
Designing for a Billion Users: A Case Study of Facebook

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Abstract

Facebook is the world's largest social network, connecting over 800 million users worldwide. The type of phenomenal growth experienced by Facebook in a short time is rare for any technology company. As the Facebook user base approaches the 1 billion mark, a number of exciting opportunities await the world of social networking and the future of the web. We present a case study of what it is like to design for a billion users at Facebook from the perspective of designers, engineers, managers, user experience researchers, and other stakeholders at the company. Our case study illustrates various complexities and tradeoffs in design through a Human-Computer Interaction (HCI) lens and highlights implications for tackling the challenges through research and practice.

Author Keywords

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ACM Classification Keywords

H5.2 [Information interfaces and presentation]: User interfaces — *User-centered design*;

General Terms

Design. Human Factors.

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Introduction

Facebook is the world's largest social network. It connects over 800 million users and continues to grow at a phenomenal rate worldwide. Users on Facebook today come from all walks of life, live in different countries, interact in over 70 different languages, have varying levels of computer expertise, and have individual expectations when engaging with their social networks. More than half of the active users log on to Facebook every day and interact with over 900 million objects, such as pages, groups, and events¹. Such high growth and engagement is intriguing on several levels for Human-Computer Interaction (HCI) researchers and practitioners.

In this case study, we take a behind-the-scenes look at how various product stakeholders at Facebook understand users and tackle design decisions. We carried out one-on-one interviews with 17 engineers, designers, and managers at Facebook working across different products. Following our conversations with product stakeholders, we carried out focus groups and follow-up interviews with members of the User Experience (UX) research team and the User Operations (UO) team that handles support issues.

Our overall findings suggest that design and engineering activities at Facebook are influenced by three key dimensions (Figure 1): 1) creating novel social networking experiences; 2) launching products in a timely manner; and 3) making products enjoyable and useful for over 800 million users. Although design and engineering decisions in any kind of software

¹<http://www.facebook.com/press/info.php?statistics> (retrieved January 15, 2012)

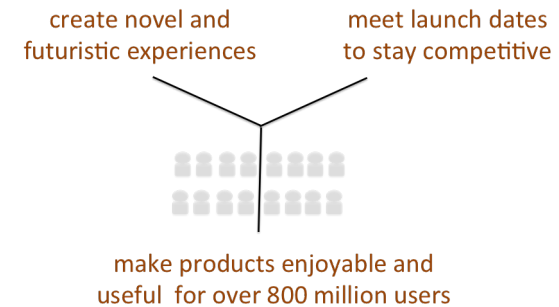


Figure 1: Three dimensions that influence design and engineering activities at Facebook

development involve tradeoffs, the dimensions that exacerbate the tradeoffs at Facebook are the scale of the user base and the focus on innovation and novelty. As we highlight findings from our case study, we also draw out some comparisons to Gould and Lewis' [5] classical work on user-centered design in organizations. In addition to recommending key principles for designing usable software, Gould and Lewis were pioneers in investigating software designers' perceptions of users and design principles.

The main contribution of this case study is that it illustrates the perspectives of product stakeholders as they innovate in the space of social networking while embracing agility and designing for a billion users. Although previous reports from practitioners highlight some of the challenges of doing user-centered design in agile development environments [1,4,10,15], our case study also considers the other dimensions (Figure 1) that influence design and engineering at Facebook. In addition, our focus is not just on upfront design, but also on how product decisions evolve after deployment

and how information from users becomes useful for improving designs in the long run. Our findings and analysis will be useful for HCI researchers, practitioners, and educators who are interested in optimizing methods for agile development environments and for training the next generation of UX researchers to design for a billion users.

Method

We carried out one-on-one interviews with 17 product stakeholders at Facebook working across different projects. The participants included: 5 Engineering Managers/Directors, 4 Product Managers/Directors, 3 Product Designers, 3 Software Engineers, and 2 Product Marketing Managers. On average, the stakeholders had been at Facebook for about 3 years.

Each interview lasted around 30-45 minutes. The interview questions focused on design decisions that stakeholders had to make when launching a new product or feature and how these decisions fit in with business priorities. Our next set of questions focused on sources used to gather information about users and how user information was used in the design process. Lastly, we probed into stakeholders' perspectives on how users interacted with the products that they created and the role of user education and help.

