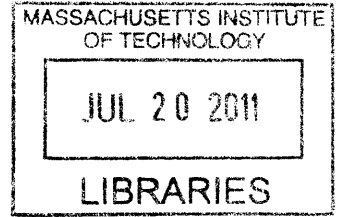


# A Social Networking Approach for Mobile Innovation in Emerging Countries

By  
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B.S. Horticulture, National Taiwan University, 2000

**ARCHIVES**

Submitted to the System Design and Management Program  
In Partial Fulfillment of the Requirements for the Degree of  
Master of Science in Engineering and Management

At the

Massachusetts Institute of Technology

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## **Abstract**

Addressing the global challenges and the next billion mobile subscribers, the MIT NextLab course engages students, industry partners, entrepreneurs and the next billion mobile subscribers to develop innovative mobile services that improve the quality of life in the emerging countries. In three years, NextLab teams developed and deployed 29 projects in 14 countries, and five teams founded their own ventures after perceiving the strong demand from the vast mobile users in the developing world. However, the size and the amount of NextLab projects are limited by the schedule and the location of an academic course.

The focus of this thesis is to research and develop a social networking platform that replicates the success of the NextLab course to reach out to more participants around the world. In this document, I utilized the social analysis framework to identify social processes among stakeholders in a general NextLab project, specify the possible social failures and research the possible solutions. Besides, I also reviewed the NextLab projects in 2008 and 2009 and developed the NextLab Project Development Process (NLPDP) that highlights the 12 critical stages of a NextLab project. Finally, I proposed the NextLab 2.0 Community that integrates with the social networking solutions and the NextLab Project Development Process.

The case study of the mobile logistics (m-Logistics) project is used to demonstrate how the proposed solution facilitates the collaboration and communication for a large and cross-country mobile innovation project. A number of recommendations were also discussed for further research.

Thesis Supervisor: Professor John R. Williams  
Title: Professor of Civil and Environmental Engineering

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To *Professor John R. Williams*, thank you for introducing me to the software architecting and the design of web systems. The proposed solution in this thesis is done with invaluable knowledge and benevolent guidance from him.

To Mr. Jhonatan Rotberg, the Director of the NextLab program, thank you for giving me the opportunity to participate in the innovative mobile development initiative and sharing your insights of the future mobile innovation.

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# Chapter 1

## Introduction

*“Eventually there will be more cellphone users than people who read and write. I think if you get that right, then everything else becomes obvious.”*

*- Eric Schmidt, chairman of the board and chief executive officer of Google*

*“It's the technology most adapted to the essence of the human species – sociability...”*

*“It's the ultimate tool to find each other. It's wonderful technology for being human.”*

*- Arthur Molella, director of the Smithsonian's Lemelson Center*

### 1.1 Motivation

The Next Billion Network (NBN), founded at MIT Media Lab in May 2008, addresses the empowerment of the next billion mobile users in emerging countries. The NextLab course is part of the NBN initiative that brings together students to develop mobile applications that address real-world problems in the developing world. MIT students from diversified programs join NextLab project teams to solve global challenges – Economic Empowerment, Education, Civic Engagement, Environment and Community and Health. The NextLab project teams are sponsored to deploy their applications in the target regions after the semester and are encouraged to found their own ventures. I joined the Next Billion Network staff as the Teaching Assistant from the beginning and then the Associate Director of Technology of the NextLab program to contribute what I learned from MIT System Design and Management program and my former working experience to direct the research and lead engineering teams to discover the best sustainability model for the next billion people in emerging countries.

The Next Billion Network is the incubation platform for Information and Communication Technology for Development (ICT4D) projects, and the NextLab course is the arena offered by the NBN staff to MIT students, project partners, people in emerging countries and industry advisors to fight together against the tough global challenges. The NextLab course is a one-year course that starts in the Fall term and ends in the Summer term. Before the start of the Fall semester, the project proposals are submitted by NGOs, program partners and entrepreneurs who find unmet needs or problems that could be solved by using Information and Communication Technologies. The NextLab staff carefully review these proposals to filter out those that mutually address the technical challenges and create a significant impact in the developing world. In the beginning of the semester, students bid for selected projects, and form project teams with students from different programs. After developing core technologies and initial sustainability plans, project teams travel to the target countries in January to deploy the solution and gain in-depth understanding of needs and feedback from real users in the base of pyramid.

In the second semester, students strive to create sustainable ventures. After the pilot testing in January, some of the projects transition into fledgling ventures. Those student teams are encouraged to join the second semester at NextLab as project partners, who can propose their own projects that aim not only to advance their core technologies, but also to cook a feasible business plan and join MIT \$100K Business Plan Contest. After the second semester, NextLab teams go deploying services and conducting testing in the target regions during the summer. Project teams are expected to conduct more rigorous research for the local market and consider launching the services in the target communities.

This entire cycle requires a well-planned curriculum and a well-defined process along with monetary and other important resources that enable students to achieve their goals among different semesters. However, one course at MIT can facilitate only six to

eight projects per semester. If this model works as an academic course, is it possible to upgrade the process to make it able to support vast concurrent participants and projects around the world to solve real-world problems in developing countries and to attract more talented mindsets to collaborate together to uncover the sustainable mobile solutions? This thesis aims to dig out answers to those questions.

## **1.2 Approaches**

The research approaches includes conducting the survey with NextLab students in the end of each semester, interviewing NextLab students and review the project activities that are done by student teams in Spring 2008, Fall 2008, Spring 2009 and Spring 2010. In order to expand the NextLab program to a real-world ICT incubation platform, the author also review current researches regarding social networking and Information and Communication Technologies for Development.

After analyzing data collected from survey and interviews, I propose a social networking platform that is integrated with the project development process that enables the ICT4D incubation platform for entrepreneurs, developers and investors to collaborate together. A case study of a large project is discussed to showcase how the social networking approach enables the mobile innovations that improve the life quality for people in the base of pyramid in emerging countries.

## **1.3 Thesis Organization**

Besides the introduction in the Chapter 1, this thesis contains five other major sections:

- Chapter 2 shows the global Information and Communication Technology for Development (ICT4D) environment

- Chapter 3 gives an introduction of Next Billion Network Initiative and NextLab course at MIT
- Chapter 4 shows the social networking analysis of the original NextLab Project Development Process and exhibits the proposed solution
- Chapter 5 uses the case study of the m-Logistics project to evaluate the proposed solution
- Chapter 6 concludes the author's research and discusses future works

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# Chapter 2

## **The Information and Communication Technologies for Development Environment**

Information and Communication Technologies for Development (ICT4D) covers the activities and applications that utilize information technology (IT) and telecommunication technologies of Mobile or Fixed networks to improve the quality of life for people in the base of the pyramid [1]. Addressing on using mobile phone to change the world, the NextLab course at MIT engages participants with creative and entrepreneurial students from various programs at MIT, Harvard and Tufts University, people in the base of pyramid and advisors from ICT industries. NextLab project teams work closely with the target users to deliver a venture plan and a working prototype by using information and communication technologies. However, how can we keep students staying in the ICT4D arena instead of leaving it after receiving their grades in the end of the semester? How can we attract more people, who understand technologies, to the ICT4D activities? How can people in the base of the pyramid know that ICT4D can improve their lives and seek for capable developers and entrepreneurs to work with them to build the solution? This chapter presents the market analysis and findings of ICT4D environment.

### **2.1 ICT4D Market Analysis**

Since 1990s, ICT technology has gradually become a commodity in everyone's daily life [2]. With the wider coverage of mobile networks and the lower cost of handhold devices, 3.3 billion out of 6.8 billion [3] people on Earth possess their own mobile phones. Various value-added services are developed to provide daily

communication and facilitate people’s working and personal needs. Among various mobile technologies, the Global System for Mobile communication (GSM) is the most widely adopted mobile network around the world. As the data announced by GSM Association (GSMA) in Figure 1, 930 networks use GSM system, and those networks serve 2.76 billion subscribers in 222 countries and regions in January 2008. GSMA also claims “Terrestrial GSM networks now cover more than 80% of the world’s population.” GSM is currently the major mobile technology that provides telecommunication services in developing countries.

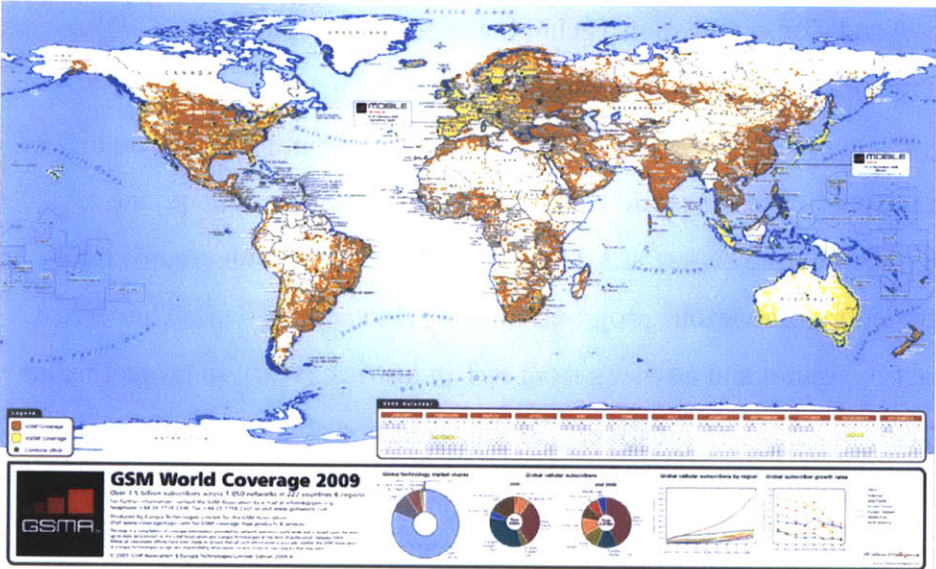


Figure 1: GSM World Coverage 2009 [4]

After GSM, General Packet Radio Service (GPRS, 2.5G) and the Universal Mobile Telecommunications System (UMTS, 3G) increase mobile data transfer rate from 9.6 Kilo-bits-per-second (Kbps) in GSM, 115Kbps in GRPS to 1.8Mbps and 14.4Mbps in 3G [5]. Those wireless technologies enable the Information and Communication Technology (ICT) services that can provide end users with various voice and data convergent services instead of pure audio services.

However, most of the ICT services deployed by mobile service providers and operators in developing countries are charged with premium rate. International Telecommunication Union (ITU), the leading United Nations agency for information



and communication technology issues [6], develops the ICT Price Basket methodology to be the index of ICT service costs of countries around the world. The ICT Price Basket value is the average of the sum of three ICT submarkets – fixed telephone, mobile cellular and fixed broadband Internet divided by the Monthly Growth National Income (GNI) per capita of the country [7] as shown in Figure 2. The ICT Price Basket value can be read as the percentage of GNI spent in ICT services per capita in a country. Therefore, the higher the ICT Price Basket value is, the lower the incentive and affordability of subscribing ICT services will be.

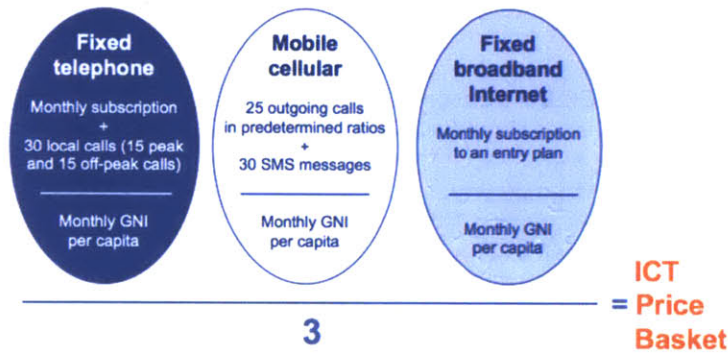


Figure 2: ICT Price Basket Equation [8]

The research done in 2008 reveals that the ICT cost of 50.46% of surveyed 109 developing countries is over 9% of GNI per capita, but the ICT cost of all surveyed 41 developed countries is less than 9% of the GNI per capita. From the result one may assume that the ICT service subscription rate and penetration rate should be very poor in developing countries.

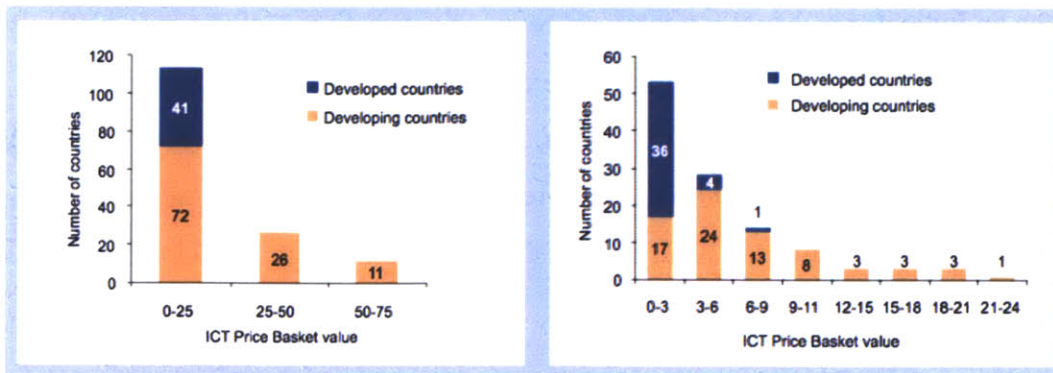
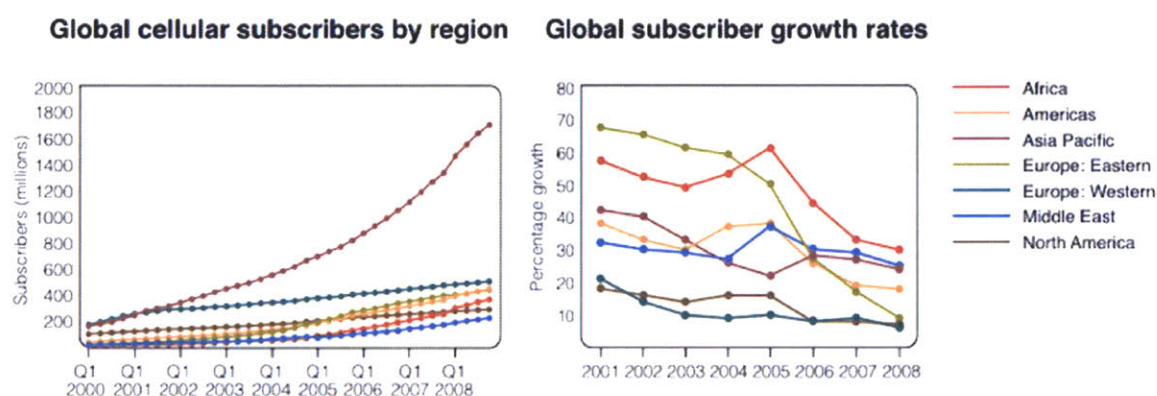


Figure 3: ICT Price Basket Value in Developed and Developing Countries [9]

However, as the data showed in Figure 4, since 2001, Africa, Americas (excluding North America), Asia Pacific and Middle East have higher mobile subscriber growth rate, which ranges from 20% to 70%, than North America and Western Europe do. The subscriber amounts in Africa, Americas, Asia and Eastern Europe are in the Top 5 subscriber amount list among all regions. This contradiction between the ICT Price Basket Value and the high subscriber growth rate shows that people in those emerging regions are urged to use ICT services.



**Figure 4: Global Cellular Subscriber Amount and Growth Rate [4]**

Undoubtedly, increasing the profit is the eventual goals of all mobile operators, and the two major factors for profit generation are the Average Revenue per User (ARPU) and the amount of subscribers. The telecommunication industry treats ARPU as an indicator of Mobile operators' revenue generation performance [10]. Although higher ARPU can bring mobile operators more revenue from users, the other dimension – the amount of subscribers, is also an important indicator of revenue generation. The operators and mobile entrepreneurs should focus on how to provide service to large communities instead of focusing on specific high ARPU customer demographics or segments [12].

Billions of people in the emerging regions have subscribed to ICT services, and the high growth rate indicates that more people want to have the services as well. From the research done by Rehan Asad (2008) in Figure 5, it shows that low end mobile customers exist in all major Telecommunication markets and the percentage of the base of pyramid is larger in emerging countries than it is in the developed world. Even though the ARPU from the people in the bottom is lower, the amount of potential users creates a lucrative market in emerging regions.

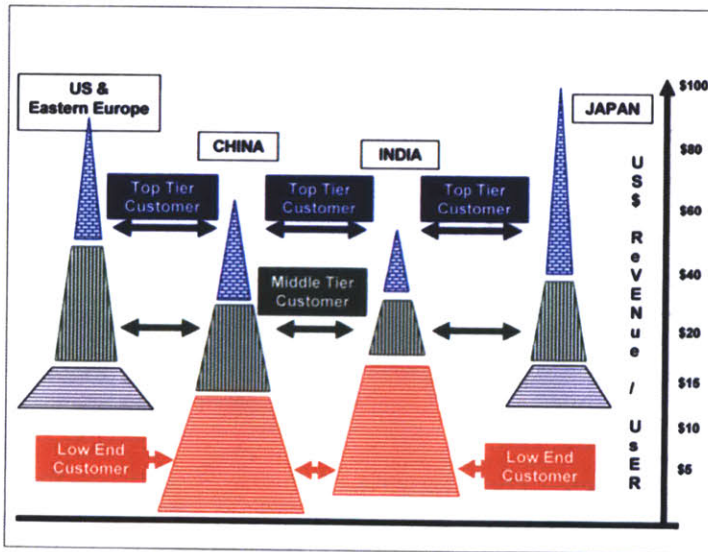


Figure 5: Global Telecom Users Triangle Pyramid (ARPU Expenditure) [11]

Last but not least, even with the severe economy downturn in 2008, the global ICT market is still growing and the total ICT spending is expected to be USD \$4.4 trillion in 2011 [Figure 6] with 7.7% annual compound growth rate. Figure 7 compares the ICT spending growth rate before the economy downturn to the rate in the downturn, even though the spending growth rate decreases significantly among all regions, the rate in the developing areas still have better performance than the developed ones.

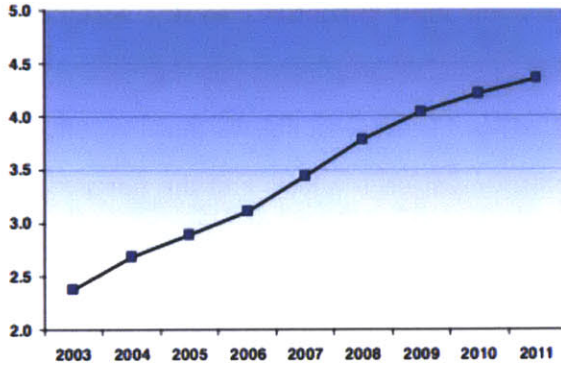


Figure 6: Global ICT Spending (USD \$Trillion) [13]

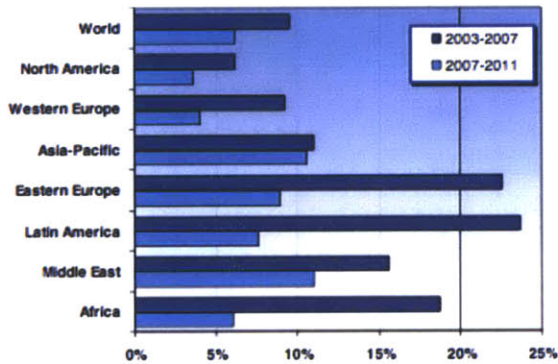


Figure 7: ICT Spending Growth: History and Forecast [14]

With the large user base and the high user demand, running an ICT4D service is no longer a charity activity but a profitable business that can grow and sustain as a social enterprise. The Next Billion Network Initiative is then founded at MIT Media Lab to not only find a potential market to identifying the real world challenges in developing countries but also developing and sustaining localized and affordable ICT services to a vast amount of users in the base of pyramid.

