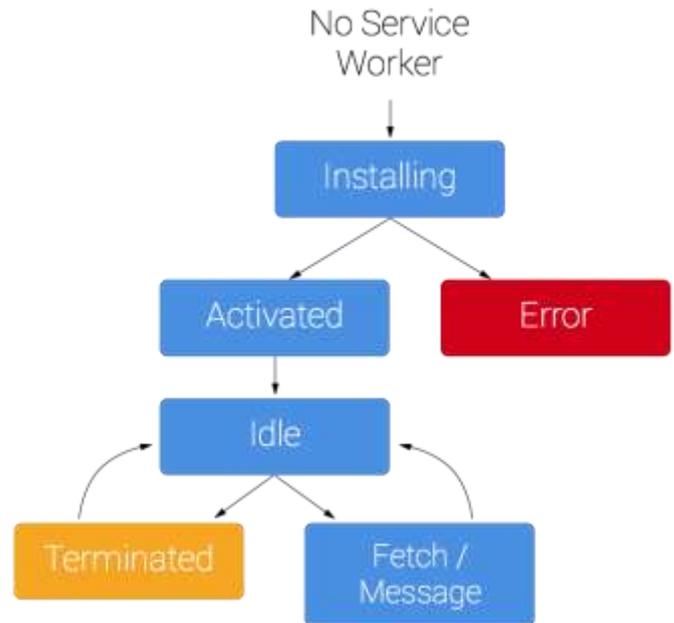


Fig-1: Service Worker Flow Chart

3.6. Comparison With Native App

Installed Progressive Web Apps run in a standalone window instead of a browser tab. They're launchable from the user's home screen, dock, taskbar, or shelf. It's possible to search for them on a device and jump between them with the app switcher, making them feel like part of the device they're installed on.

But having both an installable web app and a native app can be confusing for users. For some users native apps may be the best choice, but for others they can present some drawbacks:

- **Storage Constraints:** Installing a new app might mean deleting others, or cleaning up space, by removing valuable content. This is especially disadvantageous for users on low-end devices.
- **Available Bandwidth:** Downloading an app can be a costly and slow process, even more for users on slow connections and expensive data plans.
- **Friction:** Leaving a website and moving to a store to download an app creates additional friction and delays

a user action that could be performed directly on the web.

- **Update Cycle:** Making changes in native apps might require going through an app review process, which can slow down changes and experiments.

In some cases, the percentage of users that won't download your native app might be large, for example: those that think that they won't use the app very often, or can't justify spending several megabytes of storage or data. You can determine the size of this segment in several ways, for example by using an analytics setup to track the percentage of "mobile web only" users.

Once a PWA meets the installability criteria, most browsers will show an indication that the PWA is installable. For example, Desktop Chrome will show an installable icon in the address bar, and on mobile, it will show a mini-infobar.

The ability to have an icon in the user's home screen is one of the most engaging features of applications. Given that historically this was only possible for native apps, companies might think that showing an app store install banner would be enough to convince users to install their experiences. Currently there are more options to have the user install an app, including offering lightweight app experiences in the stores, and letting users add PWAs to the homescreen, by prompting them to do it directly from the website.

3.7. Feature Comparison

The table below shows how PWA features outweigh the features of those of native apps and responsive apps.

Table-1: Sample Table format

FEATURES	PWA	NATIVE APP	WEBSITE
Multi Platform Capability	YES	NO	YES
Low Cost to Build	YES	NO	NO
Installation Not Required	YES	NO	YES
No Updates Required	YES	NO	YES
Push Notifications	YES	YES	NO
Easy Sharing	YES	NO	YES
Low Data Consumption	YES	NO	YES
Offline Usability	YES	NO	NO
Faster UI	YES	NO	NO

3.8. Future Scope

Progressive Web Apps seem to be the future of web design, allowing web app developers to create user experiences that have the reach of the web and the

functionality of native apps. As with any new technology, they come with their own fundamental design considerations, but their abundant benefits make them a worthy investment.

4. CONCLUSION

Progressive web apps are a significant step forward into the application development segment. Mobile applications and websites both contribute significantly towards enhancing customer experience. PWA apps are a stride ahead in this approach. They combine the best of both the mobile application and website features. It is important to understand that every business has its very own app. However, downloading and installing apps for every product, service or platform is not a feasible solution. PWAs are a fresh outlook to the scenario. Without installation, progressive web apps provide the benefits of website browsing through the look and feel of the application. Thus, it can be predicted that they are the future in the app development sector.

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