Based on perspectives that emerged in our conversations with product stakeholders, we carried out focus groups and follow-up interviews with 6 members of the UX team and 6 members of the UO team.

All interviews were audio-recorded and transcribed. We organized, coded, and analyzed all the transcripts using a qualitative data management and analysis software.

We followed an iterative process of applying *open coding* and *axial coding* to discover relationships among emerging concepts in our data, followed by *selective coding* to integrate the results [14]. Through this analysis process, we continually explored different facets of the data and identified recurring themes.

Designing for Users

We first asked product stakeholders to identify key decisions they had to make when designing a new product or feature. Gould and Lewis [5] had found in their studies that the majority of product designers and engineers were not aware of key design principles, such as a focus on users, user testing, and iterative design. However, we found that over half of the product stakeholders in fact identified user experience as a key factor driving design decisions.

To design for user experience, most product stakeholders highlighted *minimalism* as a design approach. Designers particularly emphasized the importance of providing a clean and efficient user experience:

I think obviously the number one thing is being sensitive to user needs and making sure we're providing the best and most efficient, cleanest user experience possible. Cleanliness and efficiency is very important. I think the whole social aspect is very important... when I'm designing, a big thing to consider is anxiety... what the button says or where the button is placed may cause people anxiety. Just anything like that.



Even most of the engineers who we interviewed appealed to an iterative design approach and valued user input in creating new functionality:

Sometimes it's not that hard to build a particular functionality...we try to do UX and iterate on various designs versus just getting something out there, make sure it's reasonable, and then iterate on the design based on how people are using it...not just the design but the how the whole interaction flows...

Product stakeholders in managerial roles who were involved in setting the overall product strategy and vision considered a focus on users to be a natural part of the process:

There [are] essentially two broad strokes that I think along...with the existing products, what are the pain points...what are the use cases that we are not capturing right now...secondly, is there a completely adjacent experience that we should be striving for [i.e., in mobile]...

Overall, we found that product stakeholders were much more aware of key design and usability principles than what Gould and Lewis [5] had found in their earlier studies. This change may not be that surprising given that user-centered design principles have been adopted in industry for over two decades now and there is formal training offered in user-centered design at all levels of education.

Tackling Tradeoffs in Design

Facebook and many other modern software companies today appeal to *agile* development processes [2]. Unlike the traditional linear “waterfall” software development lifecycle, the agile approaches emphasize

iteration, continuous feedback, and incremental mini-releases. Given the shorter release cycles, the product stakeholders in our study felt that they had to tackle a number of tradeoffs when it was time to actually make design decisions.

For example, stakeholders in managerial roles highlighted tensions between balancing deadlines and resources, and achieving desired product goals:

There's often a problem we're trying to solve or there is some opportunity...so we try to figure out if it meets our goals and is it at a quality level that's good enough for the company and for the users...there often are tradeoffs when we try to get something out the door, in terms of the number of features and the completeness of features...you know sort of the engineering versus shipping tradeoffs...biggest tradeoffs are near-term design and long-term design...

Similar to the above narrative, other product stakeholders also cited tradeoffs in designing for the “near-term” versus the “long-term.” Although most software design arguably involves tradeoffs in time and resources [5,12], an agile environment compounds the effect of these tradeoffs:

...design is hard...really hard. Just doing our best with very smart people, we screw up plenty...design and consistency takes time...we really work to make each experience as good as it can be...design and simplicity are often after thoughts...designers propose designs, engineers go build it...then they work iteratively to improve it...at a certain point, it's just good enough and we go with it...

Product stakeholders explained that it was important to be able to tackle these tradeoffs because the company was a leader in producing innovative social networking products. Producing “novel” and “futuristic” designs that users had not seen before involved some risk, but most stakeholders felt that thinking about the long-term vision and impact rather than short-term disruptions was important for progress:

I think what I like the most about this company, we will make changes based on how people are using our product...but we are not afraid of taking risks and having a big gamble...we have a sense of where this thing is going and maybe in the short-term lose engagement or users...but even if no user is asking for this feature, we're going to go ahead and build it...