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# Chapter 3

## Next Billion Network and NextLab at MIT

### 3.1 Next Billion Network At MIT

#### 3.1.1 Information and Communication Technologies for Development Laboratory

In Spring 2008, Information and Communication Technology for Development Laboratory (ICT4D Lab), an experimental class, was offered at MIT Media Lab. Eight projects in education, economy empowerment, healthcare, environment and Civic engagement were collected from Non-Governmental Organizations (NGOs), companies and entrepreneurs and planned to be deployed in seven developing countries.

Project	Category	Partner	Target Country
Assured Labor	Economy Empowerment	Student Entrepreneurs from MIT Sloan School	Brazil
Beehive	Education	BeeHive School	Malawi
CIDRZ - Cervical Cancer Screening	Healthcare	Dimagi	Zambia
Disaster Management	Environment	Catholic Relief Services	India
Free Press	Environment	HananTek	Bolivia
IRD - Interactive Alerts for Childhood Pneumonia	Healthcare	Johns Hopkins University, TagSense and OpenRosa	Pakistan
Mosoko	Economy Empowerment	Nokia	Kenya
Smart Microloans	Economy Empowerment	India School Fund	India

**Table 1: The ICT4D Lab Project List**

MIT students from diversified programs worked closely with those NGOs, companies and entrepreneurs in target regions to build the ICT solutions for those real-

world problems. Students were sponsored to visit the target communities twice during the projects. The two trips were the core activities of ICT4D Lab projects. They offered ICT4D teams the chance to visit the target community in the beginning of the projects and to deploy and run the service after the school semester ends.

The first sponsored trip is in the spring break. One student from each team was elected to fly to the countries to interview prospective users and conduct surveys for one week. In the end of the trip, the person worked with the team to analyze collected data to discover the hidden issues and dig out the real needs. After fully understanding the problems, students started designing and developing the possible solutions by using suitable and affordable Information and Communication Technologies. Each team had to compose a project plan, including the project scope, schedule, budget and proposed solution. Student teams followed the project plan to develop the prototype of their solutions with the support from staff, project partners and industry advisors. In the last week in the semester, a one-day public presentation event was held in the Bartos Theatre at the MIT Media Lab. Students presented their research, ran the live demonstration of their ICT services and the poster session before and after their formal presentations. The public event was not only a check point for the staff to review students' work, but also a platform for project teams to showcase their innovative services to other MIT students, project partners and potential investors.

The second sponsored trip is in the Summer 2008 after the spring semester is over. One to two students from each team were sponsored to go to target regions to deploy their services, run marketing events, train the local communities, and evaluate the possibility of running their own sustainable business in the future. The two sponsored trips help students worked closely with target users and project partners from the beginning of the project till the end.

The ICT4D Lab course was evaluated in the end of Spring 2008, and positive feedbacks were received from students and project partners. The student feedback survey

showed that 32.26% of students thought their projects have an impact to the target communities and 45.16% of the students claimed that they may continue to do work in the area of ICT4D in the future [15]. In the end of summer 2008, one project team, Assured Labor, founded their venture, and another two projects, Cervical Cancer Screening and Interactive Alerts for Childhood Pneumonia are kept running by student volunteers and project partners. Having some students stay in the ICT4D industry and having spin-offs from the course encouraged the staff to not only continue the course but also make it a formal course instead of an experimental one.

### **3.1.2 Next Billion Network at MIT**

The ICT4D Lab staff valued the success of the course and decided to extend the course scope to involve more people around the world in the project activities. Jhonatan Rotberg, the Instructor of ICT4D Lab, founded the Next Billion Network (NBN) in May 2008 at the end of the ICT4D course. Rotberg elaborated on the ICT4D Lab experience and deeply believed that “within the next three years, another billion people will begin to make regular use of cell phones, continuing the fastest adoption of a new technology in history. Soon, this next billion will make its voice heard—and connect to the global information network. This will unleash a wave of entrepreneurship, collaboration and wealth creation, turning the newly connected into a powerful force in the world economy. The kind of world that emerges from this transformation will depend on our ability to recognize it as an opportunity.” [16]

The ultimate goal of the Next Billion Network is to establish a community platform that engages NGOs, entrepreneurs, enterprises and volunteers together to solve emergent problems for the next billion mobile users in developing countries by using Information and Communication Technologies. The author, who was a student in the BeeHive team in the ICT4D Lab course, joined the NBN team as the Technical Manager and the Teaching Assistant of the next course in June 2008. The first task of the author was to do research about the community platform and propose the plan to reach the goal of NBN. After reviewing all ICT4D Lab projects, analyzing and researching the whole



ICT4D eco-system, the NBN team identified five major stakeholders – NBN staff, project partners, team advisors, students and the public, for the community platform [Figure 8].

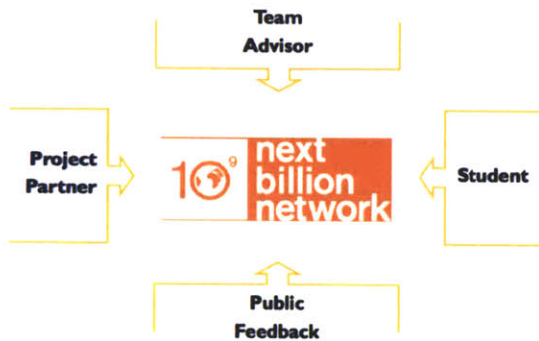


Figure 8: The Stakeholders of the Next Billion Network

The **NBN staff**, including the founders, technical team and media team, are the core of the Next Billion Network. They coordinate all stakeholders to ensure that people in the bottom of the pyramid can benefit from the NBN projects and to sustain the Next Billion Network itself. The NBN staff lecture the course at MIT, provide business and technical support to project teams, and produce the social medias to promote the NBN to the world.

The **project partners**, including NGOs, commercial companies and individual entrepreneurs, are the source and sponsors of NBN projects. They identify the problems in the emerging areas from their daily lives or business operations, propose the potential projects to the NBN staff, and are the main contact window of NBN project teams. The project partners share first hand information about the target users, environment and the identified needs with other stakeholders. They are also in charge of the funding and logistic support to the NBN teams.

The NBN team discovered that people have different objectives from the interviews with prospective stakeholders. The **NBN Staff** want to show NBN model to people around the world, and collect projects through a centralized place instead of personal email boxes. Besides, figuring out a way for project teams to raise funding for project design, development, deployment and operation is also a critical issue to the staff.

The **Project Partners** want to have a channel to reach talented people and to share the local problems or needs to the world. When working with project teams, the project partners want to communicate with the teams frequently and get updated with latest activities. Most of the **Team Advisors** are volunteers, who always want to reach people and learn about interesting projects. They want to share their professional experience and knowledge with the project teams. Most of them are working in the industries and have no choice but to work with NBN teams remotely and with rigid schedule. Therefore, they show high interests in the remote communication and off-line information sharing tools.

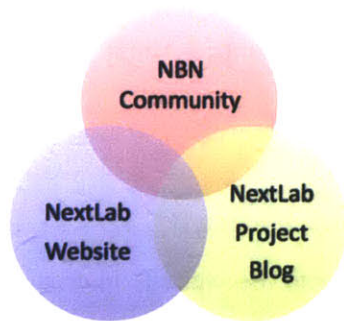
**Student:**

- Help people with my abilities
- Be able to find projects and join project teams
- Understand what other teams are doing and can join more than projects at a time
- Find great teammates
- Get good grades

**Public Feedback:**

- Want to join the community, but don't know what to do and who can be trusted
- Want my opinions to be heard and valued

The stakeholder needs are transformed into three major components of the NBN platform, the NBN Community, NBN Course and NBN Projects.



**Figure 9: The major components of the Next Billion Network**

**NBN Community:**

The website, [nextbillion.mit.edu](http://nextbillion.mit.edu), is launched in September 2008 to serve the NBN Community. On the site, people can join the community to be an advisor or a programmer, or to share information with all community members. Moreover, people can get the latest news and current project information, and, most importantly, they can be NBN partners and submit their project proposal for review. The NBN partnership sustains the daily operation of NBN. The NBN was initially sponsored by MIT Media Lab and Telmex, and Nokia and Bank of American became strategic partners later and supported NBN with professional advisors and hardware equipment.

The project submission function is another important function of the NBN Community website. It allows people all over the world to submit project in text, audio or video formats or both of them. The flexibility in file format not only helps the proposer to prepare for the proposal, but also provides NBN staff more clear and straightforward information about the phenomenon or problems that the proposer found locally. With the support of project submission function, NBN staff can receive proposals continuously, and don't need to worry the project sources will be lost if any of the NBN staff leaves.

The NBN Community site connects the NBN project teams with industry advisors, developers, investors and even people in the target project deployment region. It is key to the success that the team can get feedbacks directly from lead users in the target areas and understand more about the local environment and situations through those people. Until the end of 2009, there are 1,986 users from 53 countries registered on it.

#### **NextLab Website:**

With the launching of the Next Billion Network website, the ICT4D Lab instructors re-designed the course and named it NextLab, and the website is created to facilitate the course logistics in Fall 2008. The NextLab website carries the course materials including presentation slides and videos, and project works done by students. The NBN staff encourage students to videotape their design process and service

demonstration, so that the team can not only share the design experience with others, but also be an on-line service training materials.

The NextLab staff used this website as the major communication channel with students. Staff posts articles regularly for suggestion, concerns and course logistics. Besides, information of related seminars, fellowship, ICT4D competitions and job opportunities is also posted there. Through the course website, NextLab students learned the IEEE Gold Humanitarian Fellowship and M. Ehsan Hoque and Crystal Mao received the fellowship in recognition of their skills and knowledge to aid their humanitarian work at NextLab.



Figure 10: The homepage of NextLab course in Fall 2008

## NextLab Project Blog:

Along with the course website, every NextLab project team is asked to maintain their own project website to run their own community and show the project progress. To minimize the time and effort to create a website, the NextLab staff shared the template of the NextLab course website to teams. The project teams can create their own website in five minutes. Project teams are encouraged to share the listed information below:

- Project Introduction
- Team List
- Project Progress – Videos and pictures for design process, field research, prototype demonstration, and a tough problem or decision

The snapshot below shows the front page of a NextLab project.

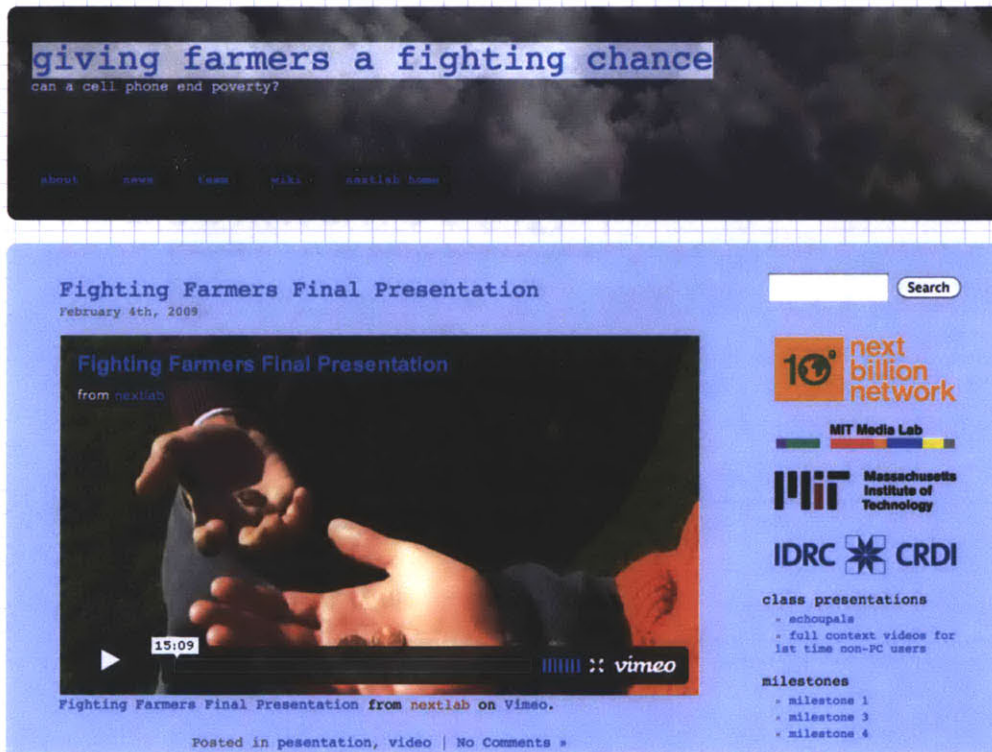


Figure 11: The example of NextLab project blog

With the support of the website, students can get exposure to the world and receive public feedback directly. The website template is developed based on the WordPress, an open-source blog system that is used by more than 200 million website by September

2009. Students, team advisors, project partners and most of the public audiences are familiar with the system and start contributing to the website content right after the site is created.

## **3.2 NextLab at MIT**

With the launching of the Next Billion Network community website, the ICT4D Lab instructors re-designed the course and named it as NextLab. The NextLab, taught in Fall 2008 and Spring 2009, is a hands-on design course in which students research, develop and deploy mobile technologies for the next billion mobile users in developing countries. Guided by real-world needs as observed by local partners, students work in multidisciplinary teams on term-long projects, closely collaborating with NGOs and communities at the local level, field practitioners, and experts in relevant fields.

Students are expected to leverage technical ingenuity in information and communication technologies together with social insight in order to address social challenges in areas such as health, microfinance, entrepreneurship, education, and civic activism. Students with technically and socially viable prototypes may obtain funding for travel to their target communities, in order to obtain the first-hand feedback necessary to prepare their technologies for fully-fledged deployment into the real world. Besides, students need to do market research and conduct interviews with lead users to propose a venture plan for each of the projects. The purpose of the venture plan is to help students to reveal the potential of the project and to plan for the required resources like funding, sales and marketing teams, or engineering force beforehand. Students are also encouraged to develop the plan into a real business plan and attend MIT 100K Business Plan Contest.

NextLab designs a mobile technologies storage and retrieval platform that will capitalize experience developing and deploying applications in the developing world. All the code developed by student teams every semester being stored and organized in a way

that enables its future use as open source. Common components in all those codes can be primary candidates for multiple reuses in different applications with different objectives. The aim is to grow this effort into a universally accessible source of mobile application code for applications in the developing world.

All NextLab student projects stem out of real-world needs as detected by a host of local partners in developing countries, such as non-government organizations, commercial companies of public entities, or even NextLab students themselves. Once student projects mature, they are taken on by these local organizations for addressing their stated needs. In this vein, the large majority of NextLab projects become real, on-the-ground deployments in low-income communities within one or more developing countries. Through specially designated fellowships and grants, NextLab students play a major role not only in the design but also in the implementation and deployment of their technologies locally in developing countries.

In Spring 2009, NextLab students are encouraged to attend the MIT 100K Business Plan Contest. NextLab staff, students and project partner collaborated together to cook business plan for six projects. Two out of the six NextLab teams, Dinube (Mobile Cloud Payment) and Hammock (Mobile Logistics), entered the Semi-final of the 100K Mobile Track, and the Dinube team won the Runner-up in the end. Besides the 100K competition, NextLab staff gives away the Technology Innovation Award and Venture Execution Award to the NextLab team that shows the excellence in each of the semester as the initial funding for the potential venture. Among those 22 project teams, four spinoff projects, Assured Labor (Job Matching), Interactive Alerts for Childhood Pneumonia (RFID Medical Record Tracking), MOCA (Mobile Healthcare) and Dinube (Mobile Cloud Payment), are running by NextLab students and industry partners after the semester.

Till the end of May 2009, NextLab students and advisors have developed and deployed 23 projects in 14 countries as shown in [Figure 12] below. Detailed project list can be found in the Appendix 1.



Figure 12: NextLab Project Map

NextLab course along with the Next Billion Network community expand students' view to understand the social impact that Information and Communication Technologies have in daily life in developing countries. Moreover, the course also helps the community to shape the vision of how pervasive connectivity can create unprecedented opportunities for empowering the next billion consumers, and reveal the potential of NextLab projects.



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# Chapter 4

## **The Analysis of NextLab Program**

The eventual goal of the NextLab program is to elaborate Information and Communication Technology for applications that can improve people's living quality in emerging areas. It is key to our success that NextLab is supported by an on-line social networking platform that is ideal for project communication and collaboration. However, even with the support of the platform, the human dynamics and project management affect the success of NextLab projects significantly. The NextLab social networking platform has to provide strong motivation to each of the stakeholders and keep them contributing to the community regularly. To achieve this goal, the author analyze the potential social networking failure of the original Next Billion Network Community website and propose the NextLab 2.0 solution that can connect stakeholders tightly with the community. Moreover, the author review the ICT4D Lab projects and NextLab projects to propose a well-defined project model that can help the project teams plan their project with milestones and phases from the problem identification stage to the operation stage.

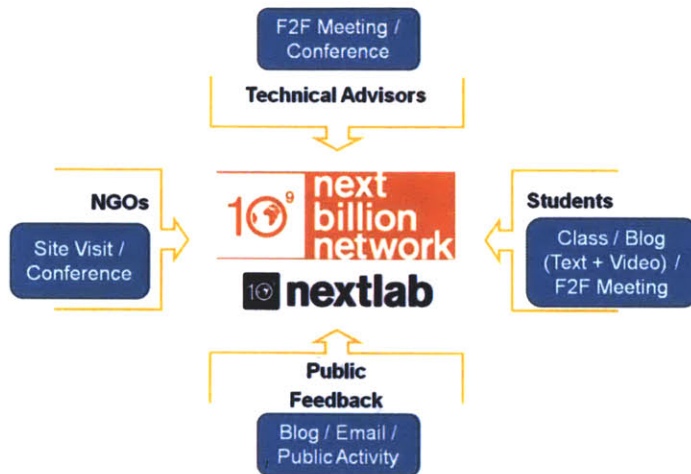
### **4.1 Social Analysis for the NextLab Program**

In this section, I utilize the social analysis framework [17] to identify the social processes among stakeholders in a general NextLab project; specify the social failures in those processes and research the solutions for the NextLab social networking community.

#### **4.1.1 Social Networking Processes of NextLab**

As mentioned in section 3.1.2, four major stakeholders [Figure 13] are identified for the NextLab course. The activities of each stakeholder that involves with social processes are discussed below:

- **NextLab Staff** lecture the NextLab course and are in charge of collecting projects, allocating balanced project teams and guiding project teams over the semester. NextLab staff are the core of NextLab community and have to interact with all stakeholders to ensure the success of each project.
- **Project Partners** are usually project partners who understand the needs in their local community and seek for help to solve those problems. NextLab staff know about the NGOs via personal network or from a friend of friend, and, in some cases, staff have to visit those NGOs in person or have several teleconference to ensure the NGOs is trustworthy and the proposed project is worthwhile and doable.
- **Team Advisors** are passionate and talent people from diversified industries. They spend personal time to mentor or work with project teams to solve technology or venture issues. Advisors usually meet project team periodically or by request via face-to-face meeting or teleconference.
- **Students** from different domains take NextLab course for credits. They select preferred project and form teams in the beginning of the semester. Each student takes at least one function role like sustainability officer, project manager, software developer, system architect, and institutional relation officer. They work closely with NextLab staff, technical advisors and teammates to accomplish the project within the semester. Students have to attend the class, post articles or video on their project blogs and have regular meetings. Project teams are encouraged to attend public activities like MIT 100K Competition, Start-up Clinic at MIT Enterprise Forum and Mobile Monday.
- **Public Feedback** is given by visitors around the world. Those visitors give project team their personal comments about the project or give advises to solve a specific issue via comments on project blogs and e-mails, and in public activities.



**Figure 13 - Stakeholders of Next Billion Networks and Involved Social Processes**

The Next Billion Network website, NextLab instructor blog and NextLab project blogs <sup>1</sup> were launched in September 2008 to sustain the NextLab community. The NBN website provides the project proposal upload, user profile, user functional roles like NGO, tech advisors and engineers, and latest news about NBN. From Sept. 01, 2008 to April 30, 2009, the Next Billion Network website has been visited 5,498 times by people from 103 countries, and 265 registered as NGO and advisors. However, only two projects are proposed on the website and none of them is adopted due to inadequate technology scope. All NextLab projects are still from existing project partners and NBN staff's personal networks, and no projects are available for volunteered advisors and engineers to work with.

