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Capstone project

Cost benefit analysis of mobile application development compared to website development

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Executive summary

The choice of developing a mobile application or a website can arise for any entrepreneur who wants to offer digital content. But there are a lot of technologies and constraints for each of those, so it can be difficult to make a choice.

The 3 main application types are native apps, specific to each platform, hybrid apps, which use web technologies, and cross-platform apps, which allow only one development for all platforms.

For websites, traditional responsive websites can adapt to all screen sizes and therefore offer a mobile experience while facilitating the development process. Progressive web apps are a mix between the 2, as they are websites that look like apps and can be used as if they were.

The most important criteria concerns the price: if the budget is big enough a native app will usually be the best solution in terms of user experience, but with fewer means cross-platform apps can offer a similar experience. The cheapest is still a website, but it is important to offer the medium that is the most adapted to the way of consuming the content: unique or infrequent use is easier on a website than on an app, which has a bigger entry barrier, but which suits more a regular use than websites do.

There are also technical constraints to take into account regarding what can be done with each technology, but that can also increase the cost depending on update frequency for example.

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1. Introduction

The release of the iPhone and the App Store in 2008, followed by the Android Market (now Play Store) by Google a few months later have completely changed the way we consume digital content. While 10 years ago a desktop website was all a company needed, now more than half of the visits on a website come from a mobile device[1], and the number of apps on the Play Store is over 2 million[2]. So it is essential for any company offering digital content to be present on mobile.

However there are lots of ways to create mobile content. The two main categories are mobile applications and websites, but within those, several technologies also exist, each with its benefits and drawbacks regarding the price, development and user experience.

So it can be difficult for a company to decide which of those to use. This work attempts to answer this question by giving a view of each solution, with their benefits and drawbacks, finishing with a summary guide aiming to help any entrepreneur to choose the mean that is most suited to their situation.

2. Technologies

Before being able to compare all the solutions it is necessary to understand them well, and how they differ from one another.

2.1 Mobile applications

Mobile Applications are downloaded, usually from the Play Store on Android and the App Store on Apple devices. 3 development methods exist, each leading to similar apps visually, but which vary in the ease, cost and possibilities of development and updates.

[1] https://www.stonetemple.com/mobile-vs-desktop-usage-study/

[2] https://www.statista.com/statistics/276623/number-of-apps-available-in-leading-app-stores/

2.1.1 Native Apps

At first only native applications existed. Those are apps developed specifically for the target platform, so they are very well integrated.

These apps interact directly with the device and have the following characteristics:

- Must be developed twice (once for Android and once for iOS)
- They can use all device features (accelerometer, GPS,...)
- User experience is adapted to the platform (appearance, button placement, ...)

2.1.2 Hybrid apps

Hybrid apps are mobile applications developed with the same technologies that website use, running in a very simple platform-specific browser, then wrapped into an app that can then be downloaded and used in the same way than a native app.

Their characteristics are the following:

- Only needs to be developed once (the same code runs on each platform)
- Some parts can be shared with the website.
- Simple updates can be performed by the app, without having to re-download it.
- All device features are not always usable (some parts of the app can still be natively written for each platform)
- The user interface is the same for each platform.

2.1.3 Cross-platform apps

Cross platform apps are, just like hybrid apps, developed in one language and run on multiple platforms, but interact directly with the device instead of running through a browser.

Their characteristics are:

- The app only has to be developed once
- The user interface can adapt to the platform
- Some device features are no usable and must therefore be natively developed for each platform

2.2 Websites

Websites have the advantage of being referenced on search engines and always providing the most up-to-date version to the user, because pages are downloaded every time.

2.2.1 Responsive websites

Responsive websites are websites that can adapt to all screen size, and can therefore be viewed from a computer or a mobile device.

They have these main characteristics:

- The website only has to be developed once, and will be viewable for any device without having to also develop an app
- Mobile-friendly websites are referenced better on search engines
- The web browser has to be opened then the website found again every time it is accessed
- The interface is a website interface, less adapted for mobile
- Few device feature are available

2.2.2 Progressive web apps

Progressive web apps are websites that are specifically developed for mobile, able to offer a look and features similar to apps, and even download its content to use it without an internet connection and add an icon on the device, making it close to a real app.

The characteristics of a progressive webs app are:

- The same code runs on all platforms
- Some device features are available, but much more on android than on iOS
- The look and interaction are close the mobile apps

3. Comparison

Comparison will be made in terms of user experience, constraints (cost, time, ease) for the company, and technical development constraints.

3.1 User experience

User experience includes interaction with the app or the website, in other words how easy and natural it is to interact with the interface and to get to the desired goal, but also how easy it is to access this app or website.

3.1.1 Performance

The app performance, so the speed with which it it reacts to user input is very important. Indeed, less than 0.1 seconds of delay gives the user an impression of instant response, and with less than 1 second they notice the delay but still feel in control[3]. According to a Google study[4] however, 53% of users leave a mobile web page if it hasn't loaded within 3 seconds.