On a related note, product stakeholders pointed out that some degree of trial and error was inherent in the design process as traditional methods of task analysis or requirements gathering were less relevant in this domain. In the absence of well-defined requirements, product stakeholders focused on the types of feelings a certain user experience may elicit:

...there are experiences you want to make possible and states you want people to get into and feelings you want people to feel more of or less of...and so, in my mind, a lot of the decisions that you make are pretty easy if you have a very clear sense of that at a high level. You know once you get into nitty-gritty, the decisions are much more about what you can rid off, essentially...what you can take off.

To make engineering-level changes based on user reactions, product stakeholders were largely data-

driven and cited usage numbers as being a crucial factor in optimizing design choices. Product teams often worked closely with data scientists and user experience researchers to learn about users and their usage patterns. However, when it came to gauging the reactions to a novel experience, some product stakeholders felt that it was difficult to capture the long-term impressions:

I would want data but it's pretty hard to always get data, particularly for this look and feel kind of stuff...it's slow right...if I make a change, it may change your impression of the product over months perhaps...not a short period of time...so it's hard to get data that corroborates that...

Overall, despite being cognizant of user experience, product stakeholders described various complexities that surrounded decision-making about product features and design. It was interesting to see that constraints on design in terms of development lifecycles identified by Gould and Lewis [5] still persisted after two decades.

Accommodating User Diversity

There was a sense among product stakeholders that they were striving to design a product usable by anyone, in any part of the world. However, achieving universality with an increasingly diverse user base that was growing by the millions every week was viewed as a key challenge by the stakeholders:

You know we're trying to make a universal product and we think some very core pieces of Facebook are universal, so we feel like there is a solution that works for everybody for the very key things...like how

you manage identity...the profile should look basically the same for everyone...but once you get farther away from the core products, it's not necessarily obvious to us that there is a magic way that a feature can work and everyone can find value in it...

Gould and Lewis [5] raised the issue of user diversity in their analysis and found that designers either over-estimated user diversity or under-estimated user diversity. They also found that designers and engineers often relied on their intuitions and hypotheses about users. Many of the product stakeholders in our study also cited their own intuitions and experiences as being important in pushing for certain designs; however, as explained in the following account, increasingly the stakeholders realized that their own intuitions were less relevant:

...when I started here the demographic and socio-economic makeup of the company was very similar to the user base...our own feelings were an excellent proxy for users...what we thought was cool, many users would agree was cool...we're now many moons from that time...when we make a new photo upload button, it needs to be equally intuitive to a 90 year Mongolian grandmother to a 14 year old Brazilian soccer player...

To accommodate user diversity in the face of innovation and product cycles, some product stakeholders used the approach of addressing use cases for the "least common denominator:"

Given the broad sophistication of our users...with 750 million users, it's very diverse. So, often times you have to design for the least common denominator.

Obviously, that's over simplifying it...often times, we reject things that we could make because the adoption rate would be so miniscule that it wouldn't be worth making. I think ease of use and thinking about broader scope of people is our priority.

Other product stakeholders felt that it was hard to discern what the least common use cases would be for all products, particularly as millions of new users were joining the network every week. New users, for example, took time in getting up to speed on even the basics of social networking:

I think understanding who can see what you share is a huge area of confusion for new users. Like the distinction between groups and posting a status update on your wall...and just understanding how to tweak to your audience is quite complex for new users. I also think just fundamentally understanding how all the different pieces fit together, the different elements of the user experience...people don't get right away.

Apart from thinking about new users, product stakeholders cited other examples of user groups that had different needs. For example, celebrities and politicians on Facebook had different expectations in setting up their fan pages compared to college friends trying to stay in touch. Also, as Facebook was expanding its platform products and allowing millions of software developers to integrate products with Facebook, stakeholders had to cater the expectations of end-users and developers alike.

Overall, product stakeholders indicated that designing for over 800 million users required tough compromises

and stakeholders realized that providing custom experiences to users was not an optimal solution:

It's really tough...you could imagine having different views for different users...one for like new users and one for more sophisticated users...but then you run into problems where not everyone is operating the same site...so how do we understand it...I think it's a tough problem and then you run into problems of clutter...say if I put a question mark box next to everything [for help on the screen]...total [design] failure...

