

Developing a Campus Mobile Strategy: Guidelines, Tools, and Best Practices

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1. Introduction

It is predicted that by 2013 mobile phones will overtake desktop computers as the most common web access devices worldwide.¹ By just the end of this year, the number of mobile-connected devices will exceed the number of people on Earth.² People are not only using mobile devices to access websites and applications—whenever they want, wherever they want—but they are using them to produce media-rich content, make transactions, and interact with virtual environments through alternatives to pointing and clicking: touch gestures, location-based data, and voice commands. As mobile technologies expand and grow, so do the expectations and needs of web users.

From student populations to faculty and staff, nearly every user interaction that is taking place from a desktop browser is also occurring through smaller-screen phones and tablets. From visiting websites, to registering for classes, to checking final grades, people interact daily with educational institutions through mobile devices—whether anyone wants them to or not. For higher education, the time to develop a mobile strategy has never been more critical.

However, not all higher education institutions are the same. As most institutions differ by population size, technical expertise, and budgets, the spectrum of mobile methodologies, strategies, and frameworks used from one school to another can be vast. For some institutions, “having an app” might be the perfect mobile platform to engage students and alumni; for other schools, an easy-to-build mobile website might make more sense from budgeting and maintenance reasons, while others may focus on a crowdsourcing effort by deploying a campus toolkit that enables campus developers to leverage a mobile web framework for distributed websites.

The current mobile development landscape is not only incredibly complex, but it changes dynamically with every season of new devices and updated operating systems. For higher education institutions, understanding the pros and cons of various mobile frameworks and methodologies can be challenging enough. However, navigating a course toward an effective mobile web strategy can be even more difficult.

To assist institutions in the understanding and collaboration around available mobile web frameworks, an EDUCAUSE ACTI group was formed in late 2011.³ The ACTI Mobile Web Frameworks Working Group (ACTI-MWF), comprised of institutions across the United States, has met over the course of the last year not only to act as a forum for mobile strategy

¹Gartner, “Gartner Highlights Key Predictions for IT Organizations and Users in 2010 and Beyond: This Year’s Predictions Span 56 Markets, Topics and Industry Areas” (January 13, 2010), <http://www.gartner.com/it/page.jsp?id=1278413>.

²Cisco, *Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2011–2016*, Executive Summary, http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.html.

³For more information on the formation of this group, see ACTI 2011 Meeting Report by Karen A. Wetzel (EDUCAUSE, August 11, 2011), <http://www.educause.edu/node/233778>.

discussions but also draft to this document as a guide to other universities in the approach, adoption, and engagement with mobile framework strategies and initiatives.

What this document aims to do is act as a set of general guidelines and best practices to help readers form a high-level mobile strategy. The document will outline factors that should go into a strategy including mobile development options (native or web), as well as institutional factors, such as characteristics, resources, mission, goals, and needs. Once a direction is developed, the criteria within this document will also assist by offering evaluation matrices, mobile scenarios, and case studies that cover both native and web mobile deployments.

Lastly, this document is focused solely on developing educational mobile strategies and frameworks. This document is not intended to be a technical how-to guide on developing mobile offerings, nor does it provide a roadmap for policy related concerns that arise in this era of “bring your own device” (BYOD), like device registration requirements, remote shutdown, and incident response. (See Section 5.5 for more information about policy and security concerns in this environment.)

2. Making the Case for Mobility

In the 2011 EDUCAUSE Center for Applied Research report *Mobile IT in Higher Education*, Bill Allison and Kyle Bowen warn in the foreword that, while there is no one right or most popular path forward, “When considering how to support mobile technology, the only mistake is not to start.”⁴ Why is that?

Findings from industry research, higher education–focused research, and personal observations clearly demonstrate the widespread adoption of mobile technology and the growing use of mobile apps. In its 2012 update, the Pew Research Center reports that 46% of American adults own a smartphone, up from 35% in 2011.⁵ Among 18- to 24-year-olds, ownership rose 18% to 67%. Within higher education the story is the similar. In 2011, 55% of students surveyed owned a smartphone and 33% deemed smartphones as “extremely valuable for academic success,” using them to e-mail professors (66%), check grades (62%), search the Internet (59%), and communicate with other students about coursework (61%).⁶ More recent international numbers put smartphone ownership even higher. In Qatar’s Education City, 84% of students surveyed own smartphones.⁷ As smartphone adoption increases, so does the use and expectation for

⁴ Gregory Dobbin et al., *Mobile IT in Higher Education, 2011*, Research Report (Boulder, CO: EDUCAUSE Center for Applied Research, December 2011), <http://www.educause.edu/library/resources/mobile-it-higher-education-2011-report>.

⁵ Aaron Smith, *Nearly Half of American Adults Are Smartphone Owners* (Pew Internet & American Life Project, March 1, 2012), <http://pewinternet.org/Reports/2012/Smartphone-Update-2012.aspx>.

⁶ Eden Dahlstrom et al., *The ECAR National Study of Undergraduate Students and Information Technology, 2011 Report* (Boulder, CO: EDUCAUSE Center for Applied Research, October 2011), <http://www.educause.edu/library/resources/ecar-national-study-undergraduate-students-and-information-technology-2011-report>.

⁷ Eden Dahlstrom and Khalid Warraich, *Student Mobile Computing Practices, 2012: Lessons Learned from Qatar* (Louisville, CO: EDUCAUSE Center for Applied Research, May 2012): 4, http://net.educause.edu/ir/library/pdf/ecar_so/ers/ers1202/ERS1202.pdf.

applications and services. For example, a recent report states that three-quarters of American smartphone owners use location-based services.⁸ This percentage will likely trend upwards with future advances in location-awareness-based mobile learning.⁹

To conclude, mobile computing is not just a desire for incoming students, but an expectation. Incoming millennial students have immersed themselves in mobile technologies. A student today is much more likely to forget his wallet than his phone. Clearly the world's gone mobile and we must adapt.

3. Thinking Through a Mobility Strategy

Constructing a mobile strategy for a higher education institution starts with recognizing the needs, culture, and desires of the institution's community. In addition, it is just as critical to understand an institution's ability to commit resources to the creation of a robust mobile environment. Benchmarking against our peers, learning from early adopters, and reviewing the growing body of literature can further inform your approach.

Multiple studies report that, first and foremost, students want to stay connected with others and to source information with mobile devices—in order to e-mail, text, access social networking sites and location-based services, and search the Internet, among other uses.¹⁰ When asked what mobile device functions would facilitate academic success, learning management systems, access to recorded course material, registration for classes, access to grades, e-books, library searches, and homework tracking are among those most often reported. As for what schools are offering, the top-five services cited as partly or mostly mobile-enabled in ECAR's 2011 survey were: (1) primary web presence, (2) learning/course management service, (3) library catalog and other library services, (4) student recruitment and admissions, and (5) administrative services for student information. In the same survey, student services and learning management systems were identified as the “killer” mobile applications for higher education by half of the respondents. These findings provide a helpful frame of reference, though the report admits to much variation and few clear trends across schools.

Given the experience and path of early adopters, a reasonable set of milestones can be envisioned. The first mobile milestone that an institution may embark on is a campus utility mobile presence to give real-time data to the campus community. This mobile presence would be delivered as a public information channel that provides both data and functionality. While “real time,” it would not be very interactive. Sample modules include the following:

⁸ Kathryn Zickuhr, *Three-quarters of Smartphone Owners Use Location-based Services* (Pew Internet & American Life Project, May 11, 2012). Available at <http://www.pewinternet.org/Reports/2012/Location-based-services/Summary-of-findings.aspx>

⁹ Rick Oller, *The Future of Mobile Learning* (Louisville, CO: EDUCAUSE Center for Applied Research, May 1, 2012), <http://www.educause.edu/library/resources/future-mobile-learning>

¹⁰ See, for instance, the top key finding from *Student Mobile Computing Practices, 2012*: “Students are avid mobile device users and are open to expanding the ways in which they use them” (p. 2).

- News
- Events
- Directory
- Maps and tours
- Bus schedule
- Courses
- Dining
- Resources or links

Such a presence may be achieved by internal or external resources and could make use of existing data stores. Effectively, this mobile presence would be a collection of these resources pulled together to be delivered as a mobile presence or distribution channel.

The next generation of an institution's mobile presence might focus on individualized content. This phase would largely be defined by providing the institution's community with user specific, password-protected (or other mechanisms) access to data content. Checking grades, course schedule, account balances, and other user specific content might be some of the functionality provided in this evolution of mobile services.

A third-generation mobile presence could progress to password-protected access for authorized transactional activity. This version of the mobile environment could include scheduling courses and appointments, performing financial transactions, reserving or renewing library books, and even conducting university business via mobile workflow interfaces and direct enterprise application integration.

Across all of these generations of mobile capability is the need to support online and real-time communication between all university constituents, students, faculty, and staff. This support must be technical as well as cultural.

With this general set of expectations and milestones in mind, institutions need to consider how much they are willing to undertake, in what ways, and in what time frame. This is a very individualized decision, as the campus use cases in 0 demonstrate. A more detailed analysis of goals, organizational readiness, resources, and other factors as described below can inform that decision as well as any plan to move forward.

4. Developing Institutional Mobility Goals

4.1. Introduction to the Mobile Audience Model

The first step in developing a set of mobility goals is determining and listing the primary audience you are trying to serve. Higher education institutions have a difficult communications task because they are serving many audiences. If you cannot make a single group your primary

audience, then you may want to prioritize some audiences into a Phase II and Phase III set. For example, the University of XYZ's website aims to serve these audiences (Figure 1: .