#### 4.1.2 Social Failures of NextLab

The NextLab staffs are not satisfied with the result and still want to promote NextLab to be the incubator for a global mobile venture. The NBN initiative shouldn't be limited to a course boundary and it has the potential to be a self-sustainable community that exposes the needs and problems in developing regions and gathers the global resources to change the world. The NBN staff endeavor to attract more volunteers to use

<sup>1</sup> The NextBillion website – <http://nextbillion.mit.edu>; the NextLab instructor blog – <http://nextlab.mit.edu/main>; the NextLab project blogs – <http://nextlab.mit.edu/fall2008/>

mobile technology to quench the needs from the next billion mobile users in developing regions.

After analyzing the original NextLab model, several social failures are identified in social processes among stakeholders.

- ***NBN Staff:***
  - Limited resource: with limited man power and facilities, NBN staff can only mentor six to eight projects per semester
  - Medium project vitality rate: 56% of projects are still running by project either partners or ventures founded by student teams after each semester. The rest of projects are stopped due to no follow-up from students and project partners. NBN staff expect to see better vitality rate in projects operation
- ***Project Partners:***
  - Time consuming and high travel cost: when not having enough projects, the staff have to go through personal network to reach potential project partners, and it takes tremendous time and money to seek for suitable projects by visiting project partners in different regions
  - Unreliable or unclear project scope: Two out of 23 NextLab projects changed project partners in the mid of semesters and one project even changed its project topic after understanding the real needs of local users
  - Difficulty in project collection: as mentioned before, projects are still from existing project partners and NBN staff's personal networks. NBN is expected to collect more projects that can be done by not only students teams but also teams formed by volunteers from everywhere
- ***Team Advisors:***
  - Tight schedule: technical advisors are from industries and project teams have to wait for their available time to get responses
  - Insufficient information transparency: advisors usually mentor one or two project teams, so that their advises to a specific issue are only known by

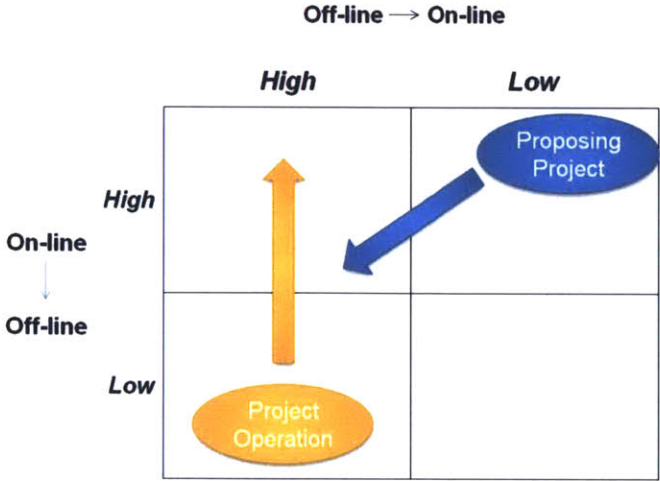
specific project teams. Other teams have to seek for the advises from other advisers or peer teams

- **Students:**
  - Busy in school works: students are always busy. Even NBN staff raised NextLab from 9 credits to 12 credits, which means course workload is 12 hours per week, students are still complaining that they are busy
  - Lost after NextLab: only 20.63% of NextLab students keep working on projects after the semester. The rest of them are responsive to inquiry about the project but not working on the project anymore.
- **Public Feedback:**
  - No long-term relationship: most of people visit project blogs and give comments in a casual basis. They leave comments and may not be back anymore. When project teams need further information, they cannot find the person and have to do their own research.

### 4.1.3 Proposed Solutions for NextLab 2.0

The goal of NextLab 2.0 is to solve social failures mentioned above. The first strategy focuses on improving on-line activities of proposing projects to raise the amount of feasible projects. Collecting projects is originally done by NBN staff via off-line activities, e.g. personal emails, site visits or teleconference, and the new strategy is to increase on-line activities through either Internet or Mobile network. People who have the ideas can share their findings on-line. This will help increase the amount of proposal and, moreover, on-line feedbacks from others can provide diversified point of views and may enhance the quality of the project. The second strategy is to get more stakeholders' involvement in the project operation in local regions after project deployment. The strategy encourages project team members who work collaboratively on-line to not only deploy the project at target regions but also have more incentives to execute and maintain

the project with off-line and on-line activities. Figure 7 shows the two strategies that leverage existing NBN relationships.



**Figure 14 – Leveraging Existing NBN Relationships**

4.1.3.1 Project Collection Strategy

SMS proposal submission and public voting and feedback for proposals, are proposed to generate excitement among people in developing countries and raise the project collection amount.

- SMS Proposal Submission**

SMS is the new and flexible way to collect projects from not only NGOs but also people, who are facing problems and don't have much time and resources to meet the exiting project proposing criteria. In the original NBN website, it requests project proposers to submit project description, target region, execution info and risk analysis, and encourages proposers to submit videos that introduce the project and show local situation and future operation plan. Even though the on-line form and videos can help collecting and filtering promising projects, they are culprits of low proposed project amount. Take Mzuzu at Malawi [18] for example, the whole city has only one satellite Internet connection that is shared by government, university, and private companies. Local people can only access Internet via

American Corner, the only Internet Café in the city. One-hour fee at American Corner equals to the cost of the one-week mobile phone bill.

The new function allows people to send their emergent needs or problems by using short messaging service on their mobile phone. By downloading a tiny Java application, which is developed by NextLab team to collect disaster data via Twitter and can be run on almost every low-end mobile phones, proposers can even send project proposal with more than 140 characters. The backend application can collect tweets and restore the proposal from several tweets. Proposals will then be categorized into Economic Empowerment, Education, Environment and Community, and Healthcare.

- **Public Voting and Feedback for Proposals**

After the proposals are listed on-line, everyone can vote and leave comments for preferred projects on-line or by sending SMS. What NBN wants to know is not only how many votes the project gets, but also how many people are facing the same problem and where they are. NBN Project Evaluation Committee will take the voting result in to consideration and choose projects that are doable and can sustain themselves and can be replicated in the future. In most target countries, the incoming message is free, so that proposers can choose whether to get weekly SMS notification about the voting status and the final feedback from the Evaluation Committee. If the proposal is approved by the committee, NGOs, technical advisors and engineers can bid to join the project team and start working with proposers to turn the short proposal into project plans. If the proposal is rejected, the proposer will be informed about the result and be advised on how to refine next proposal or just wait for the more similar signal from other regions.

The NBN staff expect to see more needs and ideas from the next billion mobile users, and the SMS proposal submission and public voting and feedback will let them know that their proposals are seen and valued by people around the world.



### 4.1.3.2 Project Vitality Strategy

Next Billion Network staff anticipates that the booming of mobile ventures in emerging regions. Therefore, the staff plan to incubate projects and fund promising projects to form new ventures. The new NextLab will be the centralized platform that matching diversified talents to form project teams, collecting funding from partnership and donation, and distributing resources to projects.

- **Talent Bank**

Undoubtedly, users are the most important asset of a social networking site. Prof. Mikolaj Jan Piskorsky at Harvard Business School analyzed the unique action clicks excluding navigation done by on-line social networks [Figure 15] and found that 79% of the clicks are watching profiles of friend, strangers and the users themselves [17].

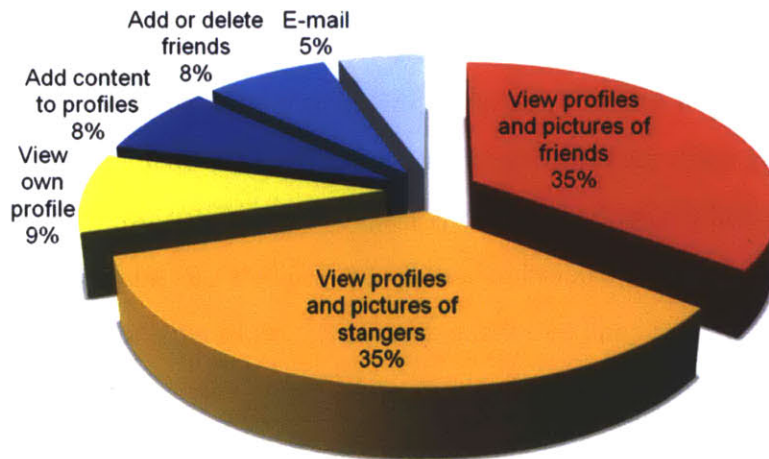


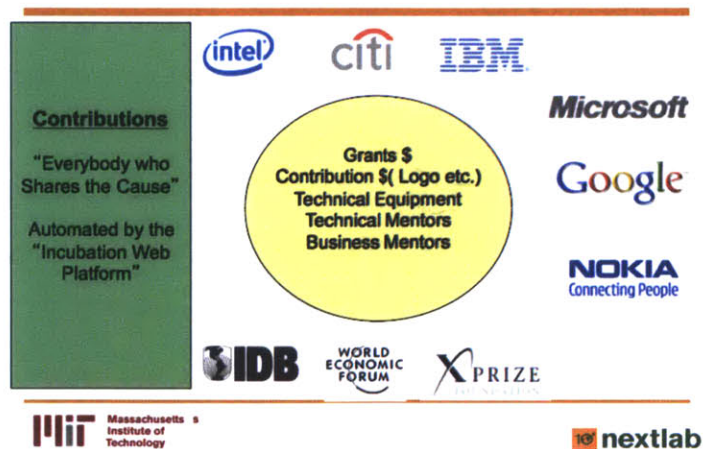
Figure 15: On-line social network: What do they do once they log on?

The NextLab website aims to be a talent searching and team formation platform that can attract not only entrepreneurs but also industry professionals and investors. How to attract more users and keep them in active state are very important to us.

The original NBN website only requests users to register with full name, email address and a functional role, which is insufficient for users to understand each other. The new NextLab will collect more personal information like background, technical skills, and shows credits for accomplished projects and testimonials from former project teams. The credits and testimonials from project teams give more incentives for members to work hard on their projects, and allow new project leaders to contact qualified members to form teams. Moreover, the NextLab website will encourage users to show their current status and location, so that others can understand each others more and find teammates or advisors from the target project deployment regions.

- **Partnership and Donation**

The Next Billion Network gets funding, hardware and software and technical advisors from partners like MIT Media Lab, Telmex, Nokia and Bank of America, and those resources are sufficient to sustain the NextLab project teams in each of the semesters. However, the new NextLab focuses on incubating projects proposed by community members, so that new fundraising sources need to be developed. [Figure 16] shows the existing and prospective partners.



**Figure 16: Existing and Prospective Partners of the NextLab**

NBN staff have reached corporations and organizations like Microsoft and X Prize and seek for partnership that can nurture more project teams. However,

partnership is not enough and hard to develop in this economy downturn. NBN staff plan to re-use the in-house developed micro-loan project and consult micro-loan model at kiva.org to get loans for promising mobile ventures and get donation for early stage projects. Loaners and donors can review projects and team members' profiles on the new NextLab website, and then decide where they want to put their money in. After ventures pay back loans, loaners can choose to invest the loan into NBN micro-loan pool again, or donate it to NBN or project, or withdraw their funding. Last but not least, loaners and donors will receive periodical project progress report to know the project status.

## **4.2 The Analysis of The NextLab Project Development Process**

As a hands-on design class, each of the NextLab project teams has to finish a working prototype and a venture plan in one semester. In order to ensure the success of NextLab projects, the NextLab staff keep improving the projects team structure and the design and development progress after the end of each semester based on the outcome of projects and feedbacks from students and partners. The design and development process is critical to short-term projects. It helps all participants clearly foresee the required tasks, work load and milestones from the start date of the project, so that they can well plan their schedule to balance their project work, lives, and other activities beforehand. The improvement of the design and development process not only helps the NextLab staff to supervise the progress of each project team, but also raises the success rate of each project.

In this section, I would like to discuss the original NextLab project model and the proposed NextLab Project Development Process that is refined by the feedback from NextLab students and alumni, and is integrated with the key findings in the social analysis in Chapter 4.1.

## 4.2.1 The Original NextLab Project Model

The NextLab staff intentionally integrated the project management milestones with the course syllabus to help students accomplish their prototype and sustainable plan in 15 weeks. The six milestones listed below were used in Fall 2008.

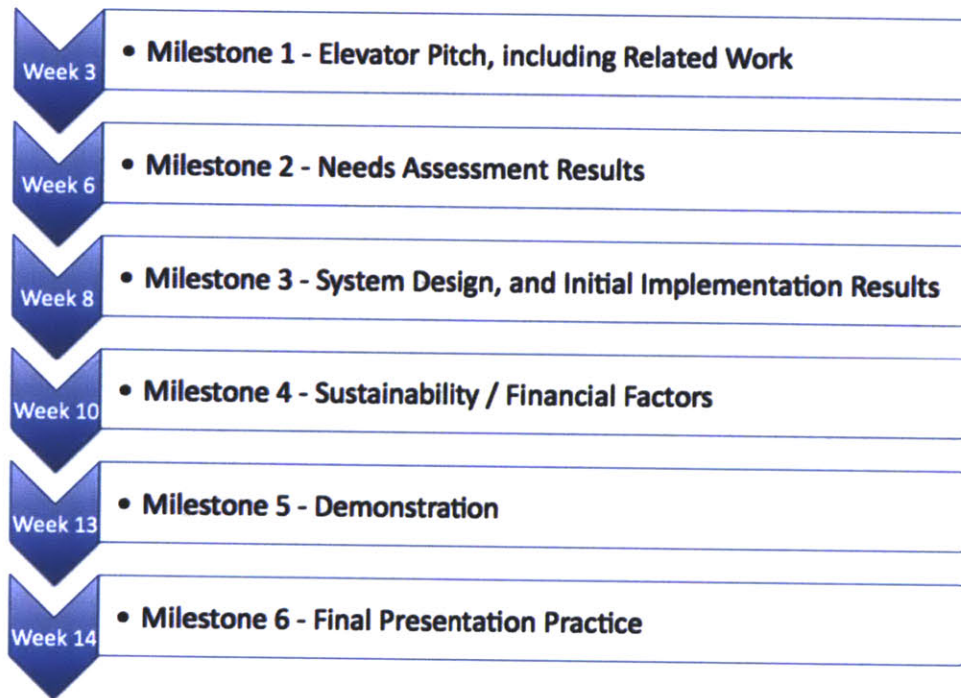


Figure 17: The Project Milestones for the NextLab Course in Fall 2008

- **Milestone 1** – Elevator Pitch, including Related Work (Week 3)  
In the first three week, each of the NextLab project teams has to talk to their project partner, industry advisors and potential users in the target emerging regions to discover the real needs and problems by interviewing people. After analyzing collected information, the team needs to propose a draft project plan and the team structure and present the findings in the class. On the due date, the project team will do the elevator pitch and present the project plan to NextLab staff, project partners and other students to get feedback and support.

Presentation format:

- Time: 10 minutes per team

- Content:
  - One-minute elevator pitch
  - Project plan – team organization, project scope, schedule and budget plan
  - Two-minute Q&A
- Due time: at 12PM on the presentation date
  
- **Milestone 2 - Needs Assessment Results (Week 6)**

NextLab teams start doing rigorous research for their projects. Each team needs to conduct a survey to evaluate the needs with prospective users in the emerging areas. The survey, starting with qualitative questions and ending with open-ended questions, reflects the real, urgent and undiscovered needs from local community. Project teams utilize the data to priority the features of their solutions and modify their project plans to ensure that the solution will solve major problems in the given timeframe, and will present their findings and updates of their solution and project plan in the class.

Presentation format:

- Time: 10 minutes per team
- Content:
  - The survey result and findings
  - Updated project plan
  - Two-minute Q&A
  
- **Milestone 3 – System Design, and Initial Implementation Results (Week 8)**

After updating project plans based on the real needs, students start to design and implement the solution. The system architects and the software developers work together to design the system architecture, use cases and wireframes, and then start to install the infrastructure and implement the service logics. The project managers oversee the project progress and coordinate the resources like external support, hardware and software. Students have to demonstrate their system architecture and use cases in the class.

Presentation format:

- Time: 12 minutes per team
- Content:
  - Project Scope
  - System Architecture
  - Wired frames
  - Updated project plan
  - Two-minute Q&A

- **Milestone 4** – Sustainability / Financial Factors (Week 10)

The sustainability officers and institutional relation officers start doing further market research and getting connected with other teams, alumni and industry advisors right after the Milestone 2. In the end, the sustainability strategies and financial statements have to be presented in the class.

Presentation format:

- Time: 12 minutes per team
- Content:
  - Sustainability strategy
  - Financial statements
  - Two-minute Q&A

- **Milestone 5** – Demonstration (Week 13)

All student teams demonstrate their prototype on mobile phones or on the websites in the Milestone 5. The Milestone 5 is also a checkpoint for NextLab staff to understand the real progress of each project. If the development progress is delayed, the NextLab staff can provide immediate support to the project team. Besides, project teams can get feedback from others to improve their user interfaces or service logic before releasing to the emerging areas.

Presentation format:

- Time: 12 minutes per team
- Content:
  - Technical demo by using mobile phones

- Two-minute Q&A
  
- **Milestone 6** – Final Presentation Practice (Week 14)  
In the end of each semester, the NextLab staff host an open event for student to exhibit their working to the public. In order to help students to be well prepared for the event, NextLab staff let project teams rehearse their presentation and demonstration one week before the event. Project teams get invaluable feedbacks from staff and peers, and have a chance to improve their prototype and presentation slides.

Presentation format:

- Time: 15 minutes per team
- Content:
  - Project Introduction
  - Sustainability plan
  - A three-minute video for demo
  - Five-minute Q&A

The original NextLab project model works for NextLab course in one academic semester. It helps students understand the project progress in the beginning of the semester and ensures the workload of each of the NextLab students. However, when trying to replicate the model to real-world mobile venture incubation and project management, the model misses some of the key processes. The author interviewed the NextLab staff, student and project partners, and proposed the new NextLab Design Process, which not only fits the NextLab projects in academic area but also serves as the project design framework for mobile ventures.

#### **4.2.2 The Proposed NextLab Project Development Process**

The NextLab project activities are analyzed and generalized into three phases and twelve stages. The three phases, the project planning, project design and

development and the project operation and maintenance, complete the original NextLab project model that misses the activities outside of the academic curriculum. The [Figure 18] shows the proposed NextLab Project Development Process (NLPDP) and its project phases, stages and the flow.

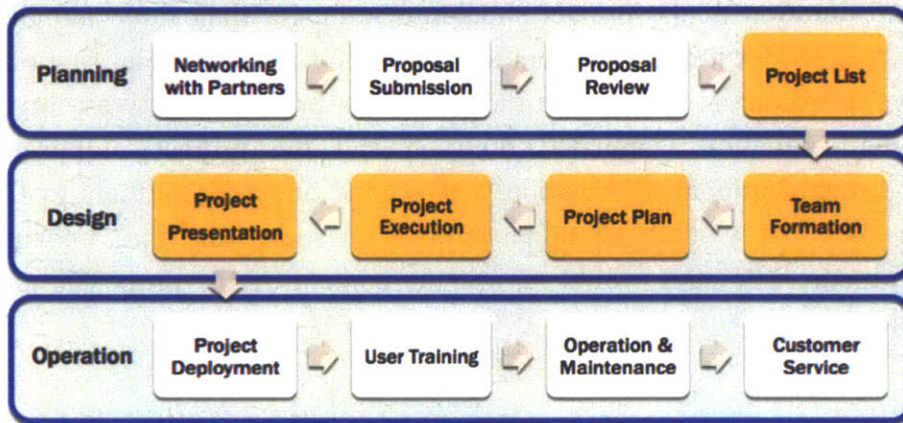


Figure 18: The NextLab Project Development Process

- **The Planning Phase**

The Planning Phase is suggested to start two months before the semester. The NextLab Alliance staff have to seek for potential partners, collect funding and proposals, and list featured projects during this phase. The information for the four stages is listed below.