Learning about Users

As discussed before, most product stakeholders were aware that their own intuitions were far removed from the diverse experiences of users on the site. To more formally learn about users, product stakeholders relied on several initiatives around the company, such as UX activities, data about product use, and user feedback through support channels.

Learning from UX Insights

Product stakeholders described the UX research team as often playing a key role in helping understand “regular” users, capturing nuances of how users interacted with particular designs, and gauging user reactions before launching new products.

Product stakeholders cited usability tests as being particularly helpful for learning about different types of user behaviors and their interactions with current prototypes:

I have watched a series of live user studies where we had users in the room...we could watch how they

move their mouse...it was eye-opening to see how many of your assumptions are wrong and to see all the things you take for granted because you're an engineer. You've been using computers every day all the time for 2 decades. To watch somebody who just has you know who is nowhere near there and not see a link or a button or start typing in the wrong place...and I'm not talking about the hilarious grandmother who writes an entire message in the URL bar...I'm talking about totally smart people who're can't upload a photo because they're not in the mind-set of I know there's a way to do it and I just need to find a button...we [engineers] know that there's a way to do it...but they're not sure that there's a way to do it...

In addition to usability tests, product stakeholders felt that it was valuable to get broader information about users and to get into the mindset of users outside the company:

I just find [UX] to be a strong resource whenever you just want to talk about something because [they] know users really well...and [have] good principles on how users would interact with this stuff...that for me is much more helpful for me than seeing [the] findings because I'm not a designer...my role is not to get [their] findings and then figure out how to incorporate them...for me getting into the frame of mind of the user is very valuable because I'm not the average user and I know that...working with that team to get that feeling is very valuable...

Although several product stakeholders mentioned the desire to know about the “average” user of a certain product, they recognized that with over 800 million

users, characterizing the average or a representative user was almost an intractable challenge. But, as advocated by Gould and Lewis [5], many stakeholders believed that it was valuable to identify user issues even with small samples (i.e., in usability tests) than not incorporating the users' perspectives at all.

Learning from Usage and Support Data

Unlike traditional desktop software development, web application development usually consists of shorter product cycles. Increasingly, web companies are moving towards making constant improvements based on usage data and user feedback. The product stakeholders in our study also emphasized the value of understanding users based on product use and through reports from User Operations (UO), the team that deals with support requests and bugs.

Stakeholders explained that for new products, product teams had a number of hypotheses about user reactions:

It's certainly the case that debates either before or after product launches, people throw out these hypotheses and a lot of time the data just isn't there to back it up or and it would take a lot of instrumentation to do it...

Most product stakeholders in managerial roles considered data to be vital for all their decisions. Based on past experiences, stakeholders pointed out that there was a lot of variability in the long-term uptake of a product compared to short-term reactions. They felt that continuous monitoring of the usage was necessary to understand the trends and check against hypotheses:

Were we right? You know we do some small sampling of testing beforehand but once it's out the door, we have to see if the metrics hold up...some things look good initially, possibly because of the novelty effect, but once it goes out to everyone, the benefit wasn't actually there...and sometimes it's reserved...once we roll it out, the network effects will kick in...

Overall, it appeared that product stakeholders were learning a lot about product use through internal instrumentation and logging techniques. But, the instrumented flows did not always provide insight into *why* users were behaving a certain way or what could be causing particular breakdowns. To this end, product stakeholders pointed out that information from help tickets provided by the UO team was sometimes helpful. They could get a sense of where users were confused and what aspects of functionality they did not like or did not understand.

A few of the product stakeholders were skeptical of the information from the help tickets because they believed that the issues were not necessarily representative and came from a vocal minority. For example, one of the managers explained:

...you know sometimes users have a dissonance between what seems important to them versus how important something really is...so you constantly have to toll that line...there's also a skew in the reporting, there's a sampling bias...I've never seen data on this, but I have a pretty good guess that people who are writing [to UO] are younger and skewed towards more active users...just by nature...so you have to be careful when you consider it given the long tail impact you could have...