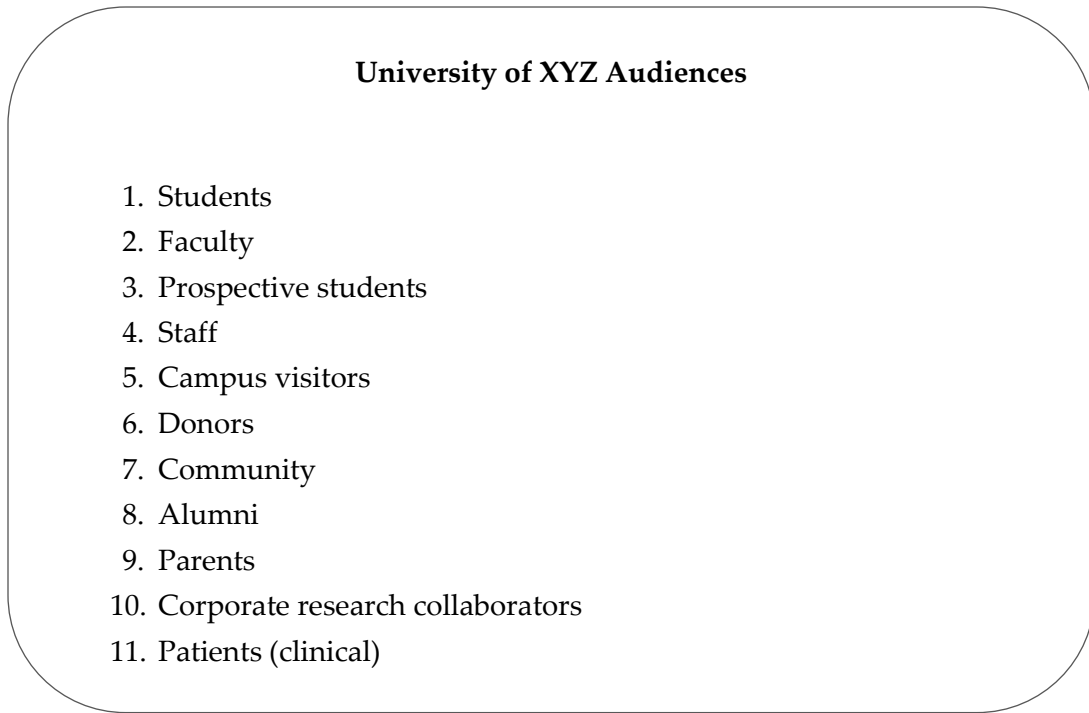


Figure 1: Higher Educational Institution Audiences

It is an understatement to declare that developing a university communications strategy is a complex task. Therefore, a first step toward developing a mobile strategy is grouping the audiences into a smaller set of manageable categories. For example, we suggest the model of examining the needs, wants, and desires of two categories of audiences:

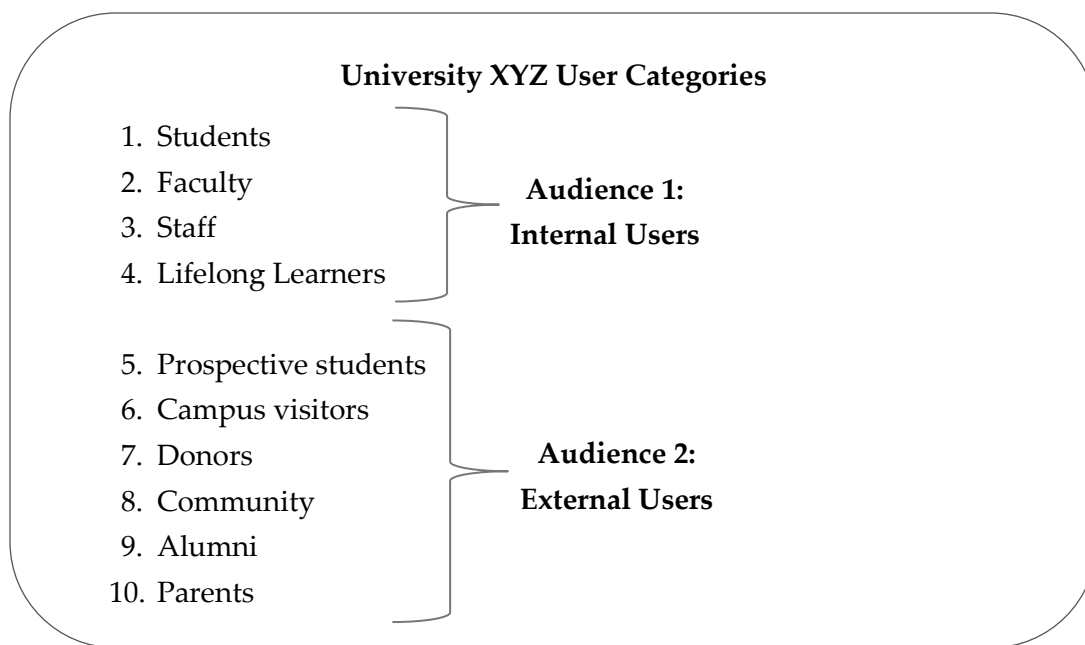


Figure 2: Mobile Audience Model

Combining the audiences into two categories is useful in formulating your mobile strategy because each grouping has particular characteristics. The first audience identifies internal users, a group that is more predictive—you know them well and already have many websites and data feeds set up to serve them. If authentication is needed, then you can be sure that you are dealing with the internal audience. In fact, you may already provide them with a specific device or family of devices with which to access your web-based resources. You probably know less about the second audience, external users, and certainly cannot possibly ensure a homogenous set of devices. These users will want mobile access to institutional resources and will undoubtedly expect your institution to support the BYOD trend. Keep in mind that users’ device preferences can border on religious conviction and, despite any incompatibilities with your applications, many will not abandon their device of choice.

4.2. Data Planning

Mobile applications typically involve at least two components: the application code itself (which may be programming code, HTML, CSS, or any combination of these and other elements) and the data that the application displays or gathers. While issues arise in association with the planning and design of the programming component, in many cases the implementation of the data component may be as or more challenging. Mobile applications present a set of data challenges and issues that may be less prominent or acute for traditional “fixed place” applications. There is a challenge of making data owners comfortable with the idea that their data will become much more readily, immediately, and widely available. Two other challenges

often arise that you should consider as you plan your mobile strategy: data consistency and data interoperability.

By “data consistency,” we are referring to the need to identify a consistent set of data sources and “dictionaries” for your campus. For example, most mobile application suites have, at their heart, a campus map (after all, mobility is all about serving a “mobile” population, and maps are central to mobility). If your campus is at all typical, you will quickly discover that there are many campus maps, not just one. Which should you use? Your facilities department will have a map that shows steam tunnels, but doesn’t show walkways. Your communications office will have a map that shows walkways but doesn’t show classrooms. And the two maps will not even show the same set of buildings because the definition of “university building” will vary from office to office: for facilities, a “university building” is something the university owns or manages. That may well not include the bookstore, and it will almost certainly not include the local convenience stores and pizzerias that your students frequent. The same kinds of basic definitional issues arise when dealing with people (who should and should not be included in your directory listing) and organizations (e.g., Is there a canonical list of “departments” at your institution? If so, who owns it, and does it match what students and faculty think of as “departments”?). One of the first steps you should take in planning your mobile strategy is to “define and delineate the data” that will form the core of your applications.

Closely related to the need to clearly identify a consistent set of core data is the need to work out how these data can interoperate across your mobile applications. A true hallmark of an application designed for a mobile device is that it allows people to click on data elements and have something useful happen (e.g., you click on a phone number and your device dials that number; you click on a location and a map comes up that displays the location). That only works if the various components of a mobile application use a common set of data elements. For example, you may be in the lucky position of having on your campus a universally accepted, canonical list of university buildings. How are those buildings identified? By name? If so, you will discover that the “canonical” building names in your list do not necessarily correspond to the names used by your students and faculty, or indeed to the names used in various university data stores. At one of the authors’ institutions, there is a building whose name appears in 17 different forms on various web pages. So your event calendar may say that an event is taking place in “Jones Hall” but your map lists the building as “Henry H. Jones Hall” (and your directory lists it as “Henry Jones Hall”) and never the twain shall meet. When a user clicks on the building name on the event display, your map will pop up and display “Building not found”! The same problems can arise with people (who, unfortunately, often have middle names or middle initials or “preferred” names and are listed in various ways by various university offices). When your “courses” application displays instructor names, it would be nice if, when a student clicks on that name, she doesn’t get a “person not found” message from your

directory application (because the registrar lists the instructor as “Bob E. Smith” and the directory lists him as “Robert Edward Smith”). Once you’ve defined and delineated your data, make sure that you have a way to make those data interoperable across the various components of your mobile applications.

In summary, as you plan for the implementation of mobile applications, try to answer the following questions:

1. Do you have a campus map that everyone agrees shows the right things (buildings, walkways, parking lots, etc.)? If not, how can you build such a map and, even more importantly, keep it up to date?
2. Do you have canonical lists of the people, places and things that make up your campus? Do all the stakeholders agree on these lists? If not, you will need to build them and find a way to keep them up to date.
3. Do you have a way to link your data stores (event calendars, course lists, directories) to the canonical lists discussed above?

4.3. Modeling IT Capacity and Resources

It is also a critical step in developing a strategy to define the IT characteristics and areas of investment for your institution. Several defining factors will likely impact the strategies you might be considering. For example, before defining your goals for mobility, you need to consider the following questions before making choices.

1. Are there available IT resources to dedicate to a mobile offering?
2. Does IT have the ability or the culture to develop a mobile web app?
3. Are there available project managers who can lead the project?
4. Does the institution have a standard development platform, or are those decisions distributed?
5. Is there a budget to outsource a mobile offering, or do I need to launch a stealth mobile pilot?
6. Is my institution comfortable with outsourcing or SaaS engagements?
7. What degree of effort is it going to take to launch a collaborative mobile effort on my campus and take it through the appropriate governance channels?
8. Should IT make decisions now and ask forgiveness later?
9. Are units charging forth with individual strategies?
10. Can I find a suitable open-source solution that I have faith in?

4.4. Potential Strategic Directions

In this next section, we will explore four very different directions that a higher education institution may take when developing a mobile strategy. Identifying a technology strategy is always a challenge because it requires trade-offs between resources, timelines, and control. Establishing an institution’s mobility priorities along with an understanding of its IT capabilities allows for the development of an optimal mobility strategic plan.