- **Networking With Partners**

Objective: build partnership from project partners.

The staff in the NextLab Alliance can seek for prospect partners from existing NextLab project partners, who are willing to be reached. Besides, NextLab staff are strongly encouraged to develop new partnership from his or her own networking and academic research community. This is a long-term activity that the staff have to devote themselves developing and maintaining the partnership all the time. The direct benefits from the partnership include funding, professional advisors, hardware and software.



- **Proposal Submission**

Objective: collect real-world challenges that project partners are facing.

The proposed challenges have to be related to logistics and supply chain, and the estimated duration of the project shouldn't be longer than three months. There are two ways for project partners to submit their proposal. The first one asks partners to fill out an on-line form to show their project objectives, target region, current situation, estimated duration and the project proposers' personal and organizational information. The second one asks partners to fill out an on-line survey that contains critical questions on the website, [mlogistics.mit.edu](http://mlogistics.mit.edu). The staff would review the content of the proposals and survey results.

- **Proposal Review**

Objective: categorize common issues among proposals and identify or compose innovative projects

After proposals are submitted, the NextLab staff review and categorize each of the proposals by using pre-defined criteria. The project assessment criteria, including current logistic resources, logistic performance, the possible involvement of mobile technologies, the estimated project duration and the foreseen impact on the target community, are used to sieve proposals and survey results. This is a two-way process. The NextLab staff and project proposers collaborate together to dig out more information when evaluating proposals. The NextLab staff can request more information from the proposers for the selected projects or to introduce the proposers to other organizations that can provide more appropriate support to solve the problem.

- **Project List**

Objective: show pre-selected project information to the public

The NextLab staff collect interests and challenges from partners and develop them into term-long projects before the semester starts. NextLab students

review those proposals on NextLab course website and may contact the instructors and partners to learn more about those projects before bidding for their term project.

- **The Design Phase**

The Design Phase starts with the semester. Students have to quickly select one of the projects and design and develop the prototype and business plan in three and a half months. There are four stages in the Design Phase, and they are coupled with the eight milestones. The four stages are for the overall project progress review. The eight milestones give students clear and detailed view about their project scope in the beginning of the semester, and also balance the workload of each of the student in a team.

- **Team Formation**

Objective: form project teams with diversified students in specific roles

NextLab integrates both mobile prototype development and business case design in team projects. Both of these are an integral part of the course and have to be done in teams of three to five students. NextLab students bid for the specific roles, the Project Manager, the System Architect, the Software Developer and the Business Manager, in their preferred projects. Those roles may have more than one person, but one person from each role must be in the leading position, so that he/she can make the final decision on behalf of the team. The responsibility of each role is listed below.

**Project Manager** communicates with all team members to write the project plan, which contains the project scope, schedule, risk analysis and contingency plan, and leads the team to the success.

**Business Manager** conducts market research and writes the pro forma finance statement and the fundraising plan. The Business Manager's work will then be turned into the business plan with the support from the whole team.

**System Architect** leads the team to identify the real user needs and problems in the target community, and develops the findings into the system architecture, which contains the functions, interfaces and adopted technologies.

**Software Developer** implements the codes that fulfill the system architecture developed by the team. The person also leads the testing and user training processes that require the participation of the whole team.

- **Project Plan**

In this stage, the project teams have to identify the hidden needs or problems for their projects, and then define the project plan and sustainability strategies. For example, the project partner of the BeeHive school project proposed to use mobile phones as the teaching material and the tool to get parents involved in the learning progress at home. However, after interviewing with primary school teachers, students and parents at Muzuzu, Malawi, the architect found that the mobile network signal is unstable in the region. Moreover, the voice call is too expensive and 36% of the short messages get lost during transmission. From the feedback in the interview, the team identified the real need of stakeholders is more educational information that can open children's eyes. In the end, the team designed and developed an off-line Internet service that provides students with health, history, geography and mathematics contents from partner websites. To achieve this project, the team sought for donation for old computer equipment and the funding to ship them from big cities to Muzuzu from the beginning of the project. After the user needs are found, the architect will transform the needs into functions, interfaces, components and the system architecture. The architect and the Software Development lead have to collaborate together to develop the system and perform the integration test before deploying the system to the target place.

After the user needs are found, the architect will transform the needs into functions, interfaces, components and the system architecture. On the NextLab website, each of the project teams has its own project portal that is integrated with the front page, the blog, the project management service and the membership function. The project teams have to utilize this portal

to show the project progress, request for help, or call for testing. The project teams have to finish the project plan in this stage and have to start writing business plan, testing plan, deployment plan, operation plan and user training documents after this stage.

- **Project Execution**

Objective: compose the business plan and service documents and implement the solution

The architect and the software developer have to collaborate together to develop the system and perform the integration test before deploying the system to the target place. In the meanwhile, the project manager and business manager have to figure out the sustainability plan and compose the business plan. The whole team has to work together to cook the testing plan, deployment plan, operation plan and user training documents in this stage as well.

- **Project Presentation**

Objective: share project information, prototype and documents

In NextLab 2.0, each of the project teams has its own project portal that is integrated with the front page, the blog, the project management service, the discussion forum and the membership function. The project teams are encouraged to utilize this portal to show the project progress, request for help, or call for testing. Besides, the NextLab staff would host an open event twice a year and every team is encouraged to demonstrate the working prototype and present the business plan to the public.

- **The Operation Phase**

The Operation Phase starts after the end of the semester. Students may stop working for NextLab projects after the schoolwork is done, so that the NextLab staff need to attract enough students, volunteers, project partners to

work in this phase. The team works as a whole to compose the deployment plan, training materials and the operation manual.

- **Project Deployment**

Objective: deploy and test the service in the target regions

In the project plan stage, the project teams go to the target region to deploy the service with the support of project partners. The teams start preparing the deployment plan and test plan since the project plan stage in the design phase, and will deploy the service and conduct tests with target users by following those plans. The deployment plan should cover the cost and availability of electricity power source and telecommunication infrastructure to ensure that the infrastructure can sustain the service.

- **User Training**

Objective: train users and start marketing the service

By using the training and marketing materials written in the design phase, the NextLab teams go to the target users and promote the service by running training sessions and marketing events. It is key to their success to have more people in the target areas learn about the projects and perceive the needs and benefits of the services.

- **Operation & Maintenance and Customer Service**

Objective: set up routine service maintenance and provide customer service to target users

After the deployment, if the teams decide to start their own venture, they have to perform regular system check to secure the operation and quality of the whole system. The project team can go through the NextLab community website to get in touch with people, who are capable of running the daily operation or being a customer service support in the target regions.

The NextLab project flow covers the most important stages that can give the project teams a holistic view of their project in the beginning. The NextLab staff keeps collecting feedbacks from NextLab students, project partners and industry advisors. After collecting those feedbacks, the NextLab staff refine the project phases and stages based on the feedback analysis to ensure that the whole process is up-to-date and meets the trend of environment and technology changes.

By integrating the researches, the NextLab 2.0 Community website is designed and developed in Fall 2009 to be the social networking platform for mobile entrepreneurs. The website integrates the proposed social network solutions with the NextLab Project Design and Development Process to encourage collaboration of the community members and facilitate the design and development of innovative mobile services. The major features are exhibited in the case study in Chapter 5 and the detailed design of the NextLab 2.0 Community website is in the Appendix 2.

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# Chapter 5

## The Case Study of the m-Logistics Projects

In January 2010, the NextLab 2.0 website was launched at MIT to test the new social networking approaches and project development process proposed in Chapter 4. Students from MIT in the United States, University in the West Indies (UWI) in Trinidad and Tobago and Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM) Campus Cuernavaca in Mexico were allocated to eight teams. The NextLab staff, students, partners and industry advisors joined the on-line community to know each other by sharing their profiles, resumes and recent activities, and to collaborate together by using project portals, project management service and team calendars. This chapter reviews the m-Logistics projects from the planning phase to the deployment phase and showcases how NextLab staff, students and project partners use the NextLab 2.0 to collaborate with each other.

### 5.1 Introduction

The m-Logistics is a research project at the NextLab program. The goal of the project is to solve the last mile delivery issue in the developing countries by using mobile technologies. When doing research, the NextLab staff was inspired by the lunch box delivery service run by dabbawalas in India. Dabbawalas are people who collect lunch boxes from workers' homes in residential areas and restaurants [20] and deliver them to workers' offices in cities and suburbs. They get service requests through text message on mobile phones, and use color codes or symbols on the lunch boxes to indicate the railways and destination of those lunch boxes [21]. The NextLab staff noticed the phenomenon and thought about using the similar model to deliver



package to rural areas by utilizing dynamic couriers, like dabbawalas, who are geographically around the shipping path and are available to deliver a package, to solve the last-mile delivery problem in emerging areas.

The objective of the m-Logistics project is to build up mobile-enabled delivery system by using dynamic freelance couriers to deliver packages to people in rural areas, where courier companies charge users high delivery rate or don't provide the service. The [Figure 19] shows the projected service flow of the m-Logistics project. Freelance couriers deliver the package by using their preferred transportation approaches, and would give the package to the next courier if the route is out of their preferred areas.

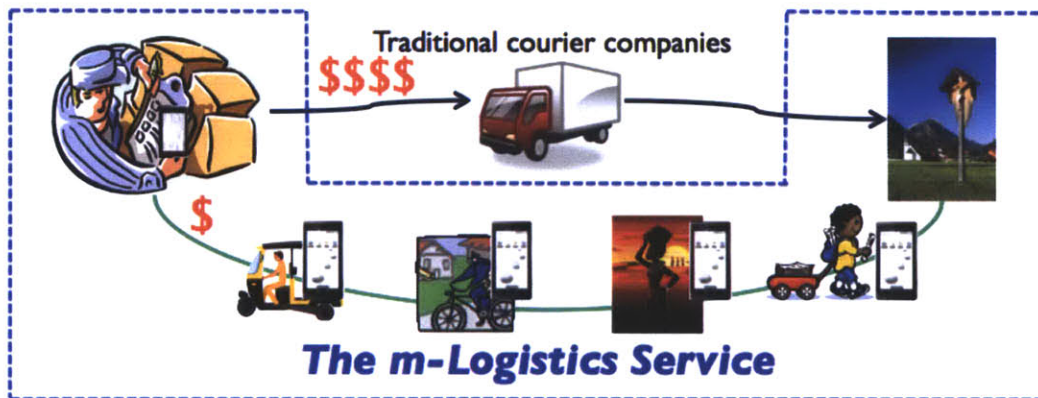


Figure 19: The projected service flow of m-Logistics project

After conducting research, the staff found that the project could be divided into seven independent mobile and logistic projects. In one hand, the seven independent projects gave project teams the freedom to design their own innovative solutions, but in the other hand, the integration of the seven projects was foreseen to be the most critical task of the m-Logistics project. Those seven project teams were expected to show their creativity and, at the same time, collaborate closely with each other to enable the success of the m-Logistics project. In the former NextLab courses, each of the project teams built independent solution by using preferred tools, servers and programming languages. This is the first time in the NextLab history to have a

large project that needs extensive integration of seven projects, but it gives the staff a great opportunity to test out the NextLab 2.0 community website.

## 5.2 The Planning Phase

In October 2009, the staff proposed the concept of m-Logistics to their industry partner, Estafeta, the leading courier company in Mexico, and the company representative showed high interests in the research about using dynamic human resources and mobile technologies to solve the last-mile delivery problem. Chung-En Kao, an experienced Supply Chain and Logistics expert from MIT System Design and Management program, then joined the staff in November 2009 to lead the research. Kao co-worked with the staff and the project partner and identified seven critical challenges [Figure 20] that were developed into the projects of the NextLab course in Spring 2010.

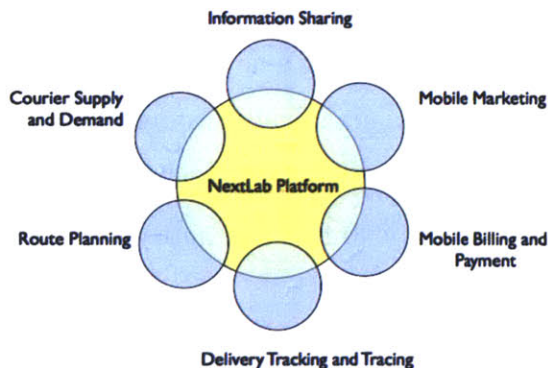


Figure 20: The Seven Challenges in the m-Logistics Project

- **Information Sharing:** When using the m-Logistics service, a shipper has to pay couriers, who get the delivery job and deliver the package to its destination. However, freelance couriers, who have free time and want to earn money, would not know a shipper in another city wants to send a package, unless the shipper knows them and calls them directly. Information imbalance, between supply and demand of delivery jobs, is definitely the most critical issue of the m-Logistics project. The goal of the Information Sharing project is to help the package shipper

find available dynamic couriers to deliver a package to a place that courier companies don't cover, and help freelance couriers know when there are new shipping jobs available [Figure 21].

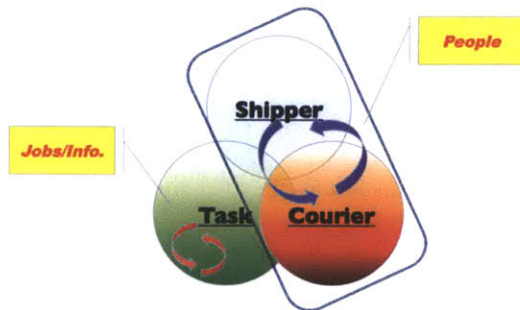


Figure 21: Information Flow in the m-Logistic Service

- Courier Supply and Demand:** When sending a package, a shipper wants to make sure that the package can be delivered to the receiver on time and remains intact. The Courier Supply and Demand project provides the solution that filters couriers by using couriers' credibility, availability and location and matches the right couriers to the shipper [Figure 22]. Instead of broadcasting a new delivery job to all couriers, only couriers, who are available and geographically around the delivery path and who are credible, will be notified with the new package shipping information. The objective of the Matching project is to find and notify qualified couriers for a delivery job.

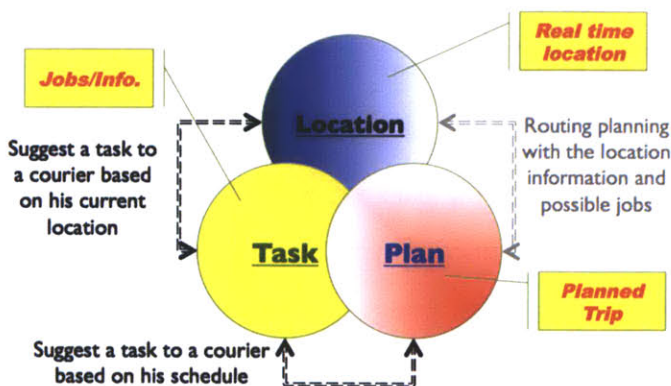
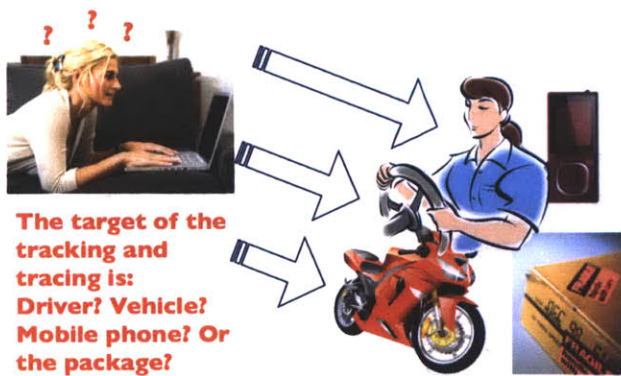


Figure 22: The Key Elements of the Matching and Route Planning Challenges

- Route Planning:** The delivery path for a traditional logistic service affects many aspects, like the availability of vehicles and drivers, the consumption of energy and time and operation cost. However, for the m-Logistics project, the delivery path may affect the courier matching rate significantly, because there may not have enough couriers in the areas of the shortest or fastest route between the starting point and the destination. The Route Planning project is aimed to provide a special algorithm to calculate several optimized routes that have sufficient couriers in the selected areas, so that it also needs to know couriers' location and availability [Figure 22]. This project utilizes the user location and availability to find out the optimized routes.
- Tracking and Tracing:** By using freelance and dynamic couriers to deliver a package to a rural area, the real time status check for a package becomes another critical issue [Figure 23]. Besides the courier credibility issue, a package may still be lost, stolen, robbed and damaged. The objective of the Tracking and Tracing project is to develop a low cost and reliable service that can not only show the location and integrity of a package to authorized stakeholders but also raise the successful delivery rate.



**Figure 23: The Tracking and Tracing Challenge**

- Mobile Billing and Payment:** A mobile billing and payment system is the heart of the m-Logistics project. The system not only accrues shipping fees from shippers via mobile phones, but also pay couriers after they accomplish delivery jobs

[Figure 24]. The objective of the Billing and Payment project is to build a solution that can not only manage the payment but also find out a business model to sustain the whole m-Logistics project.

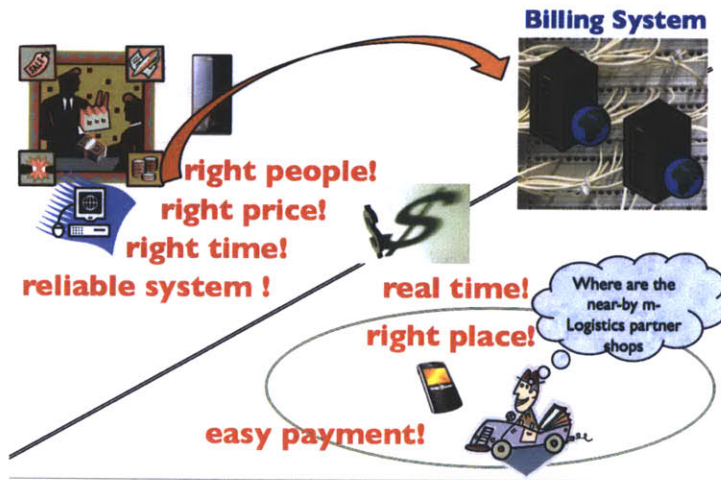


Figure 24: The Mobile Billing and Payment Challenge

- **Mobile Marketing:** All the challenges above would build up a logistic platform with vast mobile users that provide a great arena for mobile marketing [Figure 25]. Moreover, some of the users in the platform are freelance couriers travelling around to deliver packages. How to turn those couriers into travelling salesmen is another interesting topic. The objective of the Marketing project is to develop a business model that makes mobile marketing a profitable business.



Figure 25: The Marketing Challenge

- **Application Platform:** Before Spring 2010, 23 NextLab projects are developed in six different programming languages, four mobile platforms, four web server and five operating systems, which results in 23 different application servers. It is acceptable for those 23 independent projects. However, for m-Logistics projects, the first six challenges interact with each other extensively, so that the final system integration will be a serious problem if the six projects are developed in different technologies. The Application Platform challenge aims to solve the interoperability issue. The objective of the Application Platform project is to develop an architecture that can provide a general application execution environment and a common service development method for the all the challenges of the m-Logistics projects.

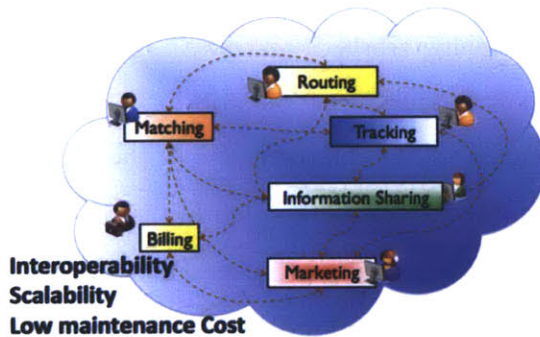


Figure 26: The Application Platform Challenge

Besides conducting the research of m-Logistics projects with the project partner, the NextLab staff also got the commitment from the partner that the pilot test of the m-Logistics project would be held in Mexico with the support from the company during the summer. All NextLab stakeholders, including the staff, project partners and industry advisors, and prospective students were encouraged to sign up an account at the NextLab Community website [Figure 27] at <http://nextlab.mit.edu>.