In our focus group with the UO team, we learned that there was a lot of variation among products in terms of the reported issues that were bugs versus confusion points or user inquiries. One challenge that the UO team faced was in aggregating issues in a meaningful way without spending a lot of time in manually processing each request. Another challenge was conveying insights gleaned from the reported issues to engineers and designers:

We have more traction with engineers versus designers – because bug fixing is more tangible – designers are more like artists, they have a vision for the product... it's a challenge to approach them in the right way to convey user feedback... Engineers listen to numbers...easier to tell them something is broken in the flow than to tell them to do something differently...

Supporting Users Through Help and Education

Given the scale and diversity of the user base, product stakeholders agreed that help and user education were sometimes a necessary part of supporting the overall user experience.

A few of the product stakeholders believed that products could be designed to be intuitive and usable by everyone (such as an elevator) and that there was a way to get the design “right.” (Gould and Lewis [5] also made a reference to this sentiment about design common among designers in many domains). However, other product stakeholders in our study disagreed with the idea of getting the design “right” upfront:

I mean you can't make a perfect design for 750 million people...you can't even design for one person

properly because they'll tell you something and what they really want is something else...I think user education is actually the way to go...I think most effective is proactive-in-place, tutorial-style things are the best way to go...

Some product stakeholders felt that in addition to educating users about the site's functionality, user education was also important in conveying the norms around the use of the site:

Most commonly it's about understanding the mechanisms of what drives Facebook...I think people don't understand what drives Facebook...people understand that you make friends but not much more sometimes...like people understand what the like [button] does, but they don't understand what the consequences are when they like something...

Apart from helping new users, product stakeholders in marketing roles explained that increasingly their focus was on messaging and helping all users leverage features for better managing their social networks:

I think you want people to orient to the product and understand what you're doing... privacy [is] an area that is obviously very sensitive...when it comes to privacy, it's not just teaching someone about the product, it's more about how we're positioning it...

Facebook currently offers a help center through which users can learn about products and submit inquiries for help. Within the help center, users can also get help from other users in discussion forums. Most product stakeholders felt that in the spirit of social networking, users often learned best from their friends or other

users. Also, through previous product launches and user education initiatives, stakeholders believed that contextual help and education initiatives benefited a large number of users and that they would continue to advocate for such initiatives:

I think it [contextual help] is very natural for users...rather than sending them to another page or a help center which is out of context...there's nothing more natural than having a hover-over bubble telling them you can do this here...kind of the modern-kind mechanism for user education...it's minimalist, it's relevant, and it's in-context, so you can't beat that.

Pushing for User Experience

As shown above, product stakeholders were cognizant of user needs but had to deal with a number of tradeoffs in design. In the face of the challenges that come for designing for a billion users, it is somewhat amazing that the social network has such high growth and a highly engaged user base. In our focus group and interviews with UX team members, we learned that they had adapted their methods and approaches to work with designers and engineers to push for user experience in the face of constraints and tradeoffs.

In choosing methods and the type of data that was used to convey user information, UX team members felt that sometimes deep quantitative studies were necessary to answer some questions, but in other cases user reactions through usability testing were just as valuable for product teams. The choice of method depended on what question was being investigated:

Given the products that we have...there are different sets of users you can study and learn different things

about the product. I think a lot of other industrial products have very defined and narrow audience...we have a complex product...we have an international brand...if we talk to people here vs. in Brazil, we will see different things...I think quantitative is definitely helpful for understanding user behavior at scale, but the problem with quantitative work and numbers is that you don't get the "why"...so, we have to design our questions appropriately...

User experience researchers felt that hybrid research was the best approach in tackling issues at a large scale. However, as known in the literature [9], the researchers felt that this type of mixed-method research took much longer and was not always amenable to constraints tied to agility in the development process. Still, the user experience researchers felt that hybrid research was necessary and they were planning more ongoing projects with other teams.

Regardless of the methods and the type of user data obtained, UX team members felt that a tight coupling between different product stakeholders was necessary in order to advocate changes. Also, UX team members felt that understanding and acknowledging the constraints of designers, engineers, and managers helped them to see when the injection of user data would be helpful for a given product. For example, one of the UX team members explained:

For a researcher to get an "in", you have to show an appreciation for the work that engineers do...because we [UX] are sometimes perceived as just critiquing and criticizing what's going on [in terms of design]...- I think it's good to give that feedback when they do

something nice, like set up a test for you...we all get busy and it's not like my job, but it's good to give that feedback. I think with designers, there is need for showing even more consideration at the beginning for what they do and how hard they work...