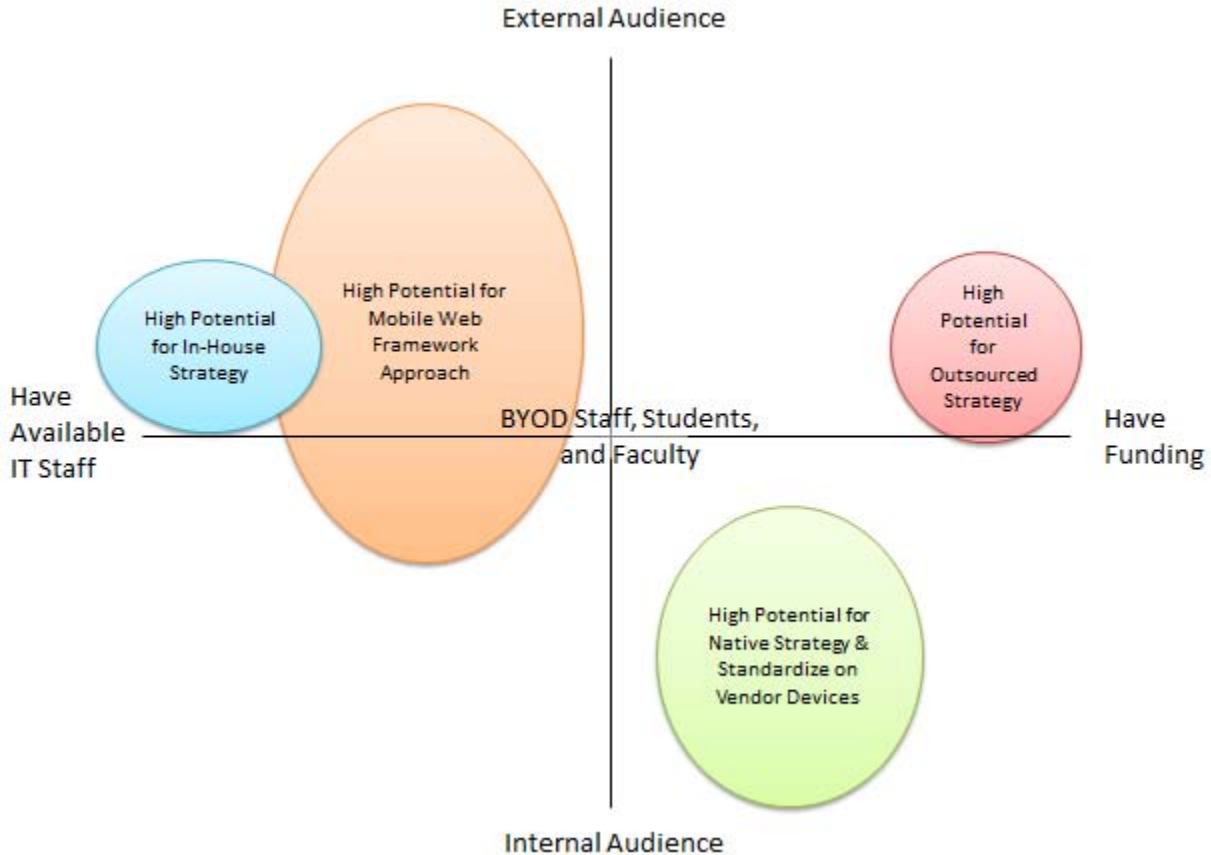


Figure 3: Mapping Audiences vs. IT Resources

When both needs and available IT resources have been assessed, they may be mapped against one another—as in Figure 3: —to model the trade-offs and determine which strategic options are available and well suited for the institution. The following sections describe scenarios that lend themselves toward each of the four strategies: Outsourced, In-House, Web Framework, and Native.

4.4.1. High Potential for Outsourced Strategy

- Our institution does not have staff dedicated to writing mobile applications, so it is important to leverage standard modules that have been developed and are in use by others. We would be potentially interested in a commercial SaaS solution.
- With a short timeline our institution needs to provide a mobile offering, mainly for campus visitors and prospective students.
- We are looking for low cost of entry into the mobile space.
- We are willing to pay for external marketing, design, proven, and well-supported products or services to handle implementing our mobile needs.
- Our institutional technologists are consumed with non-mobile priorities yet we need to get a mobile presence in place.

4.4.2. High Potential for In-House Strategy

- Our institution develops and manages many applications and already works with technologies that can be utilized for mobile development (SOA, web services, HTML5, JavaScript, CSS3, and native platforms).
- It is important to have the control to rapidly develop and deploy our mobile applications on our own schedule with robust mobile features that are constantly being enhanced.
- We are in a tough budget crunch and cannot possibly maintain five duplicative sets of code (iOS, Android, BlackBerry, Windows, and web).
- We are a highly distributed and independent institution, with many technologists eager to tackle the mobile environment.
- We already provide a basic set of mobile tools (like a directory, campus map, and news); however, we would like to focus now on targeted and secure utilities for our students, staff, and faculty.
- We want to encourage a community of practice and an empowering development environment.

4.4.3. High Potential for Web Framework or Responsive Design Strategy

- Our institution has a strong web standards development culture.
- Our web resources are constantly changing, and we want complete control over our mobile app deployment.
- It is important for our institution to have a consistent user experience, by making available a robust library of mobile objects to build campus mobile applications.
- It is important for our institution to maintain a single code base from an efficiency and a resource-optimization standpoint.

- We are interested in participating with other higher education institutions to form a community of practice and encourage interinstitutional collaboration.
- Our user base is diverse, and it is important that our mobile tools run on any mobile device.

4.4.4. High Potential for Native Strategy

- We have a strong relationship with a specific vendor. We are willing to focus on a single-vendor native strategy.
- We have enough budget to develop and maintain five very different sets of native code: XCode (iOS), Android (Java-based), BlackBerry, Windows, and web.
- We have an extremely strong developer culture and enough mobile expertise to use code generators like PhoneGap successfully, even though they are constantly evolving.
- It is important for our institution to offer native applications on iPhone, Android, BlackBerry, and other popular phones/devices.

5. Developing Your Campus Mobile Initiative

5.1. Forming Mobile Governance

When forming mobile governance on campus, three phases emerge (1) Engaging the Stakeholders, (2) Building a Mobile-Enabled Web Community, and (3) Defining the Governance Process. These phases can be thought of as a set of challenges that need to be addressed as part of the overall mobile initiative, but they do not necessarily represent a temporal sequence. Each school that seeks to develop a mobile strategy will have its own institutional culture, and this will largely dictate which of the three phases need to be pursued, and in what order. While “Engaging the Stakeholders” may be a good first phase at an institution that has a culture of top-down, highly managed approaches to innovation, “Building a Mobile-Enabled Web Community” may make more sense as a first phase for an institution that has a more distributed approach to planning for innovation. Regardless of the specific order, it makes sense to break down the mobility planning effort into these phases, as they will likely work well at most institutions as a way of organizing that breakdown.

5.1.1. Phase I: Engaging Institutional Stakeholders

In academia, IT leadership often times involves forming a “coalition of the willing” with regard to moving forward into new technological arenas, especially when those arenas are rapidly evolving, as is the case with the mobile computing landscape today. At the outset it may seem a daunting task to find and engage stakeholders who have an interest in having a mobile presence, the will to see its development through, and, most importantly, resources they are willing to contribute to the cause. However, this early phase of the project, which can be

categorized as “forming” or more traditionally, “planning,” is a critical step in gaining project momentum, creating a project vision, and starting the “Engaging the Stakeholders” phase.

Defining the appropriate stakeholders to approach is highly dependent on each institution’s organizational culture and structure. It is also worthwhile to note and consider that inviting these participants to collaborate may be met with a variety of responses, including those not wishing to engage. It is wise to prepare for these meetings with a well-thought-out methodology for the strategy you decide to pursue. On your governance committee, you will want to be sure to have broad participation to bring unique perspectives to the development process. These will include institutional stakeholders that represent both service providers and data stewards, pulling from departments such as marketing/communications, registrar, events staff, facilities, library, housing/dining, athletics, and IT. However, you will also want to consider including audience group representation, building on extant relationships with student government leaders or the faculty senate.

One of the surprising things you may encounter while engaging stakeholders is that not all of them will share your excitement about the development of mobile applications. Indeed, some may see such applications as problematic, and even “dangerous.” The general impetus for the development of mobile applications is to make more information available to more people in a more timely fashion. But there are people on our campuses whose job it is to limit access to information, even what you might regard as “public” information. For example, many mobile application suites include the ability to display campus events, and making those events easily viewable on mobile devices would seem to be universally desirable, but it may not be desirable, for instance, for those who are concerned with limiting attendance (for very legitimate reasons). Similarly, many schools strive to make course availability, and even course enrollment, accessible on a mobile device, but a dean may worry that registering for courses on a mobile device encourages a casual approach to course selection. As you prepare to meet with stakeholders, think about the concerns and objections they may have to making data more widely and easily available, and make sure you are prepared to address those concerns.

5.1.2. Phase II: Building a Mobile-Enabled Web Community

The second phase of this process consists of proposing a campus mobile strategy (see Section 4 for more information on developing your strategy), and then doing the leg work to advocate for it.¹¹ Regardless of the strategy selected, it is important to communicate your direction and roadmap so that the data stakeholders and campus developers understand your end goals and how you plan to accomplish them. A key component to building a community of collaboration

¹¹ See, for example, the “UC Berkeley Campus Mobile Strategy” (August 17, 2010), <https://wikihub.berkeley.edu/display/itac/UC+Berkeley+Campus+Mobile+Strategy>.

is gathering input and then enabling participation on an opt-in basis. This is the quickest way to build the needed momentum and resource base.