Figure 27: The Homepage of the NextLab 2.0 Community Website

The homepage of the site gives general visitors an overview of the NextLab program. Along with the introduction texts, the four-minute video in the page showcases the program with video clips from outstanding projects. Prospective NextLab students, project partners, industry advisors and mobile service users can then go to other pages to explore more about NextLab. The registration and sign-in module is on the top right corner. A visitor can register for a new account by either filling out the registration form or using the Facebook Connect function.

The Community page <sup>2</sup> [Figure 28] on the website contains all the social networking functions. It shows NextLab members' personal headshots, resumes, recent activities, project portals, and project pictures and videos. Moreover, it interacts with other social networking websites like Facebook and LinkedIn to help people roam among social networking sites without hassle.

<sup>2</sup> The community functions are integrated and customized from open source content management system, Joomla and the professional components, JomSocial and JoomlaXi.

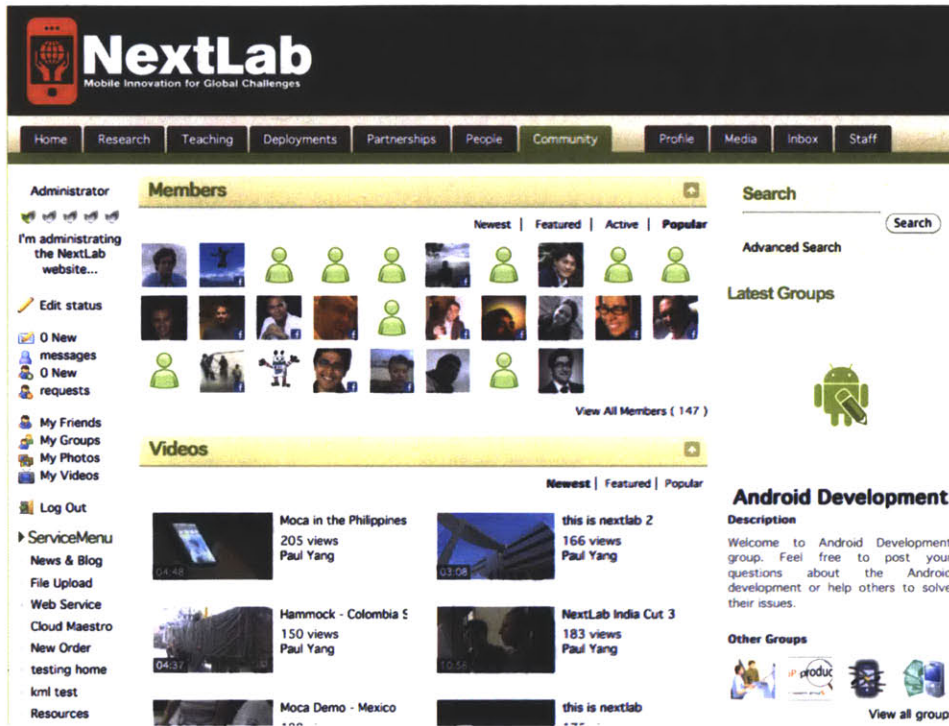


Figure 28: The NextLab 2.0 Community Page

The **Facebook Connect** function allows people to sign up and sign in the NextLab 2.0 Community with their Facebook account. In this way, they don't have to fill out the registration form and remember another set of the account and password. All they have to do is to sign in with their existing Facebook account, and their personal profiles will be imported from Facebook directly [19]. Moreover, community members can share their activities at NextLab with their friends on Facebook seamlessly. This feature let friends of NextLab members know what's going on at NextLab and expose NextLab to more prospective members.

Besides porting personal information from Facebook, the NextLab website also allows members to import professional profile from LinkedIn, a social networking website for professional network. If the community members are not LinkedIn users, they can still compose resume by filling out the resume form on the community website. Their professional resumes will then be generated and shown along with their personal profiles.



They can watch the video clips of former NextLab projects and look for people who they want to work with for the semester-long projects. After identifying the seven challenges of the m-Logistics service, the staff listed the seven challenges in January 2010 for prospective students at MIT, UWI and ITESM to preview before the semester starts.

### **5.3 The Design Phase**

The design phase started with the spring semester. Eight teams, one field research team and seven mobile and logistics project teams, were formed by students from MIT in USA, ITESM in Mexico and UWI in Trinidad and Tobago to design and develop the m-Logistics projects.

Nine ITESM students, majoring Industry Engineering, Business Administration, International Business, formed the field research team to do research about the six topics below in January 2010.

- Mobile Industry in Mexico, at the consumer level
- Marketing/distribution cost breakdown of a wide array of critical products in Mexico
- Creating the m-Logistics stakeholder ecosystem in Mexico
- Physical and operational problems of delivering critical products to rural and remote zones in Mexico
- The industry of independent, informal couriers in Mexico
- What products do poor people in Mexican rural/remote places really need?

The research results revealed 49% of Mexicans in the low-income socioeconomic segment have a mobile phone, and 78% of the population subscribed to the mobile service. Moreover, 6% of the mobile subscribers use a smart phone [22]. The result showed great potential for mobile and logistics service in rural areas. The

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six student research reports identified target users, showed positive feedbacks from potential users and partners and provided abundant information about the mobile and logistics industries in Mexico.

The seven logistics project teams were officially started in February 2010. The NextLab staff and the field research teams presented the seven m-Logistics challenges and the field research results to the whole class, and students from MIT, ITESM and UWI selected their preferred challenges and formed teams in the first two weeks. Teams had to figure out the name and the slogan of their projects [Table 2].

**Table 2: The Name and Slogan of m-Logistics Projects**

Challenge	Project Name	Slogan
Information Sharing	Common Denominator	Sharing with a common language
Courier Supply and Demand	SmartLink	Intelligent Delivery
Route Planning	Mobilizers	From A to B with the Click of a Key
Delivery Tracking and Tracking	Trakken	We'll find it...where it's going and where it's been
Mobile Billing and Payment	m-Billing	Distributed Mobile Payments & Billing With Global Reach
Mobile Marketing	MoMa	Finding Partners You Can Trust
Application Platform	Cloud Maestro	The symphony from the sky

It is very important for students to know their classmates before forming a team, because each of the project teams had to design and develop a working prototype, write a business case and present their works in the NextLab event in three and a half months, and students do want to work with energetic, responsible and competent teammates. Therefore, students were asked to register at the NextLab 2.0 website, so that they can share their personal profile and resume with each other.

All NextLab project activities were done on the NextLab 2.0 website. Teams created their own project portal and started planning their projects by using the project management service on the NextLab 2.0 website. Besides, the NextLab technical staff

created and ran on-line user groups to share information and skills about mobile application development and testing approaches.

The project portal<sup>3</sup> allows students to share the progress of the projects and facilitates the discussion among teams. For example, when designing the database schema, the architects and software developers from each of the teams and the staff used the discussion function on the project portal to share individual database schema and give feedbacks to other teams. With the easy-to-find and transparent database schema sharing and discussion, the seven teams created a centralized database, which stored user accounts and shipping orders for the overall m-Logistics service, and seven project databases, which stored data for individual project needs and maintained data integrity. An example of a project portal is shown in [Figure 29]. The site provides project teams an alternative for teams to design their own homepage of their projects.

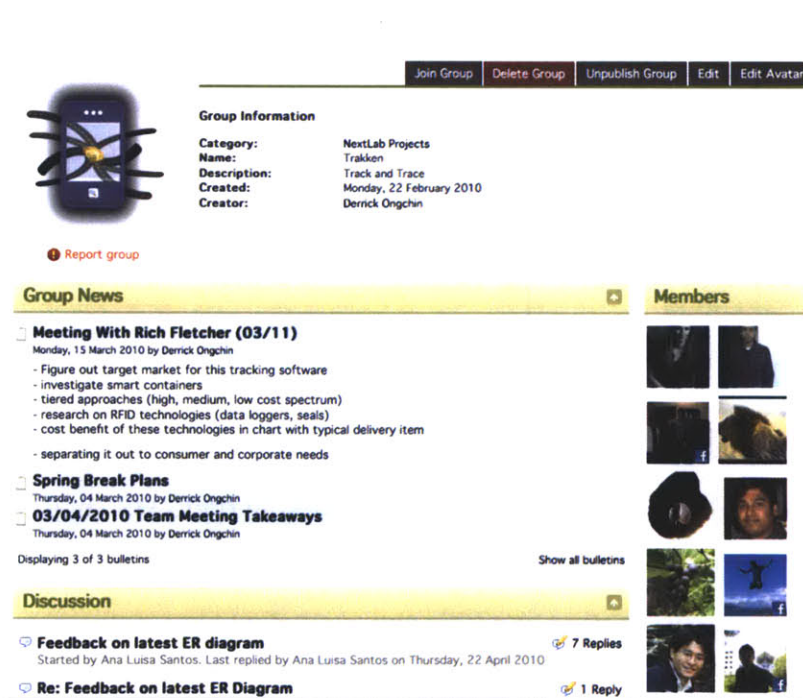


Figure 29: The example of a project portal

<sup>3</sup> The project portal function is customized from the “Group” feature of JomSocial, a professional social networking component of Joomla, an open-source content management system

Besides sharing activities Project teams managed their projects by using the project management service <sup>4</sup> on the NextLab 2.0. The project manager in each of the teams was in charge of maintaining the milestones, tasks, priority, resources and schedule of the project. The manager discussed with team members to break down the tasks, assign dedicated members to it with priority and the deadline [Figure 30]. The assigned members were in charge to update the progress frequently. With the on-line data, the staff, project partners and team advisors can easily know the progress of those projects and can understand the workload and performance of each project and each student. The staff also reviewed the project management service regularly and helped project teams to balance the workload of each member and provided immediate support to teams with slow project progress. Five out of the seven teams successfully and smoothly utilized the service to manage their projects. After interviewing with project managers in each team, I found that the NextLab project managers, who had used project management tools or had participated in the project management courses, thought the project management service is very useful. They know how to break down tasks and learn how to use the service quickly, but the other managers struggled finalizing the tasks and schedule with their team members and don't see the value of the service. It is suggested to have more lectures about the overview of project management skills and tools, so that all NextLab students can know the true value of the project management service and have stronger incentive to utilize it.

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<sup>4</sup> The project management service is customized from Projectfork, an open source project management system.

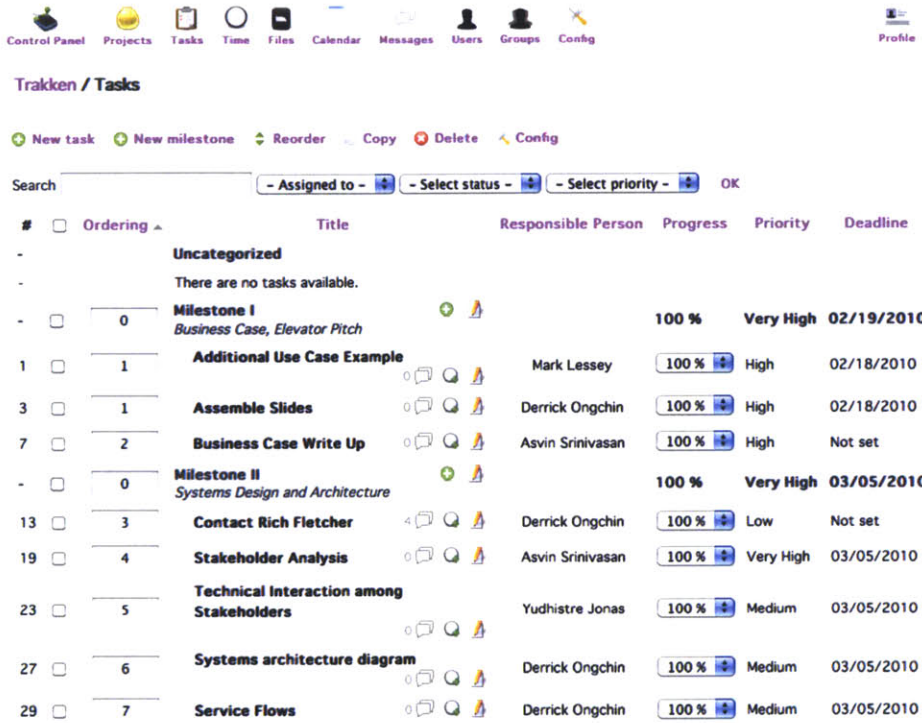


Figure 30: The Example of the Project Management Service

The integration of the m-Logistics projects was foreseen to be a critical success factor of the project by the NextLab staff. Therefore, Ana Luis Santos, a MIT Media Lab Alumni, joined the NextLab technical staff as the Technical Program Manager working with the author to manage technical aspects of those projects.

The technical staff held a thirty-minute weekly technical review meeting to track the development progress of each project. All technical students in the class were requested to attend it, and non-technical students were also welcome to join it. In the beginning of the meeting, each technical student had one minute to share what the person has done and what he is going to do. This one-minute review forced students finishing as many promised tasks as possible before the meeting and let students be aware of what's next on the to-do list. Students can also know what others were working on, so that they can collaborate together to ease the burden. After the review, the technical staff presented a related technical topic, ranging from setting up the Android Development Environment on a PC to how to develop a Web Service that

uses Simple Object Access Protocol and how to use Subversion, a version control tool, to maintain source codes. The meeting ended up with questions and answers. The staff can well track students' progress in the 30-min weekly meeting, and students can call for help and get immediate feedback. All meeting minutes were posted on the Tech Developers Corner group on the NextLab 2.0 website.

The staff also created two on-line groups, the Tech Developers Corner and the Testing group, to share technical skills and resources with students and ensure the success of the m-Logistics projects. The NextLab staff evaluated the price, penetration rate and functions of various kinds of mobile phones before the semester started, and decided to use Andorid phones for the course. Because no students in the course had developed Android applications before, the learning curve was expected to be high. Therefore, besides showing students how to do mobile application development in the weekly technical review meeting, students can also find step-by-step instruction to set up a local mobile development environment and the service development guide stating the coding conventions and development and deployment examples of Web Service functions [Figure 31] in the Tech Developers Corner group.



Join Group

#### Group Information

**Category:** Technology  
**Name:** Tech Developers Corner  
**Description:** Resources for our technical developers.  
**Created:** Friday, 19 February 2010  
**Creator:** Ana Luisa Santos

#### Group News

##### **Technical Review Meeting Agenda - May 06th**

Wednesday, 05 May 2010 by Ana Luisa Santos

Dear NextLab technical developers,

On May 06th our tech review meeting will be an open Q&A session. It's an opportunity to ask questions to other teams and to NextLab tech staff.

Please coordinate with your Sloan team members what and how your demo will be recorded on video this Friday. Take time to wrap up your code and to show it to your Sloan peers.

Please feel free to contact us if you have any questions or concerns. Thank you.

Best regards,

NextLab tech staff

##### **Please Use The Android Development Group To Share Questions And Hints.**

Friday, 30 April 2010 by Ana Luisa Santos

##### **Technical Review Meeting (Including Next Steps) - April 29th**

Thursday, 29 April 2010 by Ana Luisa Santos

##### **Technical Review Meeting (Including Next Steps) - April 22nd**

Saturday, 24 April 2010 by Ana Luisa Santos

##### **Technical Review Meeting (Including Next Steps) - April 15th**

Saturday, 17 April 2010 by Ana Luisa Santos

##### **Announcement: Development Progress As Per 04/07**

Friday, 09 April 2010 by Ana Luisa Santos

##### **Technical Review Meeting - April 8th**

Thursday, 08 April 2010 by Ana Luisa Santos

##### **Announcement On Service Flows To Be Delivered On 04/13 + Requests**

Friday, 02 April 2010 by Ana Luisa Santos

#### Members



Show All (27)

Figure 31: The Tech Developers Corner group

The second group is the Testing group. All NextLab students, staff and advisors joined it. After developing a Web Service function, developers were asked to deploy the function to the application server and post the link of the test page to the Testing group. Every Testing group member would receive an email when a new post arrives, and was encouraged to test the function and write down test result and feedbacks after testing it [Figure 32]. In this way, one function was tested by five people in average. Those feedbacks from multiple users were very useful to technical students, who can then find and fix bugs, modify user interface, and identify integration issue in early stage.



<p>🔍 <b>m-Billing checkBalance Function</b> Started by Joaquin Moreno.</p>	<p>🗨️ 4 Replies</p>
<p>🔍 <b>m-Billing reloadMoney Function</b> Started by Joaquin Moreno.</p>	<p>🗨️ 4 Replies</p>
<p>🔍 <b>m-Billing addUser function</b> Started by Joaquin Moreno.</p>	<p>🗨️ 10 Replies</p>
<p>🔍 <b>CMAlarm SendAlarm Function</b> Started by Fernando.</p>	<p>🗨️ 5 Replies</p>
<p>🔍 <b>MRRoutingCalc getMinFuelCost Function</b> Started by Tremayne Flanders.</p>	<p>🗨️ 5 Replies</p>
<p>🔍 <b>CD signUp function</b> Started by Miguel Ugalde Garcia.</p>	<p>🗨️ 8 Replies</p>
<p>🔍 <b>changePassword Function m-Billing</b> Started by Joaquin Moreno.</p>	<p>🗨️ 4 Replies</p>

**Figure 32: The list of functions in the Testing group**

By using the NextLab 2.0, the seven project teams and the field research teams can easily collaborate together even though their teammates were in different countries, and the NextLab staff were able to provide timely help to project teams. In the mid of April 2010, the seven project teams started integrating their individual services into the m-Logistics service. One Android application was developed by the seven teams together to enable the user interaction. The release of integrated mobile application was announced in the Testing group, so that everyone can download it and help test it on mobile phones. Besides the prototypes of the seven projects, the MobiHive, the mobile application of the m-Logistics service, was integrated with functions from the seven projects. The prototypes and the mobile application was showcased in the NextLab event, which was held at Stratton Student Center at MIT on May 11<sup>th</sup>, 2010. The event was open to the public and all NextLab stakeholders were invited to attend the poster session and formal presentations given by project teams.

The Common Denominator team, who worked on the Information Sharing challenge, designed a sticky, fun and trusted mobile service that was the portal of all m-Logistics projects and elaborated on social gaming tactics, like showing user rating and honoring the best courier of the week, to keep users not only staying with the service but also delivering packages with the highest performance and best quality.



Figure 33: The Features and the Wired Frame of the Common Denominator Project [23]  
 (Source: the final presentation of the Common Denominator team)

The SmartLink team that addressed on solving the Courier Supply and Demand challenge showed a courier matching service that “improves efficiency and reach of deliveries to the bottom of the pyramid, provides income opportunities to outsourced couriers, and mitigates risk by increasing shipper knowledge about and choice of couriers.”

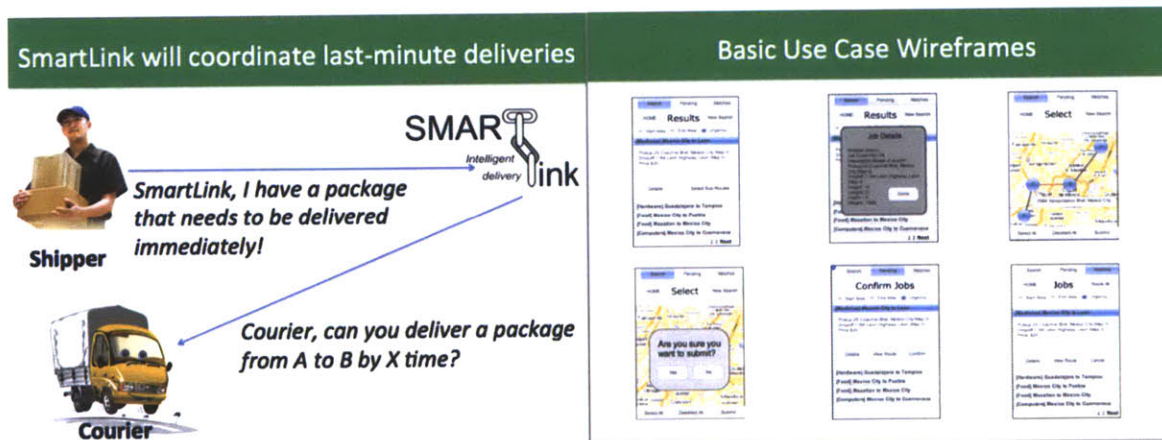


Figure 34: The Solution and Wired Frames of the SmartLink Project [23]

The Mobilizers team, who focused on the Route Planning challenge, utilized an algorithm to calculate the optimized route for a shipping order based on the availability of couriers and the location of those couriers. The algorithm was

integrated into the SmartLink's courier matching service, and used the courier data collected by the SmartLink's application to optimize the delivery route.