UX team members felt that they could make the most impact by working closely with designers, but they acknowledged that designers had a tough job in balancing their loads and negotiating with engineers:

Designers have more to hold in their head – engineers generally have to think about the implementation only – but designers have to think about the design and how it will work out...they can't hand off something that's going to be a pain to build, but they also have to keep the user experience in mind...I see the more we can take on that burden, they can pick up where we leave off...

Overall, the UX team members were making adaptations and evolving their methods to fit the needs of the development process, similar to other reports of UX in agile environments [15]. UX team members agreed that constraints on design and engineering often made decision-making about users difficult for product teams. However, regardless of the challenges, the UX team was committed to working with product stakeholders in every way possible to better understand and illustrate the diversity of the user base.

Discussion

In this case study, we have illustrated the perceptions that product stakeholders at Facebook have about design, users, and user experience as they build and support the world's largest social network. We have

highlighted various complexities that surround decision-making and the tradeoffs that have to be considered even when there is commitment towards designing for users. Although many of the findings concur with other studies of usability practices and software development [3,7,12], the dimensions that are unique to Facebook are perhaps the scale of the user base and the focus on novelty and innovation. Thus, this case study raises some new issues for discussion that has recently started among HCI practitioners, researchers, and educators [8]. In particular, the HCI community may find it useful to reconsider user research methods for agile development environments and new ways of training the next generation of user researchers to adapt to such environments.

The larger context of the findings

Although we mostly focused on drawing comparisons to the classical work by Gould and Lewis [5], several other studies in the last two decades have also shed light on software design practices at various organizations (e.g., [3,7,12]). While the domains investigated in these previous studies mostly consisted of business and office products, these studies laid an important foundation for understanding development and organizational constraints on user-centered design. Recent surveys of usability practice and user-centered design [6,13,16] have shown that to tackle different organizational constraints, lightweight strategies such as requirements gathering, task analysis, and usability testing are more widely used in industry.

When considering organizations like Facebook, however, there are no "requirements" or "tasks" per se—the focus is on designing an innovative and valuable social experience for users from all walks of

life. Furthermore, when dealing with a user base of close to a billion users, there is a constant struggle in optimizing the experience for the majority of users. For example, even if 99% of the users are satisfied, the remaining 1% still represent close to 10 million users. Most modern software companies do not even have a user base of 10 million users, so the impact of each design choice at Facebook can be enormous.

Reconsidering user research for agile environments

Over the last two decades, the repertoire of user research methods has been growing and we have even seen the emergence of “discount methods” [11] to tackle issues around organizational constraints and product cycles. However, as indicated by our findings (and experience reports by other practitioners [1,4,10]), innovation and product launches are often tightly coupled in agile environments. Thus, there is need to further adapt the so-called discount methods that take into account not only time and resource constraints, but also cultural factors, such as producing innovative products in a competitive landscape. The dimension of designing for a billion users may currently be a unique challenge for Facebook, but given the pace at which computing is becoming ubiquitous, it is likely that many more software products could face similar challenges of scale. We hope that through more case studies of current practices, we can better understand and improve the adaptability of user research methods in different settings.

Adapting HCI pedagogy

Along with rethinking methods, there also are pedagogical implications to consider. As in our study, user experience researchers have reported in previous studies that they have to constantly adapt their skills

when working in agile environments [1,4,10]. They rarely apply *textbook* or prescriptive approaches to their work when faced with tight constraints. In addition, they have to adapt their communication with engineers, designers, and stakeholders and have to understand when to inject UX findings in the process and what *type* of user data to inject. Since many software and web development environments are embracing agility, getting exposed to agile development constraints in the classroom could be valuable for future practitioners. Also, there is need to help future practitioners learn to deal with the challenges of scale and shifts in diversity of the user base. Perhaps exposure to more case studies from practice can help raise awareness of the constraints in different development contexts. Finally, students may benefit from getting hands-on experience with projects that simulate different types of constraints in industry.

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