Once you have a strategy, you can propose a pilot mobile presence and how to engage the “willing coalition” of stakeholders who will work together to make it happen. A critical factor is the timing of this phase, which requires engaging or even crowdsourcing at two levels: (1) the developers/web publishers, and (2) the core campus data stakeholders, such as the registrar, the student affairs organization, and the director of campus marketing or communications. The ideal timing scenario exists when stakeholders are aware of and prepared to participate in the campus mobile initiative. In such a case, you may want to schedule a large kick-off meeting to keep the excitement going and to get the project started. At this meeting, form focus groups to manage all the critical tasks. On the other hand, if you are ahead of the stakeholders in understanding and willingness to implement a campus mobile initiative, you will have to do the hard work of setting up one-on-one advocacy meetings with various data owners and their developers, and sell the benefits of participating in a collaborative campus strategy. Lastly, if you are lagging behind the stakeholders, then various campus resources may have already been dedicated to implementing unit-specific mobile strategies. This situation will also require one-on-one meetings with data owners and campus stakeholders to guide them towards a single campus solution. In this case, there will be a need for you to sell the benefits of a campus-wide mobile solution.

A strong example of a campus that has selected a mobile web strategy and focused on delivering a mobile framework with a developer-enabling, self-service environment is the University of California, San Diego. UCSD has built a compelling mobile developer toolkit for their campus developers to use as an easy reference tool.¹² The toolkit includes, for instance, guidelines and styles, an HTML5 template, governance guidelines, and a model service-level agreement (SLA). For another well-done mobile web framework strategy site, see Texas A&M’s Go Mobile website.¹³

5.1.3. Phase III: Defining a Mobile Governance Process

Once you have such an effort under way, the question of building a governance model is the next step. In some cases, an organic governance model can evolve out of Phase II because major stakeholders who commit resources can be asked at the time of their commitment if they would want to participate on a Campus Mobile Pilot Steering Committee. It is important to leverage the power of the word “pilot” in these initiatives and not make long-term commitments, but instead try out processes to see what works. However, other campuses have successfully been

¹² See the UCSD Campus Web Office “Mobile Web” site for more information, <http://cwo.ucsd.edu/mobile/>.

¹³ See <http://gomobile.tamu.edu/> for the Texas A&M Mobile Strategy as well as information on development and other resources.

able to utilize their existing web portal governance model, and these bodies have agreed to guide their campus mobile strategy efforts.

5.2. Gathering Requirements

Every institution has different characteristics, needs, and priorities. Needs, of course, are influenced by factors such as primary audience, resource availability, and institutional mobility goals, as detailed in Section **Error! Reference source not found.** Once the overall institutional needs and goals are determined, then it is critical to define a more detailed and prioritized list of requirements in order to analyze, review, and select the end product or option. The requirements, priorities, and resources available will ultimately drive the framework selection. Start with the “must haves”. For example, if your institution lacks the resources to build or maintain such a system, then the product “must” be a hosted solution. If your institution mandates a specific campus branding, then the product must be easily “skinned” or customizable.

5.3. Understanding Your Options

There are a plethora of choices for implementing an institutional mobile solution that continually change and fluctuate in this fast-moving realm. It is essential to understand the types of options available in conjunction with your institutional requirements, priorities, and resources in order to focus on the most relevant options.

By understanding the spectrum of mobility options available, your academic institution can select the one that best fits your organizational culture. In this section, we will provide an overview of the various mobile technologies that a campus might select. To avoid chasing the latest technologies that seem to pop up each day, we will discuss only categories of technologies rather than specific products, technologies, or options. (For a sample list of mobile technologies and products for each of the following categories, see 0.)

5.3.1. Higher Ed Mobile Web Frameworks

Universities’ needs are often diverse, encompassing a wide range of areas, from academia to administrative, medical, research, financial, and personnel. The primary target audience will differ from one department to the next, which will have an impact on many of the strategic decisions that are made. Because of these unique needs, institutions of higher education often build their own solutions with a very specific focus. In addition, other institutions leverage these solutions to address similar needs. Sometimes sharing occurs informally, and sometimes solutions are packaged formally and licensed as finished products.

The mobile arena is no exception. This product category consists of frameworks that are built out of higher education collaborative efforts to address the overall mobility needs of a

university. These products are mainly open-source efforts and emphasize integration into current campus systems. Their installations typically include common university mobile tools like maps, directories, news, calendars, and courses but can often be extended to support standard data feeds. The advantage to this approach is that you can leapfrog the design and development of many of the common functionality by simply plugging standard data feeds into an existing infrastructure.

5.3.2. Packaged/Hosted Solutions

Mobile applications typically involve two distinct components: (1) a program, or set of programs, which format and display data, and (2) one or more data “feeds,” which the program consumes. One approach to developing a mobile application suite is to separate these components and farm out the programming component to a third-party vendor. Your institution can then focus on developing the data feeds, and the vendor can focus on developing the applications. There are a number of distinctive advantages with such an approach, foremost among which is that it can generally cut down on development time (since your institution is only doing one part of the work). Typically, the vendor will have a set of prebuilt applications, along with a specification of the data feeds that these applications can accept (e.g., XML, iCal, JSON, RSS, etc.). In many cases, you can have a mobile application suite up and running in a few days (even a few hours) if you have the right kind of data feeds available on your campus.

Another advantage to this approach is that you do not need to have any mobile application developers on your staff, which can be particularly attractive, given the fact that mobile devices come in many “flavors” and developing apps for them entails staff having expertise with a number of platforms (e.g., iOS, Android). The downside is that you have to take what the vendor gives you. In some cases, the vendor will offer an SDK allowing you to do some of your own development, or may be willing to develop or modify their apps to suit your needs (for a price!), but this may not always be the case. If all that you want is a basic mobile application suite, and you do not have, and are not willing to acquire, an in-house development staff, then adopting a packaged solution (generally hosted) may be a good first step.

5.3.3. Native Apps and Code Generators for Native Devices

A native app is an app for a certain mobile device (smartphone, tablet, etc.) that is installed directly onto the device. Users typically acquire these apps through an online store or marketplace such as Apple’s App Store or Android apps on Google Play.¹⁴ It is built specifically for that device and can leverage the native functionality of the device like the camera or file system. Native apps are written with a required programming language, such as Objective-C

¹⁴ Apple iPhone App Store is available at <http://www.apple.com/iphone/from-the-app-store/>; Google Play Android Apps is available at <https://play.google.com/apps>.

for iPhone and Java for Android. Native apps typically perform faster and get built-in marketing through the online app stores. It's best to write native apps when there's a need to access the device features, information, and hardware. Since there doesn't appear to be a slow-down in new devices and mobile operating systems entering the market, code generators are often seen as the biggest bang for the buck as tools to help develop apps for deployment on multiple mobile OS platforms and web browsers. With these tools, developers can write one set of code and the tool generates the appropriate code for specific devices like iOS, Android, Windows, BlackBerry, Symbian, webOS, Bada, etc. There are some limitations for accessing the device features when using code generators, so it is best to use code generators when there's a need to create native apps for a wide range of devices with limited programming resources.

5.3.4. Mobile Web Apps and JavaScript Libraries

Mobile websites, also known as mobile web apps, are similar to standard websites in that they consist of browser-based HTML pages that are linked together and accessed over the Internet. They are, however, designed to run on the smaller handheld display and touchscreen interfaces. In addition to the standard website capabilities, mobile web apps can take advantage of mobile-specific features like location-based mapping or click-to-call. Since mobile web apps run on the device's web browser, they can deliver mobile-friendly content to the widest possible mobile audience. There is no need to download and install an app on the mobile device itself. Mobile web apps are written in HTML, CSS, JavaScript and server-side languages or web application frameworks of the developer's choice (e.g., Java, PHP, Rails, .NET, or Python). A JavaScript library is a library of prewritten JavaScript modules and features that allow for easy development of mobile web apps or websites. Examples of JavaScript modules within a mobile framework may include user-interface elements, as well as feature-rich actions for animations and page transitions. The greatest benefit of implementing mobile web apps is writing and maintaining just one set of code across all platforms. Other benefits include not needing to download and install an app and making updates to the app (on the web server) without user intervention.

5.3.5. Responsive Web Design Frameworks

The number of devices, platforms, and browsers are continuing to proliferate. Responsive web design (RWD) is an approach to web design in which a site is crafted to provide an optimal viewing experience across a wide range of devices (from desktop computer monitors to mobile phones).¹⁵ A responsively designed website is one that responds to the device that accesses it and delivers the appropriate output for its screen size. Rather than designing multiple sites for different-sized devices, this approach designs one site but specifies how it should appear on

¹⁵ Ethan Marcotte, "Responsive Web Design," *A List Apart* 306 (May 25, 2010), <http://www.alistapart.com/articles/responsive-web-design/>

varied devices. As a result, users will have access to a single source of content, laid out so as to be easy to read and navigate with a minimum of touch-based navigation gestures, including pinching, zooming, and scrolling. RWD is the newest technical solution for creating and delivering a pleasing mobile experience. An upfront investment is needed to design the web application with RWD best practices in mind; however, the long-term benefits make up for that investment. The end result is a single website or web app that that looks and feels custom-made for any device and browser, mobile or not. In order to save time, there are RWD frameworks available that bundle libraries and functionality and ensure compliance on various browsers. This approach is recommended to save time. Only if precise control over all aspects of the web app is desired is building the site or app from scratch recommended.

5.4. Product Comparison

Having a short list of “must have” requirements and product options is important, however researching, reviewing and comparing products and options can still be a daunting task, especially in the rapidly evolving mobile realm. To more easily assess and compare potential options, a detailed list of evaluation criteria has been provided in the form of a product evaluation worksheet (see Appendix D). These categories have been thoughtfully identified to account for the review of all aspects of an option. In addition, this resource will guide you in what to consider when finalizing your institution’s requirements and priorities. The following is a broad description of the criteria categories extracted from the product evaluation worksheet:

- **General characteristics:** Type of product, cost considerations, maturity level, community engagement, and future roadmap
- **Technical requirements and interoperability:** Hardware and software requirements; supported devices.
- **Implementation and support:** Implementation complexity, required skill set, documentation, training, and community support
- **Licensing:** License and usage model; support costs
- **Security:** Authentication and authorization capabilities, web security, and local data storage needs
- **Performance:** Size and overhead, scalability, and graceful degradation
- **Design and development:** UI components, customizability, accessibility, data integration, user preferences, and branding
- **Marketing:** Usage analytics, native app deployment, and marketing
- **Modules and add-ons:** Out-of-the-box features, community-contributed modules, and app-sharing environment

5.5. A Note about Policy and Security

Generally speaking, policy and security are often afterthoughts when new functionality beckons. In a rush to catch the latest wave, the mobile web in this case, developers, business owners, and users may simply forget to consider the policy and security implications of the new paradigm. Further, existing policies and security requirements may need to be adapted, given new threat and usage models. Regardless of your strategy or tool selection, your institution is going to depend on you to think through the potential policy and security impacts and to make recommendations to guide them.