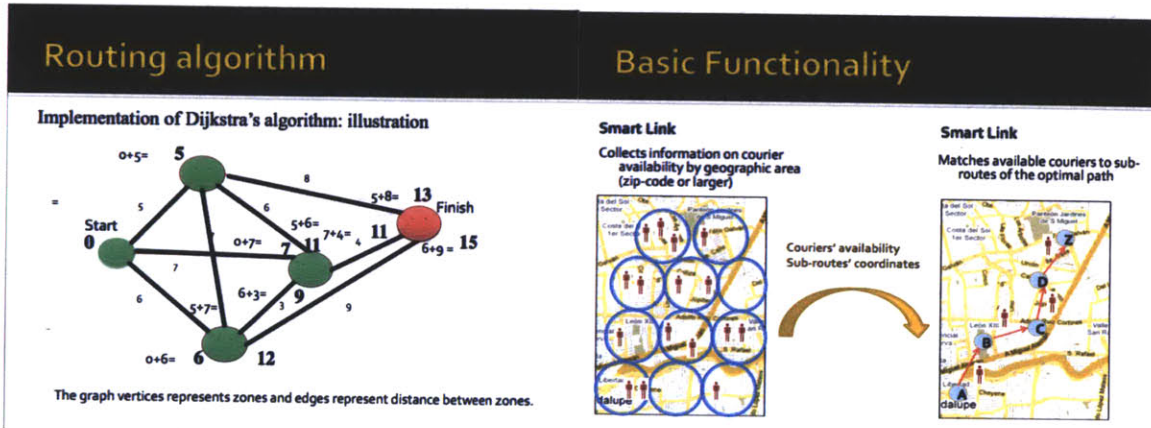


Figure 35: The Routing Algorithm and Wired Frames of the Mobilizers Project [23]

The Trakken team worked on the solution of the Tracking and Tracing challenge. They demonstrated the application that integrated bar code reader and GPS tracking services on the Android mobile phone to enable the secure package delivery acknowledgement and show real-time package tracking service to the shipper and receiver.

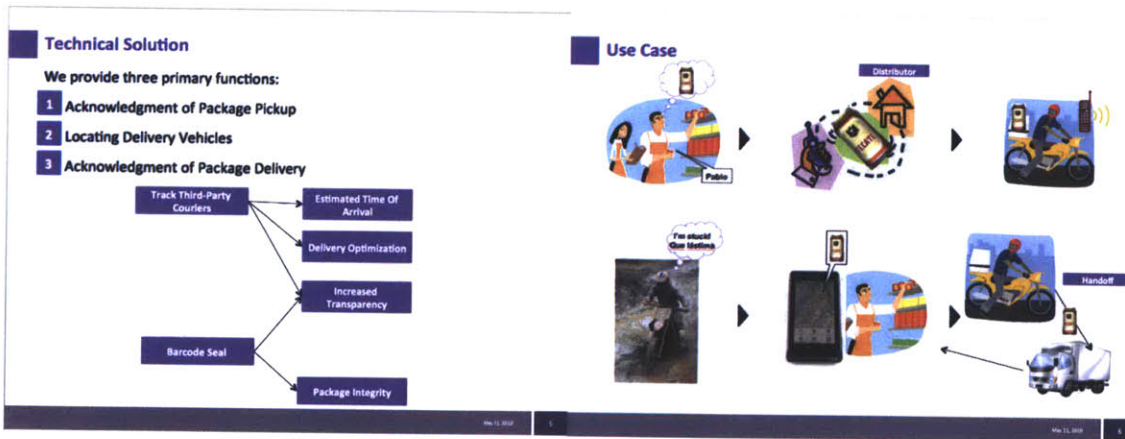


Figure 36: The Solution and Use Case of the Trakken Project [23]

The m-Billing team that addressed on solving Mobile Billing and Payment challenge designed and developed the carrier-independent and convenient mobile billing and payment service. Currently, most of the successful mobile money transfer

services are developed and run by telecommunication operators, for example Smart Money [24] run by Smart Communications in Philippines and the M-PESA run by Safaricom in Kenya [25]. Mobile users have to be the subscribers of specific operators to get the service. With the carrier-independent feature, the m-Billing service and reach more unbanked people in the rural areas to provide a safe and convenient way to deposit money into their m-Billing account and pay for purchases and package shipping by using mobile phones.




Mobile Payments Global Challenge	m-Billing As A Mobile Payments Platform
<p><b>Situation</b> 3-4 billion people living at the “base of the pyramid”</p> <p><b>Challenge</b> To make Last Mile Delivery a reality, new payment, billing &amp; invoicing systems are needed to serve the “underbanked”</p> <p><b>Solution</b> New financial exchange platform and tools</p> 	<p><b>m-Billing</b> Personal Mobile Billing With Social Media</p> <ul style="list-style-type: none"> <li>• Carrier independent mobile payments system</li> <li>• Mobile app based</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Distributed network of agents exchange money for mobile credits</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Consumers use credits to transfer money or purchase goods</li> </ul>  

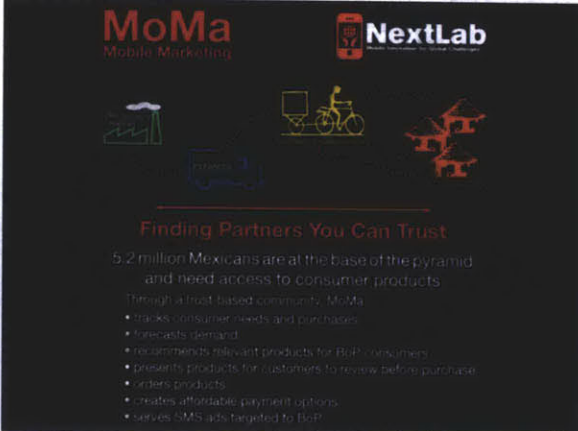
Figure 37: The Description and Features of the m-Billing Project [23]

The MoMa team developed the solution of the Mobile Marketing challenge. They enabled couriers, who deliver package to rural areas, to be travelling salesmen. The MoMa mobile application turn mobile phones into a sales tool, which can show product information and store consumers’ needs and purchase history. The m-Logistics couriers can earn money by not only delivering packages but also sell products or collect consumers’ requests when travelling to rural areas.

## MoMa Solution

- **Couriers as Business Agent**
  - Helps Consumer choose right products & payments
  - Additional Income Opportunity
- **Marketing Platform**
  - Connect Brands/Sellers to Rural Consumers
  - Collect consumer marketing metrics
  - Marketing Mix – Product, Price, Place & Promotion

**Finding Partners You Can Trust**



**MoMa**  
Mobile Marketing

**NextLab**  
Next Generation of Mobile Applications

**Finding Partners You Can Trust**

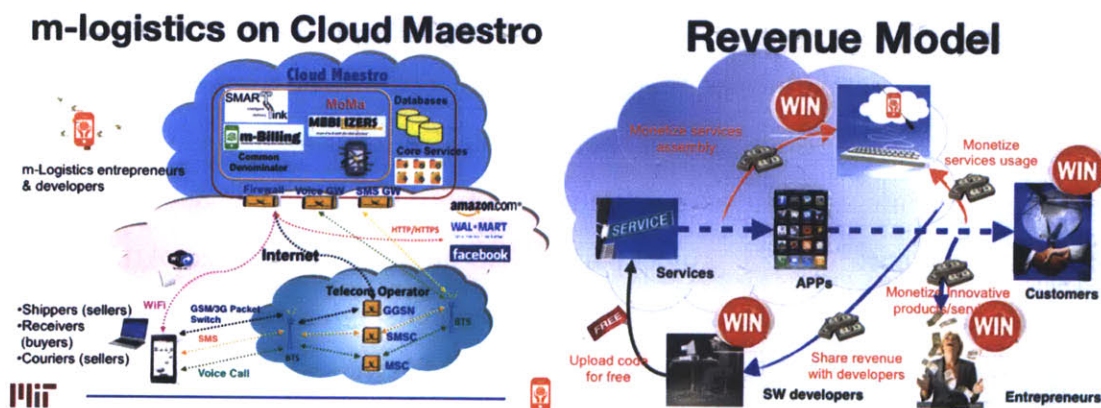
5.2 million Mexicans are at the base of the pyramid and need access to consumer products.

Through a trust-based community, MoMa:

- tracks consumer needs and purchases
- forecasts demand
- recommends relevant products for BOP consumers
- presents products for customers to review before purchase
- orders products
- creates affordable payment options
- serves SMS ads targeted to BOP

**Figure 38: The Solution and Features of the MoMa Project [23]**

The platform developed by the Cloud Maestro team is the core of the m-Logistics service. In order to seamlessly integrate the six mobile-enabled logistics applications introduced above, the team reviewed the application servers and features of all former NextLab projects and filtered out the fundamental features for a mobile service platform. The Cloud Maestro was a cloud based Web Service platform that acts as the backend application server to interact with mobile phones. It also enabled the communication among different mobile services and simplified the integration of those m-Logistics projects. By using the Cloud Maestro, mobile service entrepreneurs can spend more time on understanding the user needs and designing the friendly user interfaces on mobile phones.



**Figure 39: The Architecture and Revenue Model of the Cloud Maestro Project [23]**

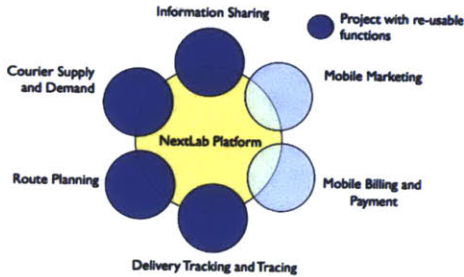
The NextLab 2.0 website successfully facilitates the communication among the staff, students, project partners and advisors through the four stages, team formation, project plan, project execution and project report, in the design phase. Even though the semester is done, all project documents, discussion and project management records are kept accessible and alive on the website. People, who are interested in the NextLab projects, can find useful information from the project portals or volunteer to join the projects and collaborate with other on the project enhancement.

## **5.4 The Operation Phase**

In the Operation Phase, selected NextLab students are sponsored to travel to the target country to deploy their projects and conduct user training. Three students at ITESM, Mexico and two students at UWI, Trinidad and Tobago from different m-Logistics project teams were selected to work on the Summer Pilot project with the NextLab staff. In the meanwhile, Chung-En Kao and the author from NextLab staff and Kevon Andrew from UWI kept enhancing the MobiHive application and integrated more functions from the seven m-Logistics projects into the m-Logistics service. The detailed design of the m-Logistics service is exhibited in the Appendix 3.

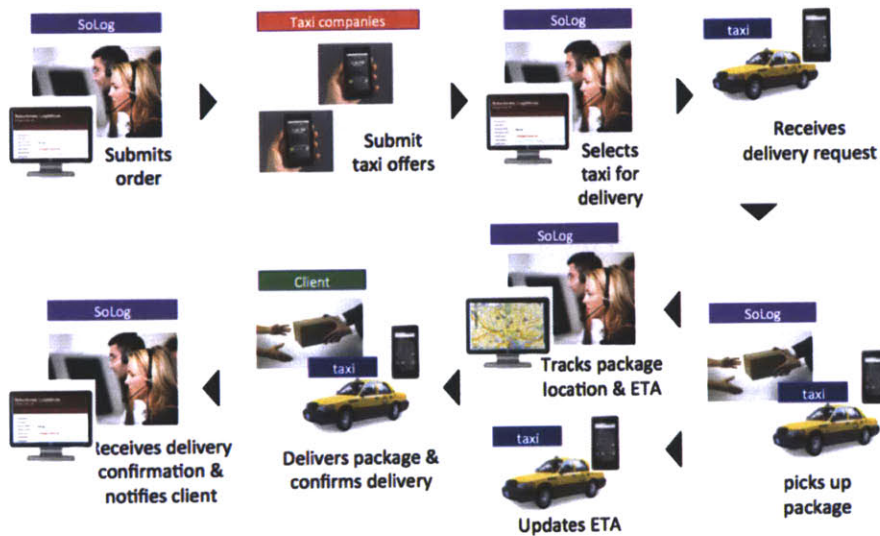
The NextLab Project Development Process, like other m-Logistics projects, was applied to secure the quality and success of the Summer Pilot project. The staff, students and the project partner evaluated all the projects. Instead of deploying the large and complex m-Logistics service, the team decided to customize some m-Logistics projects into a mobile express delivery service that would be deployed and tested with the support from the project partner's local facility in Mexico. After interviewing target users, including the courier customer service agents, local taxi call center agents and taxi drivers, and analyzing the involved logistic operations, the team defined the project scope to be developing and deploying an information and communication technology service that can find a trusted taxi driver, who is free and near the warehouse, to pick up the package from the courier's warehouse and deliver

it to the destination within two to four hours. The team reviewed the seven projects and decided to re-use functions of the NextLab Platform, Information Sharing, Courier Supply and Demand, Route Planning and Delivery Tracking and Tracing projects [Figure 40]. The technical resources, e.g. the database schema, the mobile applications and backend services, from those five projects were also re-used to speed up the design and development progress.



**Figure 40: The m-Logistics Projects for the Summer Pilot Project**

Ana Luisa Santos, the Technical Program Manager from the NextLab staff team, held the project review meeting three times per week during the design phase of the summer pilot, and used the NextLab 2.0 website to share the project plan, meeting minutes and feature updates. Within one and a half months, the web service and applications that fulfill the logistic operations shown in [Figure 41] were done. The innovative service replaced the former paper works and enabled courier service agents to manage orders, taxi call centers and taxi drivers, track packages on the map in real time, and review historical reports.



**Figure 41: The Service Flow of the Summer Pilot Project**

Santos flew to Mexico City in Mexico with one student from UWI and three students from ITESM, to deploy the service and train users. The managers of the project partner, customer service agents, taxi call center agents and tax drivers joined the one-week testing and training event, which started with the presentation talking about the overall service flow and the benefits to respective users. The project team tested each of the items on the testing plan with users, and wrote down feedback from them. After the testing, users were asked to try the service by themselves with the company of a project team member. The team observed the user behavior and noted it down on the NextLab 2.0 for review and future service improvements. After the one-week event, the project partner decided to integrate the summer pilot project into their daily operation, and an internal team was formed to start the integration.

## 5.5 Summary

The m-Logistics project is the first multi-dimensional and cross-country NextLab project, which integrated the features of seven logistics projects to solve the last mile delivery problem in developing countries and was comprised by students from USA, Mexico and Trinidad and Tobago in Spring 2010. Those teams utilized the



NextLab 2.0 Community website, which is a social networking website integrated with the NextLab Project Development Process, to facilitate the collaboration and communication among teams. With the support of the website, teams were able to integrate the seven projects into one large m-Logistics solution in three and a half months.

During Summer 2010, the NextLab staff and volunteering students kept working on the summer pilot project to deploy the m-Logistics project in Mexico. Along with the project partner, the team identified the four-hour express service that can be quickly developed by integrated four logistics projects on top of the NextLab Platform. Within one and a half months, the customized service was deployed in Mexico City, Mexico, and tested by target users from different organizations.

The success of the summer pilot project proved again that the NextLab 2.0 website and the NextLab Project Development Process can facilitate the mobile innovation with distant project team members in a short timeframe.

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# Chapter 6

## Conclusion and Future Work

### 6.1 Conclusion

Addressing the global challenges and the next billion mobile subscribers, the MIT NextLab program engages students, industry partners, entrepreneurs and the next billion mobile subscribers to develop innovative mobile services that improve the quality of life in the emerging countries. In two years, NextLab teams developed and deployed 23 projects in 14 countries, and five teams founded their own ventures after perceiving the strong demand from the vast mobile users in the developing world. However, the success of the NextLab program doesn't satisfy the staff.

The focus of this thesis is how to extend the success of the NextLab program to reach more people and more countries. After reviewing former projects and analyzing activities among stakeholders, the author proposes a social networking approach that encourages collaboration and communication for innovative mobile service development. The NextLab 2.0 community website that seamlessly integrates the NextLab Project Development Process is launched in January 2010. The functions of the NextLab 2.0 website support the activities of three NextLab project phases, the planning phase, the design phase and the deployment phase.

The mobile service entrepreneurs in the emerging countries are no longer alone. Through the community site, ambitious entrepreneurs can submit proposals, recruit talented people, find useful resources from other projects, share personal insights, and get feedback from people around the world.

Rapid mobile service development by distant teammates is possible. The NextLab staff, students from MIT in USA, ITESM in Mexico and UWI in Trinidad and Tobago and industry advisors are the first group of people utilizing the NextLab 2.0 to work on the seven challenges of the m-Logistics project, which aims to use mobile phone to solve the last mile delivery problem in rural areas. Within three and a half months, each of the teams builds a working prototype and a business case and, moreover, the unique functions from those seven projects are integrated for the m-Logistics service and its mobile application.

Do you have a compelling idea that addresses a global challenge? Do you want to participate in the mobile innovation with people around the world? Come and join the NextLab 2.0 Community at <http://nextlab.mit.edu> and start using mobile phones to change the world with us!

## **6.2 Future Works**

A number of potential projects that would grow the community and advance the mobile innovation were identified in the developing this thesis and from the feedback of the NextLab 2.0 community.

- A common mobile service platform: In the first two years of the NextLab program, there are 23 NextLab projects deployed in 14 countries. It is noticed that most of the teams are new to Information and Communication Technologies. NextLab project teams spent significant time reviewing technologies and integrating selected ones into their solutions. The various technologies result in 23 different combinations of web servers, database servers, short message service server, application servers, operating systems of servers and programming languages. A common mobile service platform for service development and execution can not only shorten the time in research and implementation, but also encourage the re-use of codes from other projects.

- **The Certificate of the NextLab Project Development Process:** The NextLab staff guide teams to adopt the NextLab Project Development Process by using the NextLab 2.0 website during the semester. However, if the NextLab 2.0 starts to collect projects from worldwide, it is not possible for the staff to mentor all projects. An on-line training and certificate program will be a blessing to help NextLab members, especially, the project managers, learn how to apply the NextLab Project Development Process to ensure the quality of their projects.