[3] https://www.nngroup.com/articles/website-response-times

[4] https://www.marketingdive.com/news/google-53-of-mobile-users-abandon-sites-that-take-over-3-seconds-to-load/426070/

Websites have to download the whole page when they are opened so they are slower, especially with a bad internet connection, and usually have to download new data with each page change. Progressive web apps have better performance because they can cache a lot of information to avoid redownloading it, but apps are still faster.

Within those, native apps are the fastest, as they directly interact with the device, followed by cross-platform apps, which can even sometimes be as fast as native apps. Lastly, hybrid apps are the slowest, because they run through a web wrapper.

3.1.2 Interface

There are well specified looks and ways to interact with mobile applications for Android[5] and iOS[6], which allow having a uniform user experience on a device. An app that doesn't follow these guidelines can lead to a user experience not as good. For example, there is no physical back button on Apple devices, but one in the top left corner of the app, and this action can also be done with a swipe. The absence of that functionality can confuse the user and give a bad impression.

Responsive websites have the least mobile friendly interface. The layout of the site adapts with the screen size, but it is still a website interface, usually not in accordance with the look and gestures of a mobile application.

Progressive web apps aim to solve this problem, by keeping the advantages of a website, but providing an interface close to the one of an app.

Nevertheless, native apps are the ones that offer the best user experience in terms of looks, because they are specifically developed for the target platform and directly use the functionalities offered by it.

[5] https://developer.android.com/design/index.html

[6] https://developer.apple.com/design/human-interface-guidelines/ios/overview/themes/

Cross-platform apps can get really close to a native experience, with an automatically platform-adapted appearance, but all aspects are not always adapted and depend on how much the framework supports all the platforms.

As for hybrid apps, just like websites they are the same for all platforms and are made with web technologies but are only targeted at mobile devices so they can take that into account. However the appearance will be the same for all platforms and therefore won't be as well adapted.

3.1.3 Access

The ease of access to the app or the website also affects user experience a lot. The best access medium depends on the goal and use frequency.

While a mobile application requires more efforts et implication for the first use, because it has to be installed, a website will always be accessed more casually. On the other hand, for later uses an app will be more easily accessible, and without an internet connection required. Mobile applications are therefore more adapted for regular use and websites for unique or infrequent visits, because most users won't want to install an app for a one-time use, or search the website every time they want to access it if it happens often. Progressive web apps have the advantage of being accessible like a website but offer the possibility of being downloaded and adding a shortcut on the device to then be accessed just like a usual app.

Natural referencing in search engines is also very important. A user won't want to go down to the second page to find what they're searching for. Moreover, the first instinct when looking for a service is using a search engine, so only websites are visible. A company only having a mobile application will loose a lot of visibility.

Updates also must happen as easily as possible for the user. An app must manually be updated, whereas a website will always provide the most up-to-date version.

3.2 Constraints for the company

3.2.1 Time and cost of development

The time and the cost of development are linked, because a longer development will lead to a higher cost. But regardless of that, the hourly cost of a developer also varies. A web developer usually costs less than a native app developer. Hybrid apps, which use web technologies, and cross-platform apps also using a web language can therefore be developed by web developers. Moreover, native apps must be developed once for each platform so they require 2 parallel developments, which make them the most expensive to make.

3.2.2 Ease of distribution and update

Once the product is developed, it must be sent to the users. For an app, it has to be published on the Play Store for Android and the App Store for Apple. The app must be approved before it is published and that can take more than a day. It can also be refused, sometimes for silly reasons, and has to be modified and submitted again, which adds more time. This process must be repeated for each update of the app. On top of that, the testing phase is shorter for websites and there are fewer bugs discovered afterwards, so fewer updates as well, because a website that works on all the main browsers and which is responsive will also work correctly on the vast majority of devices. For apps however there sometimes are big changes from one Android or iOS version to the other, so it is hard to foresee how each version will react. Mobile development is less mature in general than web development.

An other important aspect is that multiple versions of the app can exist at the same time, because users update it at different times. So it has to be taken into account when modifying the backend, which has to be able to support all existing versions.

For a website the process is much simple, it just has to be sent to a server and it is available right away. Moreover, updates are also available right away for everybody and they all get the same version.

3.2.3 Other constraints

When a means of payment is offered in a mobile application, it should be noted that Google and Apple can take a fee up to 30%. Payments are therefore much more interesting to offer from a website.

Websites and mobile application also impose different marketing constraints: a website will have to focus on search engine indexing and web ads, but will not be able to take advantage of its popularity as easily as apps can with the number of downloads and their rating, which help a lot in having a good spot in the Play Store or the App Store and in the first impression a user has before downloading it.

3.3 Technical development constraints

3.3.1 Internet connection

Another big difference between apps and websites is the need of an internet connection. After downloading it, an app can be opened without an internet connection, and the features that do not need external communication can be accessed. A website however needs an internet connection for each page loading.