At a minimum, review existing policies and security requirements as well as existing parallel functionality to be sure that your planned approach and projects won't circumvent policy, security, and even service management standards and requirements. Engage your information security team, business owners/data stewards, and application developers to help you think through issues such as: reporting and handling incidents; using new capabilities such as geo-location (and understanding the potential security and privacy implications thereof); weighing the security and policy trade-offs between native apps and web apps; and determining whether to set mobile application development standards and policies. Consult standards and guidance for the current state of secure mobile web application development and implement your software development life cycle accordingly. One useful source is the Open Web Application Security Project (OWASP) Mobile Security Project.¹⁶ In collaboration with the European Network and Information Security Agency, OWASP also published its *Smartphone Secure Development Guidelines*.¹⁷

Regardless of which standard you adopt, be sure to build security and policy discussions into your mobile web initiative from the outset to avoid complications later.

6. Conclusion

With every season of improved technology and advanced hardware, the number of people using mobile devices continues to escalate. From accessing websites to using mobile applications, users are interacting with their world whenever and wherever they want. This mobile flexibility and convenience brings with it serious challenges. IT and communication staff must meet not only mobile users' growing on-demand needs but also their increasing expectations as they integrate mobile connectivity into their daily lives. For higher education, this means delivering a robust mobile experience to a variety of populations—from prospective

¹⁶ The Open Web Application Security Project (OWASP): Mobile Security Project, https://www.owasp.org/index.php/OWASP_Mobile_Security_Project.

¹⁷ European Network and Information Security Agency (ENISA), *Smartphone Secure Development Guidelines for App Developers* (November 25, 2011), <http://www.enisa.europa.eu/activities/Resilience-and-CIIP/critical-applications/smartphone-security-1/smartphone-secure-development-guidelines>.

and current students to staff and alumni—who want to be constantly connected to the university.

However, developing a mobile initiative involves more than just arbitrarily deciding to build a mobile website or opting to launch a mobile app. An effective mobile initiative requires a thoughtful and well-planned strategy. Creating an effective higher education mobile strategy is a progressive undertaking. It offers not only a focused set of prioritized goals that account for the needs, culture, and desires of the institution’s community, but is flexible enough to adapt to the ever-changing mobile landscape and supporting technologies.

An effective strategy takes advantage of a university’s strengths—through variables such as in-house development expertise, data infrastructures, and finances—and leverages them to form a sensible mobile framework. This framework should not only build community but also effectively engage user groups while ultimately allowing users to personally communicate and connect with an institution on a variety of platforms accurately and efficiently.

An effective strategy is realistic in its scope and sustainable by the technical expertise and staffing of an institution. It is critical to understand an institution’s ability to commit resources to the creation of a robust mobile environment and to maintain it.

An effective mobile strategy takes into account the institutional culture and how mobile governance is formed. Regardless of the path chosen, any mobile presence should strive to engage institutional stakeholders into forming a robust and “on board” collaborative mobile community.

Finally, there is no a one-size-fits-all solution for an effective mobile campus strategy. However, by understanding the wide variety of options in the mobile landscape and taking the time to walk through each of the necessary steps to build your campus’s mobile initiative, you are much more likely to find and develop the best mobile solution to suit your institution’s specific needs.

Appendix A: Mobile Strategies—Campus Scenarios and Use Cases

In an effort to give concrete examples to mobile initiatives, we are including here a set of sample use cases. These use cases consist of anecdotal accounts from ACTI Mobile Web Frameworks Working Group members and do not encompass all possible scenarios.

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A1. Providing an iPhone Application

Mojgan Amini, Director of Middleware and Identity Management, ACT

University of California, San Diego

<http://www.educause.edu/members/mojgan-amini>

In 2009, the University of California, San Diego’s main mobile strategy was to provide an iPhone application to serve as an extension to our campus website. The target audience was the general university community, including campus visitors and prospective students.

Goals:

- Time to market was key. It was important to be among the first universities to offer an iPhone application.

Requirements:

- Provide basic campus services (news, maps, directory, athletics, course catalog, shuttles).
- Serve the university community (campus visitors, prospective students, current students and staff).

Resources:

- **Staff resources:** We had no staff with native iPhone development skills, but many staff members had knowledge of the university’s key data sources. In addition, we had staff members with coordination skills and university-wide contacts.

- **Data resources:** We had extensive data warehouse, web services, and real-time data feeds of key data.

Outcome:

UC San Diego hired a third-party start-up company to implement the university's mobile presence, namely an iPhone app in the App Store, and soon after, a BlackBerry app. The entire implementation was completed in a few months. The cost was nominal and existing personnel with data knowledge were used to efficiently provide the data feeds. Our university became the first public university with an iPhone app. The key stakeholders were pleased with this accomplishment, and the users had a sense of pride for their app.

A2. Enhancing Existing Offering

*Mojgan Amini, Director of Middleware and Identity Management, ACT
University of California, San Diego*

<http://www.educause.edu/members/mojgan-amini>

In 2010, the University of California, San Diego's main mobile strategy was to enhance the university's existing mobile offering, which consisted of an iPhone application and a BlackBerry application providing basic campus services like news, maps, directory, athletics, course catalog, and shuttles. The native apps were developed and maintained by an outside company. There was a need to provide more unique and personalized tools as well as support for new mobile devices, something that the outside company could not keep up with. The target audience was originally the general UCSD community, including campus visitors and prospective students, and was expanded to focus on current students and staff.

Goals:

- We need a **campus-wide** mobile strategy that allows for rapid deployment of consistently branded mobile apps across the campus.

Requirements:

- Support Android and all other mobile platforms (even those we don't know about yet).
- Focus on targeted and secure utilities for current students, staff, and faculty.
- Have control to rapidly develop and deploy our mobile applications on our own schedule.
- Allow cross-campus participation in the development of mobile apps, ideally with little training for development.
- Ensure a consistent user experience, even if mobile tools are developed and hosted by different departments.

- Ensure that it's easy to migrate to a new technology in the future, since the mobile realm is so fast changing.

Resources:

- **Staff resources:** We have a good number of dedicated technical personnel who currently build and maintain our web applications both centrally and across the campus departments. They have experience with various programming languages. They have very little experience developing native mobile applications.
- **System resources:** We have an extensive system infrastructure, including a virtualized and secure web farm, high-speed databases, high-speed networks, and fully monitored infrastructure. This infrastructure supports all the centralized campus services, including enterprise web applications. We have a dedicated team to support this infrastructure.
- **Data and application resources:** We have an extensive central data warehouse, web services, and real-time data feeds of key data. We also have decentralized data sources managed across the campus. We have hundreds of enterprise-wide web applications, developed in-house, both centrally and decentralized across the campus. Each campus department may be using different technologies, and we do not want to enforce one particular programming language or technology.
- **Governance:** We have an existing Campus Web Steering Committee that discusses and determines what information and services get showcased on the university's main website. This team can be leveraged to steer mobile services as well.

Outcome:

Our university selected a standards-based, lightweight mobile web framework, the MWF, which could be installed, implemented, and managed on our existing central servers.¹⁸ This solution allowed campus departments to leverage the framework from their own servers without changing their existing application technologies or programming language. The end result was a uniform campus mobile offering that could be accessed from any device, not just the iPhone or BlackBerry. With the involvement of other campus departments, the university's mobile tools quickly grew to include even more tools, such as secure student portal, interactive maps, key dates and events, virtual tours, dining menus and hours, local weather, bookstore catalog, library services, and social media. Existing hardware, software, systems, personnel, and governance was used for this effort. The key stakeholders are pleased with this accomplishment because it is a strategy that can grow with the university into the future.

¹⁸ The UCLA Mobile Web Framework is available at <http://mwf.ucla.edu>.

A3. Multipronged Approach after Initial Offering

Alan Takaoka, Manager of Programming, Web Services, NSIT

University of Chicago

<http://www.educause.edu/members/alan-takaoka>

The University of Chicago initially contracted with Blackboard Mobile (formerly Terribly Clever) to release a first offering of a central mobile app in late 2009. After this initial foray into mobile, the University of Chicago's IT Services formulated and executed a mobile content strategy during the 2011–12 academic year. One of the primary pieces of this strategy was to evaluate alternatives to the Blackboard Mobile app that would allow the university to have greater autonomy and flexibility (specifically, with turning items on and off and authentication.)

Goals:

- Find an alternative to the university's initial central mobile app offering that better suited our requirements for flexibility and more rapid development.

Requirements:

- The ability to provide equivalent functionality to both Android and iPhone platforms as easily and consistently possible.
- Seamlessly replace the existing Blackboard Mobile app in terms of functionality and user experience.
- Result in a solution and process that can be maintained with the resources available to us.

Resources:

- **Staff resources:** Our Web Services team has experience of building and maintaining web applications in various languages, interfacing with various new and legacy administrative systems around campus. We also have experience in good design, enforcing university visual and communication standards on the web, and usability. We also have iOS development expertise.
- **System resources:** IT Services has multiple data centers able to support any "flavor" of virtual or dedicated hardware. We have full support at the OS level for Windows and Red Hat Linux. We also have full support on the database end in Oracle, SQL Server, and MySQL.
- **Data and application resources:** IT Services maintains hundreds of homegrown and commercial applications that support the administrative functioning of the university. This includes data warehouses and business objects, the central student and course management system, the HR system, various financial systems, various facilities

management systems, the primary web portal (uPortal), and more. Our group (Web Services) is generally able to get access to data in any of these systems either with direct access, data feeds, or web services.

- **Governance:** Web Services currently drives the decision-making process regarding the university's central mobile app by seeking out and combining feedback from key areas.