# Appendices

## Appendix 1 – The List of the NextLab Projects

### Civic Engagement

Project Name	Project Description	Status After the Class	Awards
FreePress, Bolivia, Spring 2008	Developing a solution that utilizes mobile and Internet for citizens with oppressive governments involved in media censorship to provide breaking news		
Mobile Citizen Reporting (CiviRep), Venezuela, Spring 2009	A crime reporting service via short-message-service (SMS), and information is then processed and aggregated at the CiviRep engine and displayed on a web-map in real time.	Met the Mayor of Caracas, Venezuela and police in the municipalities to showcase the service and technologies [26]	

### Economic Empowerment

Project Name	Project Description	Status After the Class	Awards
Assured Labor, Brazil, Spring 2008	The marketplace for jobs in emerging markets	Founded the venture, and commercially launched in Nicaragua and Mexico	
Mosoko with Nokia, Kenya, Spring 2008	A mobile craigslist for the next billion	Maintained by Nokia, the project partner	
Smart Microloans, India, Spring 2008	The ICT solution for consumers of micro loans in the village		

Giving Farmers a Fighting Chance, Mexico, Fall 2008	The mobile service for farmers in a rural area farmers to determine fair prices for crops	The team became the partner of Zaca project in Spring 2009	
Multilevel marketing for microfinance, Ecuador, Fall 2008	A multi-level-marketing service turns mobile phone users into “micro-agents” and enables searching for other potential clients.		
M-commerce, India, Fall 2008	A self-sustaining mobile commerce system that empowers the poor and illiterate to make informed decisions about purchasing daily necessities	The project partner, United Villages, turned the prototype into its business model and launched in India	
Mobile Banking (Dinube), Mexico, Spring 2009	A cloud-based payment and transaction platform targeted at the under-banked population in Mexico	Preparing for commercially launch in Mexico	The runner-up of MIT 100K Competition in the Mobile Track and the NextLab Venture Execution Award
Mobile Rural Market Prices (Zaca), Mexico, Spring 2009	Providing resource-strapped farmers a platform to aggregate produce information and query current historical market produce wholesale and market prices	Run by students and industry volunteers	

## Education

Project Name	Project Description	Status After the Class	Awards
BeeHive School (Knowledge Box), Malawi, Spring 2008	The single knowledge box with Internet searching, browsing and forum service for primary school education in the rural area without Internet access	Collected computer donation from MIT and built the computer lab and training program in the BeeHive school	

Mobile social network for students in low-income communities, Mexico, Fall 2008	Connect fellows in Mexico to allow them to share their ideas and become influenced by one another by using mobile short message and Internet forum		
Mobile Literacy (Celedu), India, Spring 2009	A mobile platform that provides literacy and language education via mobile gaming on locally available mobile phones	Run by students and deployed and tested in India	2010 IAP Seed Grant Recipient from MIT Legatum Center

## Environment Sensing

Project Name	Project Description	Status After the Class	Awards
Disaster Management, India, Spring 2008 & Fall 2008	Collecting environmental data from mobile phone to backend database for further processing and flood reporting		
InnovGreen, Vietnam, Fall 2008	Using mobile phones to monitor the status of tree and fertilizers distribution in rural mountain to prevent from those materials been solved in the market by workers	Used by InnovGreen, the project partner and a social enterprise in Vietnam	

## Healthcare

Project Name	Project Description	Status After the Class	Awards
Interactive Research and Development (IRD), Pakistan, Spring 2008	Interactive Alerts for Childhood Pneumonia is an innovative system using mobile phones and Radio-frequency Identification (RFID) tag in the bracelet to track childhood pneumonia	Run by Nokia, the project partner in Pakistan	



Mobile diagnostics for cervical cancer and Mobile Healthcare (Moca), Zambia, Spring 2008 & Fall 2008	A mobile-enabled system that helps nurses share medical information with doctors to assist them with the cervical cancer screening process	Maintained by students and industry volunteers, and continued at NextLab course in Spring 2009	
Mobile Healthcare (Sana), India and Philippines, Spring 2009	<i>“The mission is to revolutionize healthcare delivery in remote areas through innovative mobile information services that improve patient access to medical specialists for faster, high quality, and more cost effective diagnosis and intervention.” [27]</i>	<i>“The Sana is run as an open-source data collection and collaboration platforms for clinical research by students, volunteers, partner organizations, and sponsors” [27]</i>	The NextLab People’s Choice Award

## Logistics

Project Name	Project Description	Status After the Class	Awards & Funding
Mobile Logistics Management (Hammock), Colombia, Spring 2009	The marketplace for jobs in emerging markets	Pilot tested with Argos, the project partner in Colombia	The NextLab Technology Innovation Award
m-Logistics, Mexico, Spring 2010	The mobile-enabled dynamic freelance courier delivery service	Maintained and integrated by the NextLab Staff	

## Appendix 2 – The Detailed Design of the NextLab 2.0 Community Website

In this section, I exhibit the detailed design of the system architecture of the NextLab 2.0 Community. The goal of the NextLab 2.0 Community is to improve the quality of life by replicating the NextLab Project Design and Development Process to develop and deploy more mobile services for people in the developing countries. The success of the community relies on the participation of people around the world. Otherwise, the size of NextLab projects would still be limited to the size of the NextLab class at MIT. The Figure 42 shows the intent, function and the form of the concept of the NextLab 2.0 Community website. In order to achieve the goal, the NextLab 2.0 Community is found out to be the form that connects people around the world and encourage the collaboration for innovative mobile services.

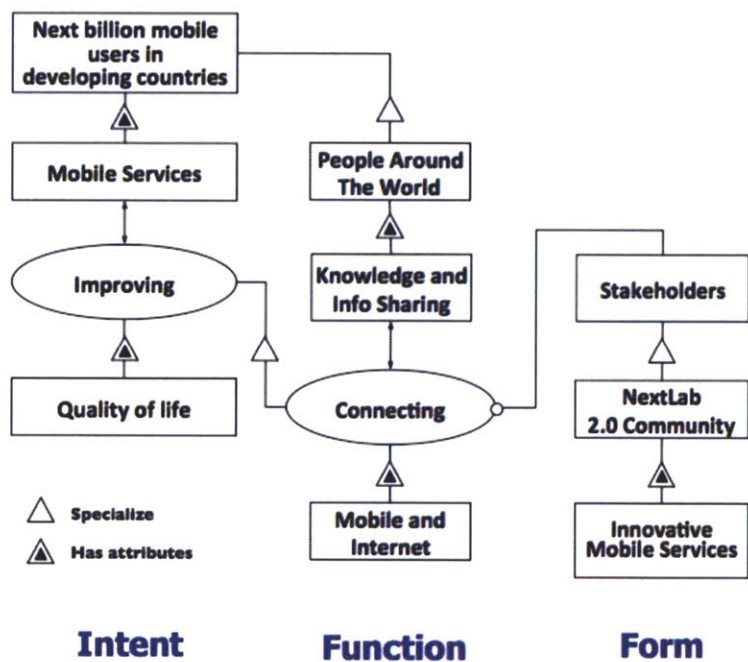


Figure 42: The Intent, Function and Form Diagram of the NextLab 2.0 Community

The core of the NextLab 2.0 Community is the NextLab projects. All the activities among stakeholders contribute to the design, development, deployment and

operation of the NextLab projects. Stakeholders in the whole system collaborate together to support the project teams to design profitable and feasible mobile services.

The diagram below indicates the needs and relationship among stakeholders. Along with the need analysis, the social analysis (Chapter 4.1) was conducted to review the social interactions that are derived from the needs between stakeholders, and the NextLab Project Design and Development Process (Chapter 4.2) was also proposed to be the structure of NextLab projects.

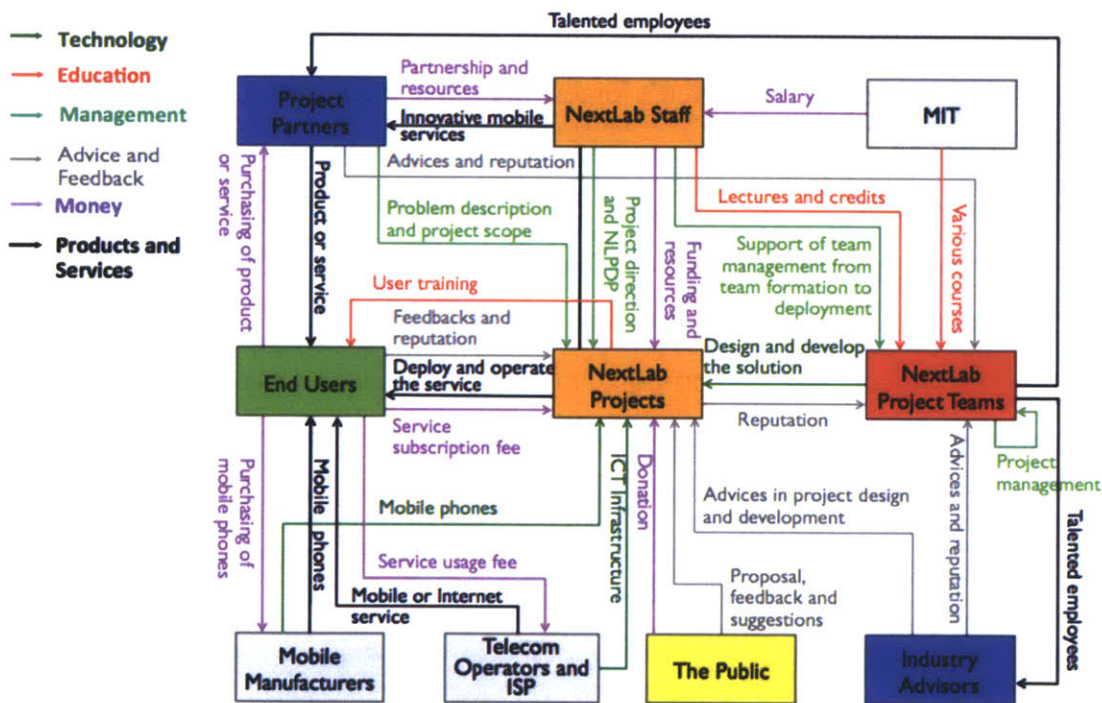


Figure 43: The Needs and Relationship Diagram of the NextLab Stakeholders

Based on the researches above, the service flows of the NextLab 2.0 Community website were designed. The functions of the website are categorized into five major components – the Community, Proposal Management, Project Portal, Project Management, Discussion Group, and each component has its respective interface for the site administrator, members and general visitors. The functions of each component are designed and developed to satisfy the needs showed in Figure 43. The website is developed and running on a Debian Linux server with Apache 2.2,

PHP and MySQL. The open-source content management system, Joomla, is used to provide the skeleton of the website and the JomSocial, a commercial component of Joomla, is installed and customized to serve the community functions.

## Community

The Community component is the entrance of the NextLab 2.0 Community website. In the community, each of the members is assigned to one user type according to their role. The available user types are the *User*, *NextLabber*, and *Staff*. With minimum privileges and functions, the members in the *User* type are people who just registered on the site and haven't joined any project team yet. Users can propose a project, maintain personal profile and resume, browse other members' profile, project portal and forums, become a friend with other members and upload photos and videos. The user type changes from the *User* to *NextLabber*, when a member joins a NextLab project team as a member or advisor. Besides having all the functions of the *User*, the *NextLabbers* have the privilege to manage the project portal and project management service. The *Staff* members have the site administration privileges, and can review proposals and approve the application of new project portals and discussion groups. The top menu bar of the website also shows the user type and the corresponding services [Figure 44].

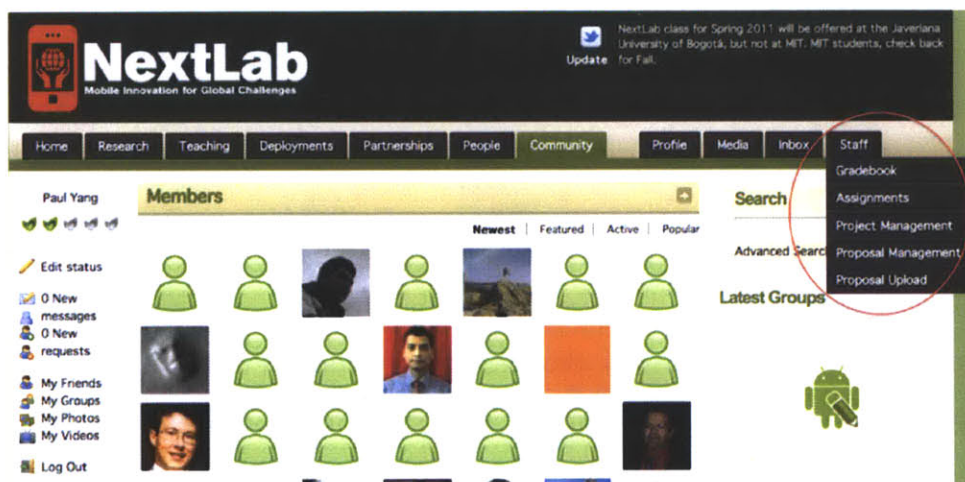


Figure 44: The Community Page and Staff Function Menu

The Community component allows users to share personal information and build up relationship. Every member is encouraged to update detailed personal profile and resume after registration. With detailed user information, NextLab project teams can find talented teammates or search people who are living in the target region to get firsthand information. Moreover, the community members can use the resume editing function to write their professional resume [28] by importing from LinkedIn or filling out the forms of education, employment, publications, awards, skills and interests [Figure 45]. As proposed in Chapter 4.1, the NextLab community aims to attract people, who are interested in the Information and Communication Technologies, to build the talent bank of ICT. Through the community, NextLab project teams, project partners and industry advisors can find competent candidates for their project or organizations, which not only facilitates the project team formation but also gives more incentives for project partners and talented people to join the community.

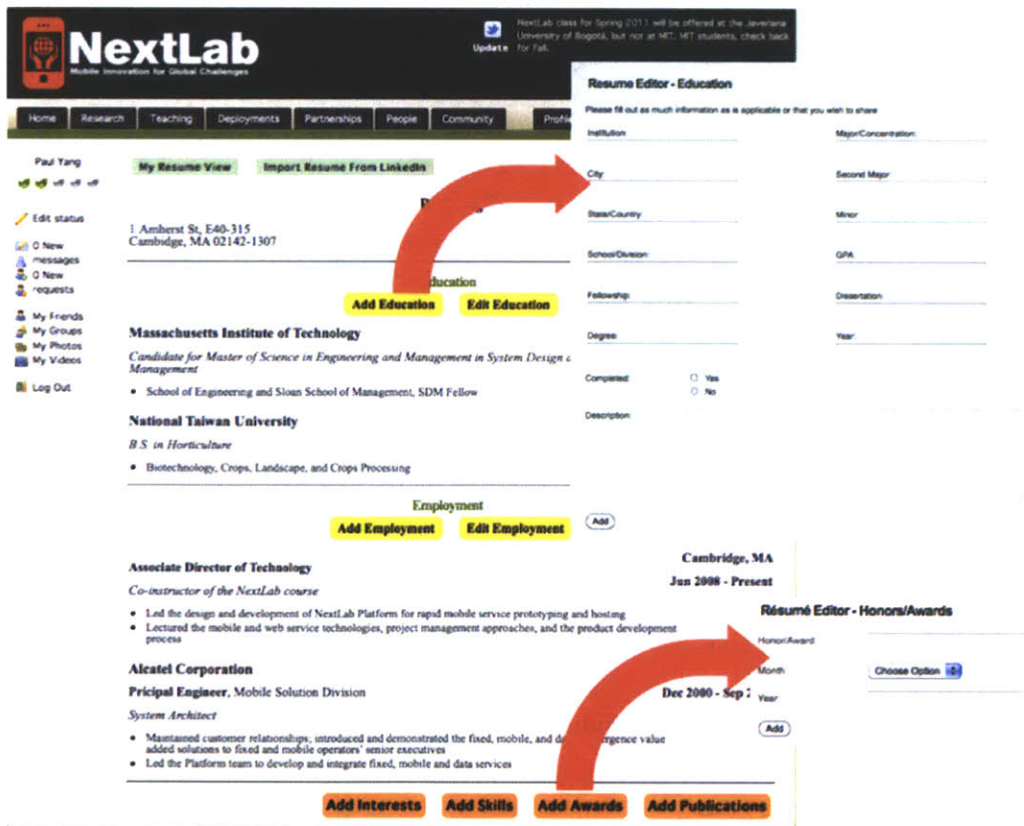


Figure 45: The Resume Editor for the NextLab Community Members

## Proposal Management

All NextLab community members can propose new projects and review other proposals by using the Proposal Management function. The content of the project proposal is derived from the standard elements of preliminary proposals of the International Development Research Centre [29] and is added the optional video section for more direct and intuitive introduction to the project. The content of the proposal form contains the proposal information, contact information and video upload sections as shown in Figure 46.

The form is divided into three main sections:

- Proposal Information:** Includes fields for Project Name, Target Town, Target State, Country, Project Objective, Project Execution and Activities, Describe What Particular Technology Will Be Used, and Project Risks.
- Contact Information:** Includes fields for Host Organization, Location of Operations, Size of Organization, Organization Mission, Contact Person, Contact Address, City, State / Country, Phone Number, Email Address (pre-filled with n3eights@mit.edu), and Website.
- Video Upload:** Includes instructions to upload videos through the user's profile, a link to refresh the video list, and dropdown menus for Project Introduction, Operation Plan, and Host Organization.

Figure 46: The Form of the NextLab Proposal Submission

Besides proposing and reviewing proposals, the staff members can manage the status of each proposal. After reviewing a proposal, the staff can change the status to “wait for update” and send a message to the proposer to ask for new inputs. If the proposal doesn’t meet the basic requirements or the proposer doesn’t update the content for more than two months, the staff can reject the proposal and send a message to notify the proposer. After the proposal is approved, the proposer can create the project portal and the project management service to introduce the project to the public and start finding teammates on the NextLab 2.0 website.

## Project Portal

The NextLab community members whose proposal is approved by the staff can create a project portal to introduce the project to the world. The project portal is customized from the Group function of the community component. In each of the project portal, a team can showcase the project with the webpage, team members, project blog, discussion forum and videos [Figure 47].

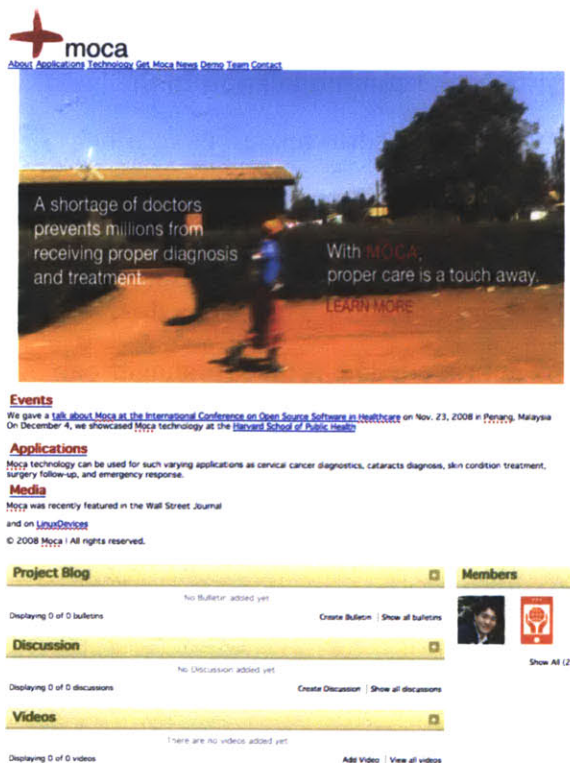
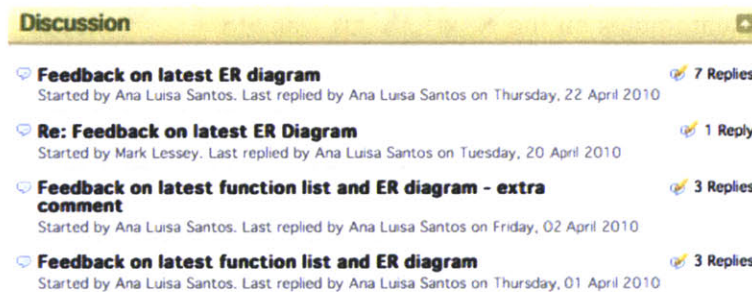


Figure 47: The Example of the Project Portal

The creator of the project portal can invite the community members to join the project and members can also request to join the project, so that they can receive the notification when there is a new post from the project team. The creator can also compose the webpage by using the what-you-see-is-what-you-get (WYSIWYG) editor, and post an article to the blog. The discussion forum allows members of the project to post an open discussion, which enables the two-way communication between the project team and its members [Figure 48].



**Figure 48: The Example of the Discussion Forum of the Project Portal**

## Project Management

The Project Management service facilitates the communication in the NextLab project teams and shows the clear project progress and useful resources to other community members. It allows members to manage project milestones and tasks, track completeness of each task and share documents [Figure 49]. The open-source project management tool, ProjectFork, is customized and integrated into the NextLab 2.0 Community website. After the proposal is approved. The project manager can send an invitation message through the service to recruit other NextLab members to join the team after identifying competent candidates by reviewing their profiles and resumes. The project teams can collaborate together to list the milestones and breakdown tasks and assign dedicate member to each task.