3.3.2 Device features

One of the advantages of mobile devices are the features they provide such as the camera, bluetooth, notifications or GPS.

Native apps can access all those features. Hybrid and cross-platform apps can access most of them most of the time, and call native code if that is not the case. For websites however, those features are not all available and Apple supports a lot less of them than Android. So this must be taken into account if NFC or contact access is required for example, as those are not usable by websites.

4. Choice criteria

The most constraining criterion is the price. The different reasons given in the previous section make native apps approximately 3 times more expansive than a website. So they are to be recommended for companies that have a big budget and lots of resources, because they do make a better user experience.

For companies with less resources, hybrid or cross-platform apps can totally suffice if what they want to offer is more suited for an app, because in any case a website will always be less expansive. Cross-platform technologies are now advanced enough to offer a good user experience for apps composed of forms, list, selection and content browsing but for content closer to games native apps are still better.

Next, content use cases must be taken into account. For unique or infrequent use, a website should be considered because the barrier to entry is smaller than for apps, but for a more frequent use an app is much better suited because it is much more accessible once it is downloaded. When a lot of resources is needed or when there is a lot of loading, websites should be discouraged because their slowness can make the user stop using it. Likewise, native or cross-platform apps are to favor against hybrid apps, for the same reasons. The situation is the same when there is a lot of interaction with the content, websites and hybrid apps being less appropriate for a mobile experience.

Content evolution frequency has to be considered as well, because each update is an additional cost, greater for apps, and the regular downloads to get the latest version as well as the inconvenience caused if the user does not have the most up-to-date version can lead to a worse experience than a website, which will always be up-to-date.

Finally, technical constraints must not be forgotten because if a feature only usable by an app is needed, a website will be out of the picture.

It must also be noted that there are cases where the question does not arise because both solutions must be developed. A company with enough resources will usually benefit from having both for a bigger presence, but when the offered content is more suited for an app in some cases but a website in others (it can be a regular or infrequent use for example), being in both places should be considered. Hybrid apps can allow a lower cost in that case.

5. Conclusion

There are a lot of factors that differentiate the available solutions. The following table attempts to summarize them to give a broad view:

Criteria	Native	Hybrid	Cross-platform	Responsive	PWA
Dev time	2 distinct dev	Some platform-specific integrations	Some platform-specific integrations efficient frameworks	Same website than desktop. Mature web technologies	Web technologies, some integrations
Dev cost	More qualified devs. 2 parallel dev Release process	Web dev Release process	Release process	Web dev Quick prod	Web dev
Ease of dev	2 parallel dev	One codebase Platform integration	One codebase Platform integration	Same website than desktop	One codebase
Cost and ease of updates	2 updates (Android+iOS) Release process Keep supporting each version	Release process Keep supporting each version	Release process Keep supporting each version	Fast and easy	Fast and easy
Distribution	Play store + App store	Play store + App store	Play store + App store	User must navigate to the website for each use	navigation to the website for 1st use, icon for later ones
Interface	Perfectly adapted and integrated for each platform	One common interface, trade-offs to make	Can adapt depending on the platform	One interface, common for desktop and mobile	One interface, trade-offs to make. Better adapted for mobile
Experience	Fast and consistent with the platform	Slow Not always consistent with the platform	Almost as good as native	Slow Internet loading for each page	Slow, but can look like an app
Internet conn.	Non required	Not required	Not required	Mandatory	Optional
Usage	Frequent	Frequent	Frequent	Unique or infrequent	Frequent or unique
Device features	All features usable	Not all usable by the common code	Not all usable by the common code	Poorly supported, the website must be separated from the desktop one	Basic functionalities, not for all browsers and platforms
Performance	Very good	Can be slow	Close to native	Slow	Slow but can be cached

Finally, it must be remembered that these answers can change in the following years with technical evolutions. It is likely that development cost and time for mobile applications will decrease and that development ease will increase, as it was the case for websites. There is a trend less and less towards native apps, big groups like Google and Facebook invest in cross-platform technologies. These solutions are still young, but with more maturity they will allow to considerably lower the development costs and increase the possibilities.

6. Additional resources

The following websites can bring more information on the subject, in particular on more technical aspects, and were partly used for the redaction of this work:

https://belitsoft.com/apps-development-services/responsive-website-vs-mobile-app

https://belitsoft.com/react-native-development/react-native-vs-xamarin-vs-ionic

https://www.mobiloud.com/blog/native-web-or-hybrid-apps/

https://clutch.co/app-developers/resources/cost-build-mobile-app-survey

https://www.zuehlke.com/blog/en/you-probably-dont-want-a-hybrid-app/

https://www.codica.com/blog/progressive-web-apps-vs-native/

https://clearbridgemobile.com/mobile-app-development-native-vs-web-vs-hybrid/