Outcome:

Jasig's uMobile was a front runner from the beginning given our heavy administrative investment in uPortal as the university's central web portal for all students, staff and faculty. With uMobile being tightly integrated with uPortal and developed by the same team, the potential for integration in the future and bringing campus portal functionality to mobile devices was very compelling. Once we were able to develop a proof of concept using uMobile that covered all the existing functionality of Blackboard Mobile app, it was clear uMobile was the way to go. Being able to deliver this proof of concept required the learning and adopting of new skills for our group, the primary example being the ability to use Appcelerator Titanium to develop and deploy uMobile native applications for Android and iOS. Our previous iOS experience came in handy in terms of making the resulting app publishable to iTunes and our extensive JavaScript experience was applicable to Appcelerator's development. By mid-December we will have replaced the Blackboard Mobile app with our uMobile app in iTunes and Google Play Store.

A4. Changing Frameworks

Serge Goldstein, Director of Academic Services

Princeton University

<http://www.educause.edu/members/serge-j-goldstein>

Princeton University implemented the Blackboard Mobile Central framework in December 2010. Since that time, we have developed a robust and wide-ranging set of modules, which are extensively used by our campus community. By summer 2012, we had fully implemented all of the Mobile Central functionality, and were looking to go beyond that functionality to add our own modules. We discovered that this was difficult to do using Mobile Central for anything other than iOS devices.

Goals:

- Move to a platform that would allow us to write our own modules without having to learn iOS programming.
- Move to a platform that would equitably support a wide range of devices.
- Move to a web application, as opposed to a native-application platform.

Requirements:

- The framework had to support web application delivery, and provide a wide range of built-in support for standard mobile functionality (news, events, courses, etc.).
- The framework would not require iOS expertise to implement.
- The framework was backed by a support organization.
- The framework was expanding and had a significant existing customer base.

Resources:

- **Staff resources:** We had no staff with iOS skills; we had staff with Java and PHP experience.
- **Data resources:** We had staff with extensive SQL and PL/SQL experience and could build web feeds in XML using PHP, Java, and/or Python.

Outcome:

We researched the existing open-source framework space and, after trying out various frameworks and engaging in discussions with colleagues at other institutions, we selected Kurogo to replace Blackboard Mobile Central as our next-generation mobile framework, with Modo Labs providing support. As of this writing (November 2012) we have ported most of our Blackboard functionality to Kurogo. This task was greatly facilitated by our having developed a set of web services (feeds) that delivered key institution data and that could be plugged into various Kurogo modules. We are targeting a rollout of the new mobile application suite, m.princeton.edu, for January 2013.

A5. Late Majority Adopter

*Mary Ann Blair, Director of Information Security
Carnegie Mellon University
<http://www.educause.edu/members/mary-ann-blair>*

In 2010, there were few compelling educational uses of mobile computing and few institutional drivers of other sorts to motivate the university to adopt a campus-wide mobile strategy. While a brainstorming exercise identified dozens of applications as “can-be mobilized,” “should-be mobilized,” and/or “low-hanging fruit,” representatives from central IT recommended that mobility not be a “man on the moon” type of initiative led by a single IT director, but should be reviewed and handled by each IT director as appropriate. Potential next steps were identified for each to consider.

Goals:

- Develop a roadmap toward assessing gaps (user requirements and current use versus current delivery/support).
- Look at existing projects and services through the “IT mobility” lens.
- Define “support” for mobile devices.
- Use planning retreats to refine and define our role in this space.

Requirements:

- Document requirements over time as determined by emerging business drivers.
- Look for opportunities to incorporate mobility into existing projects as appropriate and to enable mobile adoption.
- Monitor the mobility landscape to inform future directions.

Resources:

- Each directorate has a diverse technical talent pool spanning web application development, database management and programming, information architecture, service-orientated architecture, various operating platforms, and programming languages. They have limited experience developing native mobile applications.
- Several major enterprise efforts are mid-flight and are consuming available resources.

Outcome:

By early 2012, a few sample tests in the mobility space occurred or were considered, such as adopting third-party mobile offerings and developing a single sign-on interface as an enabler for future growth. While the CMS is capable of responsive HTML, campus templates do not incorporate responsive HTML. Student groups have emerged as a forum for mobile app developers to collaborate on software and to share knowledge. Some departments have deployed trial mobile apps. One sticking point on the mobile app front is identifying who will be named enterprise developer and who therefore must do the administrative work to get someone else's app published. To work around bottlenecks, individuals created individual app developer accounts. Tying these back to the enterprise account may prove difficult.

As of 2012, only six or so app developers emerged across academic, administrative, and research populations.

The only enterprise app is a pocket guide to the university. It includes functionality to see what's happening at the university, search the campus directory and add contacts, view campus maps including finding your current location, link to websites, and download theme songs and mascots. This app hasn't been updated in over a year.

For this institution, there have been few perceived downsides to delaying adoption of a mobile strategy. There has been insufficient customer and business demand to drive investments in mobile web and native apps. When that changes, this institution will seek to benefit from the lessons learned by innovators and early adopters.

A6. Responsive Strategy Using HTML and CSS

Christopher Ward, Assistant Director of Web Services

Kennesaw State University

<http://www.educause.edu/members/christopher-matthew-ward>

Kennesaw State University's main mobile focus is to build adaptive websites using HTML and CSS with media queries. The university already has a large HTML web-authoring community

that maintains individual departmental sites using programs like Dreamweaver and Contribute. A centralized internal web group assists departments with the development of responsive templates and theming while also adding training in maintaining the sites.

The target audience for the first departmental sites to incorporate responsive design includes those with high populations of 18–22 users (e.g., Student Life, Undergraduate Admissions). However, this strategy is gracefully expanding to any campus site that meets the needs of the general university community, including campus visitors, prospective students, faculty, and staff.

Goals:

- Build “future friendly” websites that optimize the end users’ web experience regardless of device, screen size (including feature phone, smart phone, tablet, or desktop), or operating system.
- Allow departments to create an app-like experience with existing in-house expertise.

Requirements:

- Sites render correctly in main desktop browsers, including Chrome, Firefox, Safari and IE8+
- Sites render correctly in main mobile browsers, including Safari mobile, Android browser, Chrome, Opera Mini, IE9, BlackBerry browser, and other WebKit browser engines
- Site has to be easily maintained by nontechnical personnel

Resources:

- **Development resources:** The university has a centralized internal web group that has expertise in developing responsive sites in HTML and CSS. This group also has a minimal device “testing lab,” which includes iOS, Android and BlackBerry phones and tablets.
- **Staff resources:** Each academic and administrative unit has a designated Web author who maintains site content. These individuals use programs like Dreamweaver and Contribute to manage their sites.

Outcome:

As of June 2012, our university has launched three responsive websites and received favorable feedback from our target demographic. The display and functionality of the sites on phone and tablets have allowed the departmental units to leverage the “cool factor” of having an app experience while not being tied down to specific platforms and/or devices. Students can now save the mobile sites to their home screens and have them launch just like an app without having to do an install. Additionally, the smaller screen experience has added increased functionality, including the ability to easily call, e-mail, and instant message from the responsive sites.

From a maintenance standpoint, our end users have been pleasantly surprised at how they have been able to manage their technically complex sites easily and efficiently with Dreamweaver and Contribute.

Lastly, responsive web design has been an “easy sell” to our university’s academic and administrative departments. They quickly grasp that the responsive mobile web can not only meet the needs of their users (wherever they are and on any type of device), but that they have not been locked into developing for existing devices and that their sites will easily adapt to any system with a browser for the foreseeable future.

A7. Crowdsourcing the Campus Mobile Environment at UCLA

Rose Rocchio, Director of Educational and Collaborative Technologies, OIT

University of California, Los Angeles

<http://www.educause.edu/members/rosemary-rochio>

UCLA began focusing efforts on developing a mobile strategy in support of students and broad academic and research innovation in the fall of 2009. The pros and cons of using a native mobile approach versus a mobile web framework were weighed, and a decision to focus on the latter was made for several reasons:

- This approach would allow the UCLA community to utilize their device of choice to access UCLA information, resulting in the broadest possible mobile content distribution.
- A mobile web approach would allow UCLA to present a unified mobile presence to the user while providing a flexible and distributed architecture.
- Web browser security (HTTPS) is known to provide formidable encryption protection for sensitive data.
- Using a browser-based approach significantly reduces the maintenance of distributing content to mobile devices.

This being decided, UCLA’s journey to a mobilized campus experience can be described by exploring our process of developing goals, our specific requirements, and the resulting outcomes.

Goals:

- Deliver critical mobility data streams (campus directory, BruinBus, news, etc.) to the broadest possible mobile campus audiences.
- Engage the campus web development community around a collaborative and standards-based mobile approach.
- Develop a campus-wide collaborative mobile strategy in support of broad academic and research innovation.

Requirements:

- The approach for a large public institution must be device agnostic. The UCLA community must be able to utilize their device of choice to access UCLA information, resulting in the broadest content distribution.
- UCLA must be able to present a unified mobile presence to the user.
- UCLA requires the flexibility of distributed mobile web framework architecture, where mobility applications work with the campus infrastructure but remain under the control of the functional and data-curating experts.
- UCLA researchers must be able to conduct research with BYOD participants.
- UCLA requires secure and formidable encryption protection for sensitive data.

Resources:

- Strong and committed open-source, community-development culture.
- Strong leading-edge technologists with computer science and IT expertise.
- UCLA has enough resources to have created and launched over 1,500 independent web domains.

Outcomes:

In the fall of 2009, it became clear that for UCLA—a large and very distributed public, research-focused university—the most efficient choice of platform to provide mobile content was a mobile web framework. At the time, the only prominent open-source mobile web framework was iMobileU, led by MIT. Unfortunately, iMobileU was completely server-centric, requiring all mobile applications to reside on a single server. This architecture was too centralized to fit UCLA’s strongly distributed culture and our need to leverage flexible technology platforms (e.g., .NET, PHP, Java, and Ruby).

For UCLA’s distributed IT culture (there are more than 25 distinct IT units on campus), UCLA built the mobile web framework in such a way such that a single campus mobile presence can be comprised of mobile web applications that are developed in any language and hosted in a distributed manner across any number of campus data stakeholders.

For a look at UCLA’s ongoing mobility efforts, see <http://m.ucla.edu>.

A8. Mixed Approach

Lori Tirpak, Director of Enterprise Systems

Oakland University

<http://www.educause.edu/members/lori-tirpak>

Oakland University has a small development staff mainly providing support for our university Portal based on Jasig uPortal. We started reviewing mobile options in 2011. At the same time, some of our departments, as well as communications and marketing staff, were working on making web pages that are mobile ready. They are not responsive websites.

Goals:

- Our university president, who wanted to have an app, gave funds to a faculty member to create one for the iPhone and Android. The faculty hired students to work on this project. Central IT was only involved as advisory in the beginning but obtained licenses needed to release app.

Requirements:

- The app was to have basic campus information including maps and news.
- The target audience was the general university community, including campus visitors and prospective students.

Resources:

- **Staff resources:** We had no staff with mobile development skills; we had staff with Java experience.
- **Data resources:** We had staff with extensive Banner knowledge with SQL and PL/SQL experience.

Outcome:

Central IT obtained the Apple license and was to approve code. Faculty created an app using a Appcelerator Titanium Mobile framework. The app was created mistakenly ignoring licensing and copyright regulations and reflected a student design aesthetic. The app had so many license issues that central IT had to take over the app and rewrite and remove unlicensed content. Also, download times were unacceptable because the app was poorly structured and overloaded; the extra content was carefully edited so that response time was significantly improved. We successfully launched iPhone app in winter 2012. Central IT is currently working on setting up an iPhone and Android application using Jasig uMobile to replace this app. We will also be looking into Ellucian Banner Mobile Connection product. We have approximately 100–200 mobile websites created using Microsoft ASP.net and jQuery Mobile.

A9. Mobile Web Using JavaScript Framework (jQuery Mobile)

Christopher Ward, Assistant Director of Web Services

Kennesaw State University

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Kennesaw State University's primary mobile approach is to develop a mobile-ready homepage, using a JavaScript framework that can be easily developed and deployed in a short time frame. The university has a centralized internal web group that handles all phases of the development, deployment and maintenance of the mobile site.

The target audience for the mobile homepage includes all visitors to the campus' homepage: prospective and current students; faculty and staff; alumni, friends and community visitors. When users visit the university's home page via a mobile browser, they are redirected to the mobile site.

Goals:

- Provide visitors to the university's home page with a browsing experience optimized to the smaller screen size of a mobile device.
- Allow the university to create an app-like experience using existing in-house personnel.
- Allow the university an entry into the mobile web without a great expenditure of time and financial resources.

Requirements:

- Sites render correctly in main mobile browsers, including Safari mobile, Android browser, Chrome, Opera Mini, IE9, BlackBerry browser, and other WebKit browser engines.

Resources:

- **Development resources:** The university has a centralized internal web group that has expertise in developing and managing sites built with web technologies, including HTML and CSS. This group also has a minimal device "testing lab" that tests for iOS, Android, and BlackBerry phones and tablets.
- **Financial resources:** The jQuery mobile framework is open source and comes with no costs or fees. By using browser-based tools for jQuery mobile development, including Codiqa and Themroller, no additional software is required.

Outcome:

KSU opted to go with the jQuery mobile framework for our initial mobile strategy. The time from development to deployment was just under two weeks. The mobile site launched in August 2012 and in under a year had over 530,000 visits from more than 100,000 unique visitors.

The mobile site has been well-received not only from our target audience but also from our internal campus constituencies. The jQuery site has been extraordinarily flexible, allowing for expansion through additional campus mobile initiatives, including real-time shuttle tracking, a campus directory and GPS-enabled maps.

Appendix B: Mobile Strategy Template

This template provides an outline to aid institutions in defining a mobile strategy and vision for their future.

B1. Statement of Need

Each institution or organization's mobile strategy document will need to first describe specific and documented statements of need. Easy evidence to back a statement of need can often be found from your organizational "home" or "gateway" website: simply identify what percentage of total visitors access the website from mobile devices. Further, your strategy can be well informed by determining what type of mobile devices (and at what levels) are being used by your user community, as well as how these usage patterns are trending over time.

Key audiences should also be defined in this section. At times, this can best be inferred from mobile usage data, some of which will be obvious—for instance, if a high percentage of mobile users are accessing your site to find out map or bus schedule information. Finally, data gathered from additional sources—such as student technology surveys; IT faculty and staff satisfaction surveys; or reports from coordinated student, faculty, or staff focus groups—should also be referenced in your statement of need.

B2. Current State of Mobility

This section should detail the current state of mobility at your institution or organization. This should include each early mobile adopting unit's approach, success stories, lessons learned, and struggles. Gathering and presenting this data displays due diligence and lays the groundwork for future campus or organizational collaboration.

B3. Current State of Data Availability

It is important to detail the current state of available data streams and identify the critical data that stakeholders will need to be involved in your strategic mobility effort. This will include a brief organizational description of where critical data components, such as directory data, bus data, or course data, exist and how available that data is via web services, RSS, and other methods. Gathering and presenting this information displays deep research into the technical topography of the campus data landscape.

B4. Mobility Governance

By doing the work needed to complete the above sections, you will have already done much of the necessary footwork to assemble the likely partners in a collaborative mobility effort. Next steps, then, will be to define the mobile governing body. This body will include a balanced mix

of key data stakeholders (usually including those who control the data that you want to make available for mobilization), key campus players (such as your communications/marketing group), and representatives from both the faculty and student governance bodies.

B5. Mobility Goals, Priorities, and Principles

In this section you will articulate the institutional mobility goals, priorities, and principles that set direction and steer a governance group toward making appropriate and timely decisions to meet desired outcomes. In addition, reasonable time frames can be tied to desired milestones and expectations can be limited to what is agreeably achievable.

Appendix C: Mobile Frameworks

Disclaimer: The below list is not intended to be an all-inclusive list of mobile products but rather to provide actual product examples to help clarify the product types for practical usage. EDUCAUSE ACTI-MWF does not endorse or recommend these products in any way. They are used for illustration purposes only.

Below is a categorized list of a limited set of mobile technologies and products that represent a manageable number of top mobile frameworks meeting the following general criteria:

- Popular and highly used, especially in the higher education environment
- Developed by or in partnership with a higher education institution
- Used or recommended by members of the ACTI-MWF community or participating universities
- Highly rated product with large user base, as determined by an informal web search
- Based on industry standards and therefore easy to adopt

Mapping these types of mobile frameworks and products into the “external versus internal audience” trade-off matrix gives us a visual representation and provides guidance for the type of product to focus on based on an institution’s placement in the matrix. The four strategies illustrated in the matrix include: Outsourced, In-House, Web Framework, and Native.

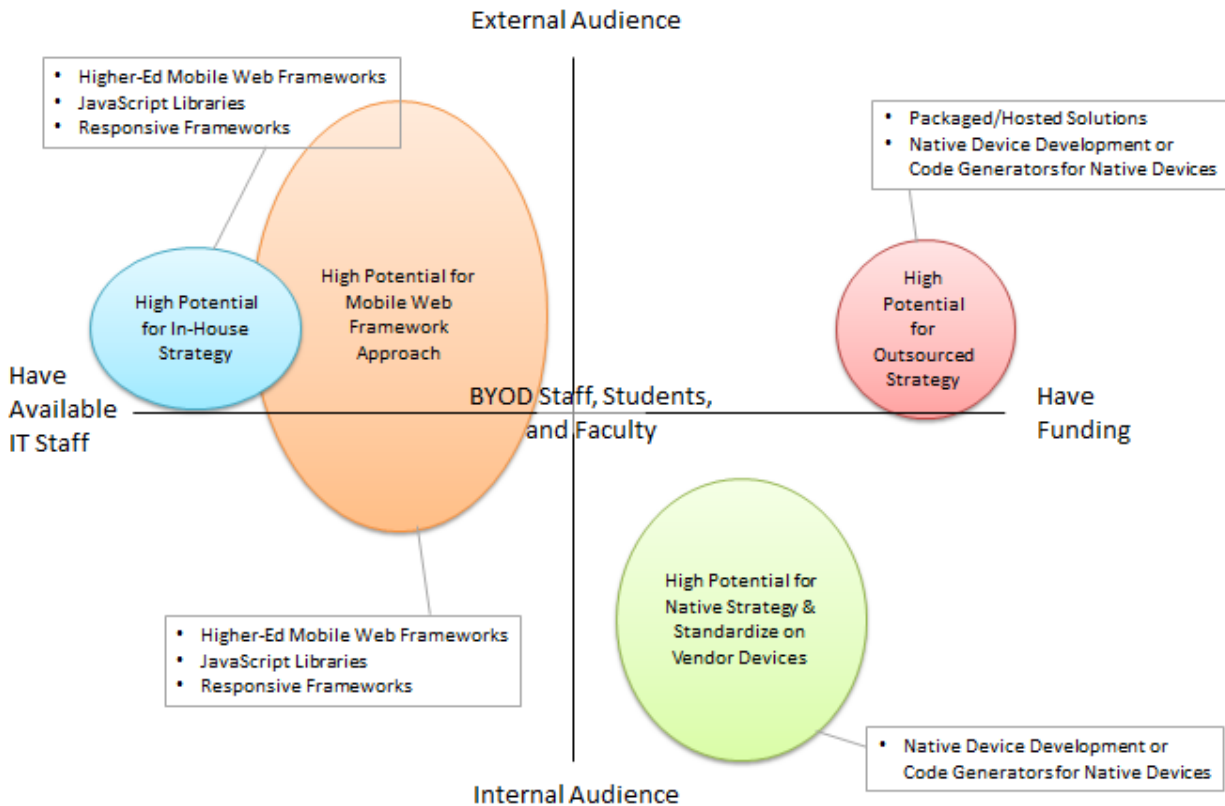


Figure 4: Mapping Framework Product Categories to Approaches

The four strategies are each comprised of various types of frameworks and products and are described in more detail below. For example, the in-house strategy can include higher education mobile web frameworks, JavaScript libraries, or responsive frameworks.

C1. Higher Education Mobile Web Frameworks

This product category consists of frameworks that are built out of higher education collaborative efforts to address the overall mobility needs of a university. These products are mainly open-source efforts and emphasize integration into current campus systems. Their installations typically include common university mobile tools like maps, directories, news, calendars, and courses, but can often be extended to support standard data feeds. The advantage to this approach is that you can leapfrog the design and development of many of the common functionality by simply plugging standard data feeds into an existing infrastructure. Examples of higher education mobile frameworks include:

- MWF (<http://mwf.ucla.edu>)
- Kurogo (<http://modolabs.com/framework.php>)
- Kualu Mobility (<http://kuali.org/mobility>)
- Jasig uMobile (<http://www.jasig.org/umobile>)

C2. Packaged/Hosted Solutions

This product category consists of packaged commercial solutions, typically offered as a hosted solution. The vendor will usually have a set of prebuilt applications, along with a specification of the data feeds that these applications can accept (e.g., XML, iCal, JSON, RSS, etc.). Examples of packaged/hosted mobile solutions include:

- SunGard Mobile Connection (<http://www.sungardhe.com/mobile/>)
- Blackboard Mobile Central (<http://www.blackboard.com/mobile>)

C3. Native Apps and Code Generators for Native Devices

Tools used to build native device applications, like native iPhone and Android apps, include:

- PhoneGap (<http://phonegap.com/>)
- Appcelerator Titanium Mobile (<http://www.appcelerator.com/>)
- iPFaces (<http://www.ipfaces.org/>)
- Rhomobile (<http://rhomobile.com/>)

C4. Mobile Web Apps and JavaScript Libraries

Mobile web apps are standard Internet-enabled websites and web apps that run on any browser, including a handheld device's web browser. A JavaScript library is a library of

prewritten JavaScript modules and features that allow for easy development of mobile applications or websites. Examples of JavaScript modules within a mobile framework may include user-interface elements, as well as feature-rich actions for animations and page transitions. JavaScript libraries are not specific to the higher education industry, and they are used to quickly create mobile web apps. Examples of JavaScript libraries include:

- jQuery Mobile (<http://jquerymobile.com/>)
- Sencha Touch (<http://www.sencha.com/products/touch/>)
- jQTouch (<http://jqtouch.com/>)
- Zepto.js (<http://zeptojs.com/>)
- Wink Toolkit (<http://www.winktoolkit.org/>)
- WebAPP.net (<http://webapp-net.com/>)

C5. Responsive Web Design Frameworks

Responsive web design (RWD) produces one single website or web app that that looks and feels custom-made for any device and browser, mobile or not. In order to save time, there are RWD frameworks (HTML and CSS) available that bundle libraries and functionality and ensure compliance on various browsers. Examples of RWD frameworks include:

- Twitter Bootstrap (<http://twitter.github.com/bootstrap/>)
- Skeleton (<http://www.getskeleton.com/>)
- Less Framework (<http://lessframework.com/>)
- Amazium (<http://www.amazium.co.uk/>)

Appendix D: Mobile Framework Evaluation Worksheet

This worksheet is provided as a resource to rate/compare products once the campus-wide mobile strategy has been identified. After narrowing down the options, this worksheet will allow evaluation teams to take a deeper dive into the details and capabilities of the final competing products. Prior to using this resource, it is important that the institution determines its mobile strategy and in turn prioritizes and possibly eliminates some of the below listed criteria.¹⁹ Priorities and needs differ across institutions and this worksheet accounts for that. The priority factor can be set per criteria to affect the final rating.

This worksheet is also available as a downloadable spreadsheet online.²⁰ See Figure 5: **Worksheet Usage Guide** and Figure 6: Sample Worksheet below for screen captures of the worksheet and guide.

Worksheet Usage Guide

Priority Weight

The priority weight should be set based on the institution's top goals and priorities. Each category can have a different weight based on the following guidelines:

- Enter value between 0-50
- 0 = not needed; 10 = low priority; 50 = highest priority
- Set the priority weight based on your institution's needs

Product Ratings

The product rating is assign by the level of evaluation performed at the institution. Ratings will differ based on the group performing the evaluation, thus it is important to have a common understanding of the rating values. These recommended values could be used as a guide:

- Enter value between 0-5
- 0 = Not Supported; 1=Poor; 2 = Fair; 3 = Good; 4 = Very Good; 5 = Excellent

Categories and Criteria

The list of criteria is meant to cover as many aspects to the mobile realm as possible. When a criteria or even an entire category does not pertain to a particular institution, it can be skipped by leaving blank or setting the priority weight to zero.

- Each category grouping has one or more criteria.

¹⁹ For examples of other comparison charts, see, for instance, the University of California, San Diego chart from October 2011, <https://spreadsheets.google.com/pub?key=0Akg5Mmp3HZZPzdGRzTWtUbTFUUKFZWmO4RE9qMXEydFE&hl=en&output%20=html>. Also see the "Mobile Frameworks Comparison Chart" created by Markus Falk as part of his master's thesis, at <http://www.markus-falk.com/mobile-frameworks-comparison-chart/>.

²⁰ The Mobile Web Framework Evaluation Spreadsheet is available at <http://www.educause.edu/library/resources/mobile-framework-evaluation-spreadsheet>.

- Subtotal ratings are calculated per category.
- The last category, “Other,” is available to add additional institutional criteria.

TOTAL

- The highest total vendor/product rating indicates the best fit for your institution.

Mobile Framework Evaluation Worksheet	
Worksheet Usage Guide	
Priority Weight	Enter value between 0-50 0 = not needed; 10 = low priority; 50 = highest priority Set the priority weight based on your institution's needs
Product Ratings	Enter value between 0-5 0 = Not Supported; 1=Poor; 2 = Fair; 3 = Good; 4 = Very Good; 5 = Excellent
Categories & Criteria	Each category grouping has one or more criteria. Each category area can be collapsed or expanded using the +/- buttons on left of category. Subtotal ratings are calculated per category The last category, Other, is available to add additional institutional criteria. To see more information or a definition for each criteria, hover over it.
TOTAL	The highest total vendor/product rating indicates the best fit for your institution

Figure 5: Worksheet Usage Guide

Mobile Framework Evaluation Worksheet						
	Priority Weight	Product One	Product Two	Product Three	Product Four	
General Characteristics						
Is Mobile Web Framework?	25	4	5	5	5	
Is Native Code Generator?	20	0	5	5	5	
Mainly Server-Side Technology	20	0	5	5	5	
Mainly Client-Side Technology	20	0	5	5	5	
Installation & Setup Complexity	20	0	5	5	5	
Application Development Complexity	20	0	5	5	5	
Development Roadmap	20	0	5	5	5	
Governance & Funding Model	20	0	5	5	5	
Upfront Cost	35	0	0	0	0	
Total Cost	35	0	0	0	0	
Community Engagement & Process	30	2	2	5	2	
Maturity Level	25	4	5	5	5	
Industry Standards (HTML, CSS, RSS, SOAP, etc.)	20	0	5	5	5	
Disposable & Easy to Swap Out for New Technology	20	0	5	5	5	
Testing Sandbox	20	0	5	5	5	
General Characteristics	350	260	1310	1400	1310	
Technical Requirements & Interoperability						
Supported Devices & Platforms	30	2	2	5	2	
Hardware & Software Requirements	20	2	2	5	2	
Technical Requirements & Interoperability	50	100	100	250	100	
Implementation & Support						
Developer Skill Set	40	3	5	3	2	
Designer Skill Set	40	0	0	0	0	
Documentation	35	0	0	0	0	
Training	30	2	2	5	2	
Conferences	25	4	5	5	5	
Community Support & Responsiveness	20	0	5	5	5	
Application & Code Examples	20	0	5	5	5	
Support Availability & Cost	20	0	5	5	5	
Implementation & Support	230	280	685	695	565	
Licensing						
License Type (Open Source, Commercial, Enterprise, Educational)	30	2	2	5	2	
License Cost	20	2	3	4	3	
Licensing	50	100	120	230	120	
Security						
Authentication/Authorization capabilities	30	2	2	5	2	
Web Security	20	2	3	4	3	
Local Data Storage Security	20	2	2	5	2	
Security	70	140	160	330	160	
Performance						
Framework Size	30	2	2	5	2	
Hosting & Scalability of Architecture	20	2	3	4	3	
Graceful Degradation	20	2	2	5	2	
Performance	70	140	160	330	160	
Design & Development						
UI Components & Control	40	3	5	3	2	
Style & Design customizable themes	40	0	0	0	0	
Accessibility features & support	35	0	0	0	0	
Data integration (RSS, iCal, etc.)	30	2	2	5	2	

Figure 6: Sample Worksheet

Design & Development						
UI Components & Control	▼	40	3	5	3	2
Style & Design customizable themes	▼	40	0	0	0	0
Accessibility features & support	▼	35	0	0	0	0
Data integration (RSS, iCal, etc.)	▼	30	2	2	5	2
Extensible functionality	▼	25	4	5	5	5
Native device feature integration	▼	20	0	5	5	5
User preference support	▼	20	0	5	5	5
Design & Development		210	280	585	595	465
Marketing						
Availability & Integration with Web Analytics	▼	40	3	5	3	2
Native Application Deployment	▼	40	0	0	0	0
Marketing		80	120	200	120	80
Modules & Add-ons						
Out of the box modules	▼	40	3	5	3	2
Community Code & Repository	▼	40	0	0	0	0
Application Sharing Environment	▼	35	0	0	0	0
Modules & Add-ons		115	120	200	120	80
Other						
Add Criteria		10	0	0	0	0
Add Criteria		20	0	0	0	0
Add Criteria		30	0	0	0	0
Other		60	0	0	0	0
TOTAL		5850	1540	3520	4070	3040

Figure 6: Continued

Appendix E: ACTI-MWF Working Group Members

The following were members of the EDUCAUSE Advanced Core Technologies Initiative Mobile Web Frameworks Working Group at the time this report was published.

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