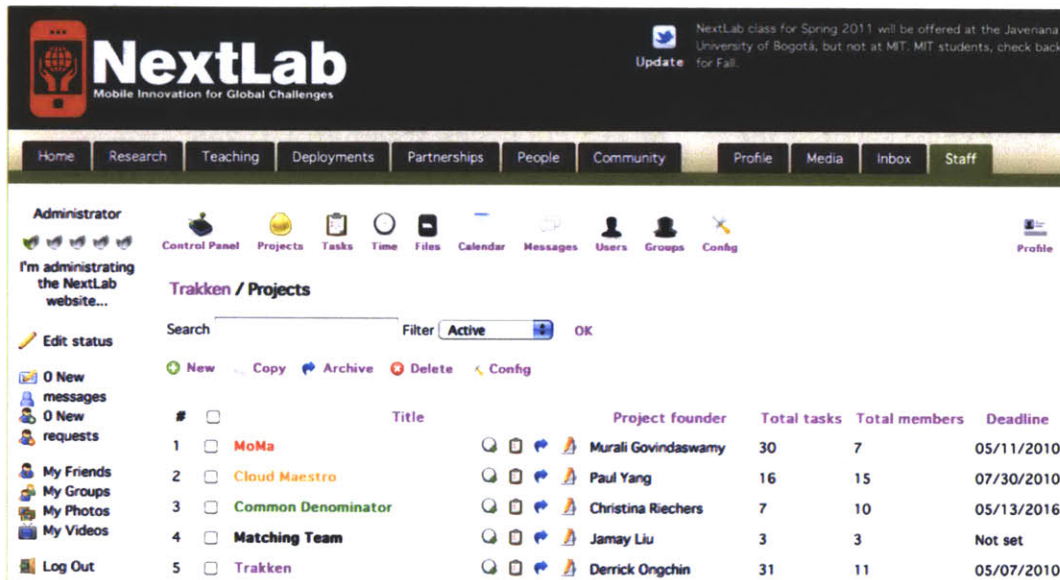


Figure 49: The Project Information in the Project Management Service

## Discussion Group

The NextLab 2.0 members can create Discussion Group in business, technology and field research segments. The objective of the discussion groups is to encourage sharing information of specific topics. Before designing the solution, the NextLab project teams need to investigate the telecommunication environment and the available handsets in the target regions to ensure that the solution can be operated normally. Hosting a discussion group that address on the telecommunication environment and inviting members in the target region would help the project team collect firsthand and latest information. The team can also call for help from the members of the discussion group for testing the prototype before deploying the project.

Besides, the NextLab projects are innovative mobile services. How to help the NextLab project teams learn about the technologies and business knowledge that would advance the design and operation of a mobile service is critical to the success of the project. A discussion group that contains the business or technology information can help the teams build up basic techniques by reading articles and

exchanging information with other members. For example, the Tech Developers Corner group [Figure 50] on the NextLab 2.0 website provides the step-by-step development environment setup guide and a video for Android and Web Service development.

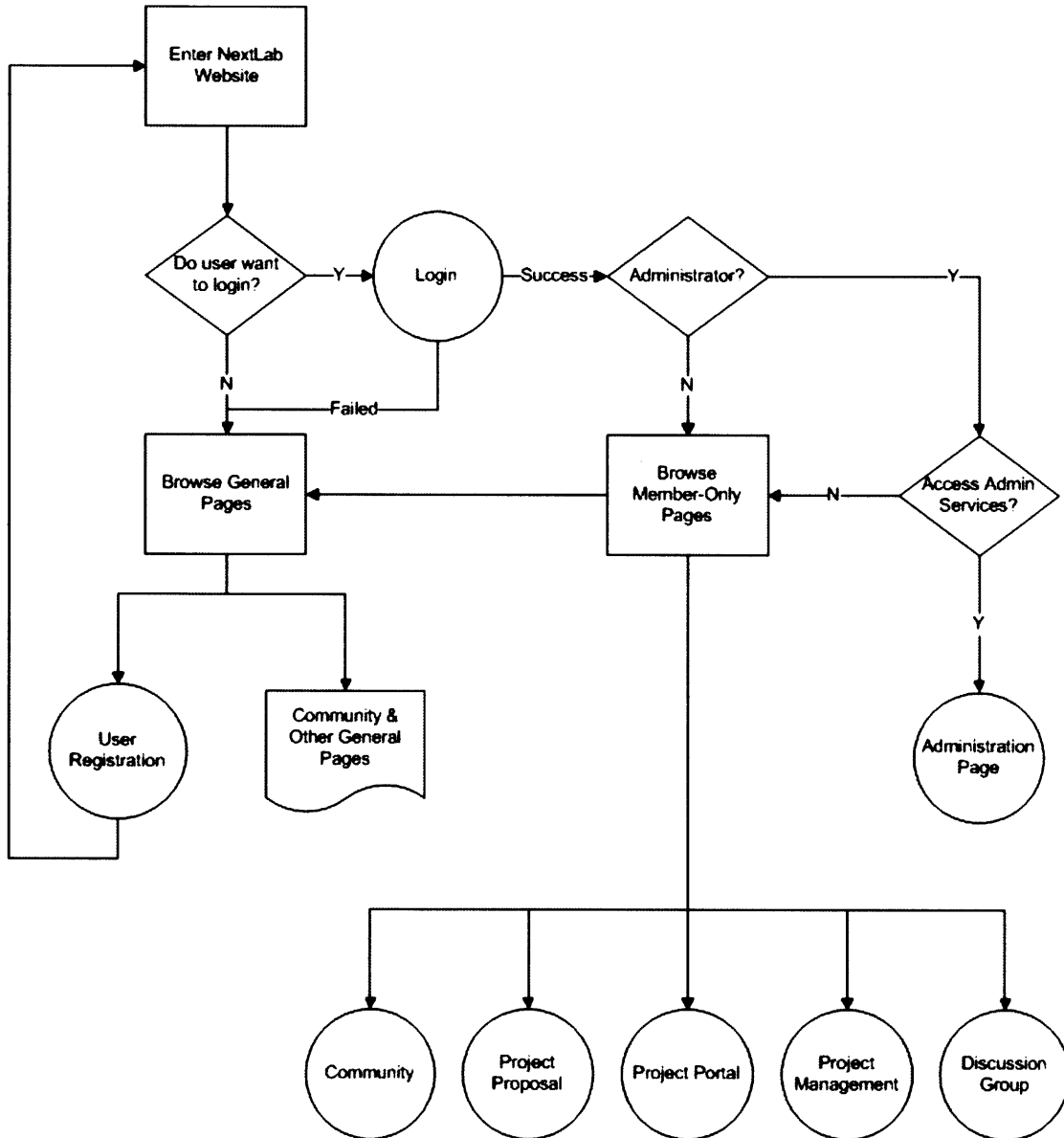
The screenshot displays the 'Tech Developers Corner Group' interface. It features a yellow header with three tabs: 'Group News', 'Members', and 'Discussion'.  
**Group News:** Contains a list of announcements. The top one is 'Technical Review Meeting Agenda - May 06th' (Wednesday, 05 May 2010) by Ana Luisa Santos, addressed to NextLab technical developers. It mentions a Q&A session on May 06th. Other announcements include meeting agendas for April 29th, 22nd, and 15th, and an announcement about development progress as of 04/07.  
**Members:** A grid of 12 small profile pictures of group members.  
**Discussion:** A list of discussion topics. The first is 'Updates on your team's technical development' (0 Replies) by Ana Luisa Santos. Other topics include 'Tomcat Server v. 6 available' (1 Reply), 'Mac Java 1.5 issue' (1 Reply), 'mysql accounts' (1 Reply), and 'Correction to the NextLab SVN Sandbox' (0 Replies). A 'Purpose' discussion is also listed.  
**Videos:** A section titled 'Videos' showing a video thumbnail for 'Troubleshooting web services' with 86 views, last updated on 2010-04-29 at 23:00:03 by Fernando.

Figure 50: The Content of the Tech Developers Corner Group

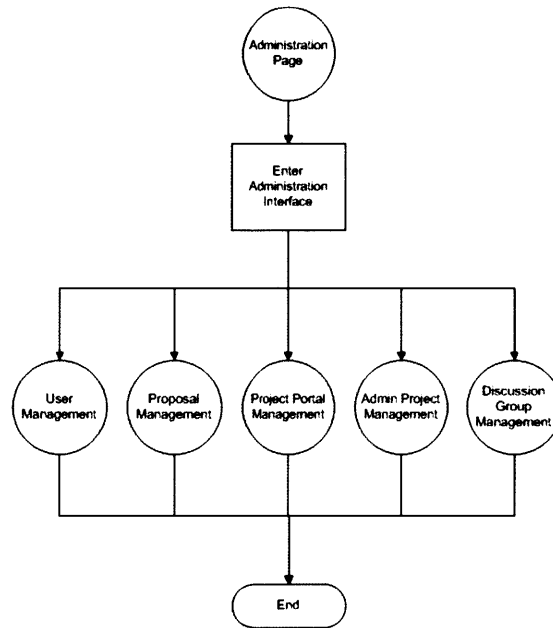
## Service Flow

The service flows of the NextLab 2.0 Community website are displayed below.

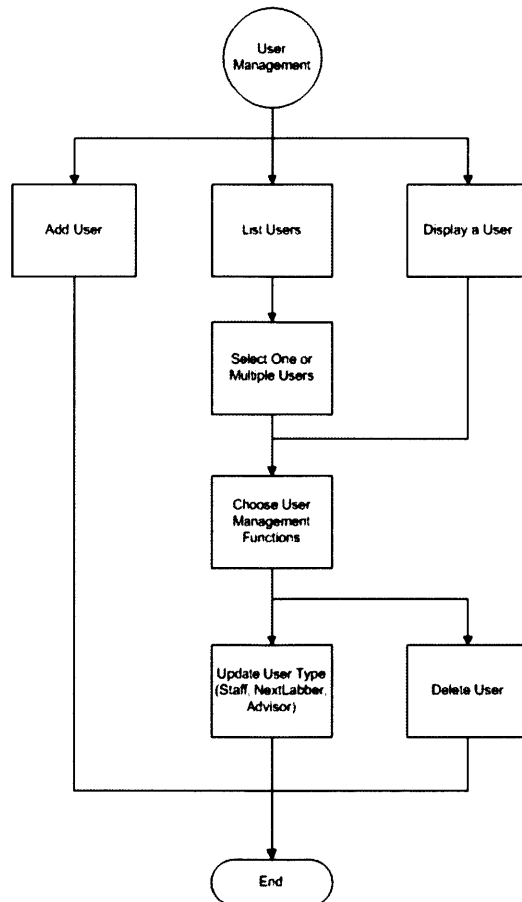
### 1. The main page



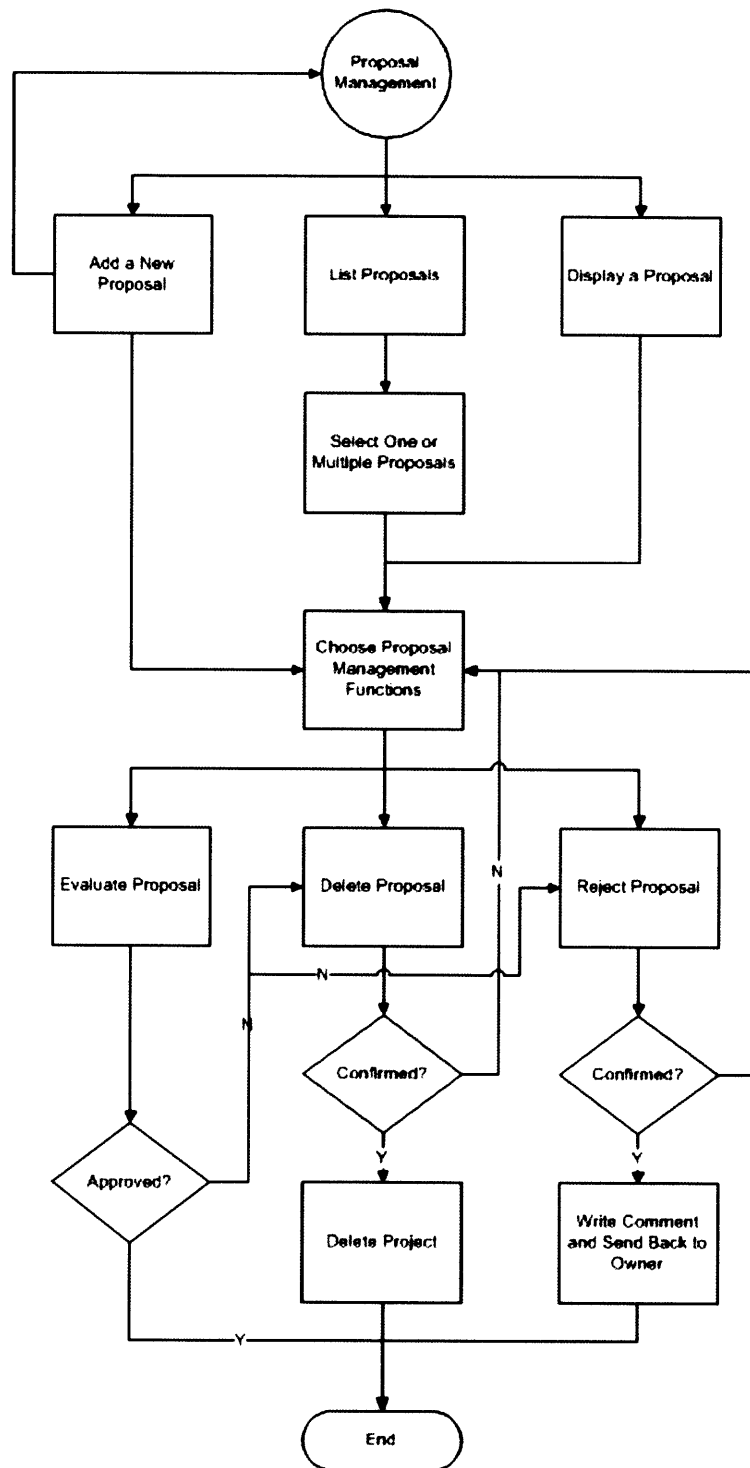
## 2. The Administration Page



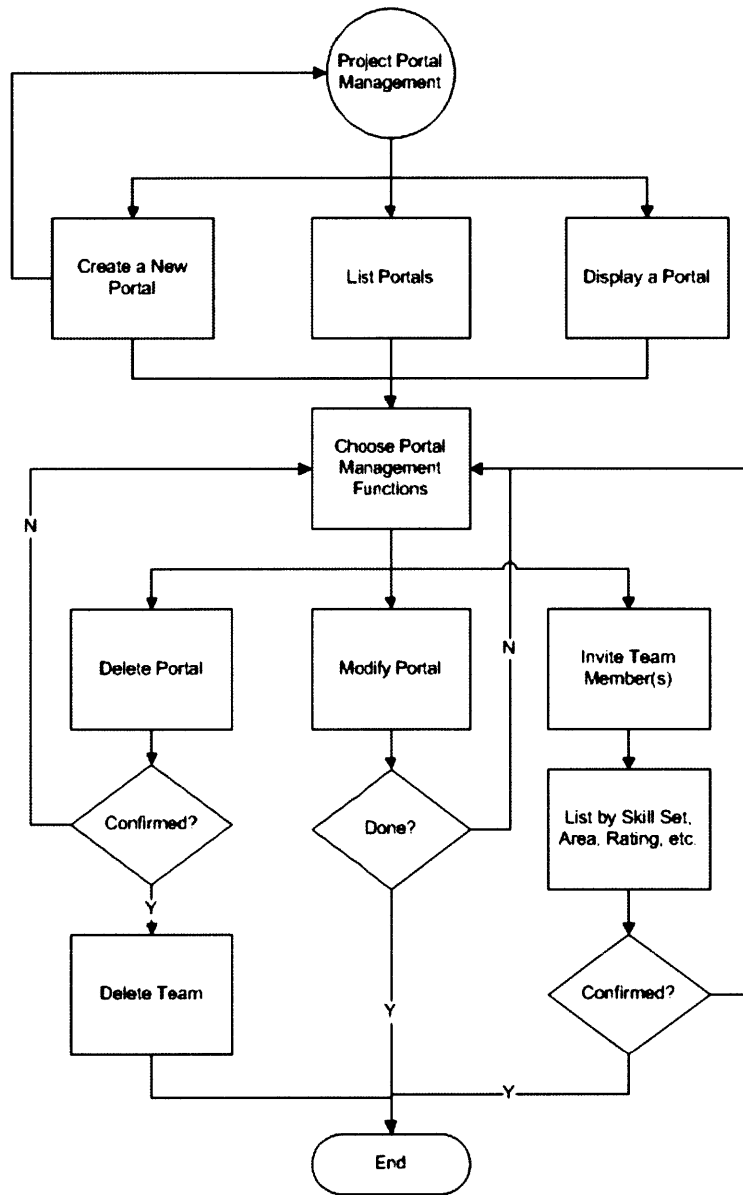
### 2.1. User Management



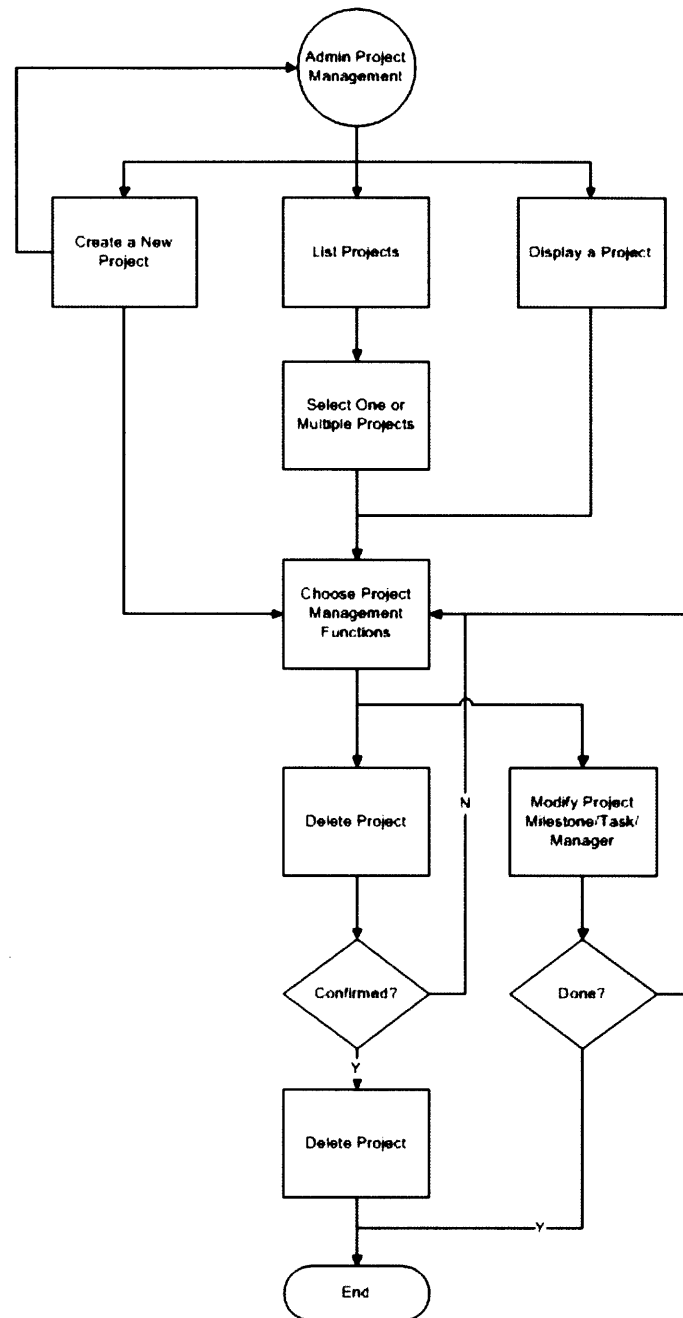
## 2.2. Proposal Management



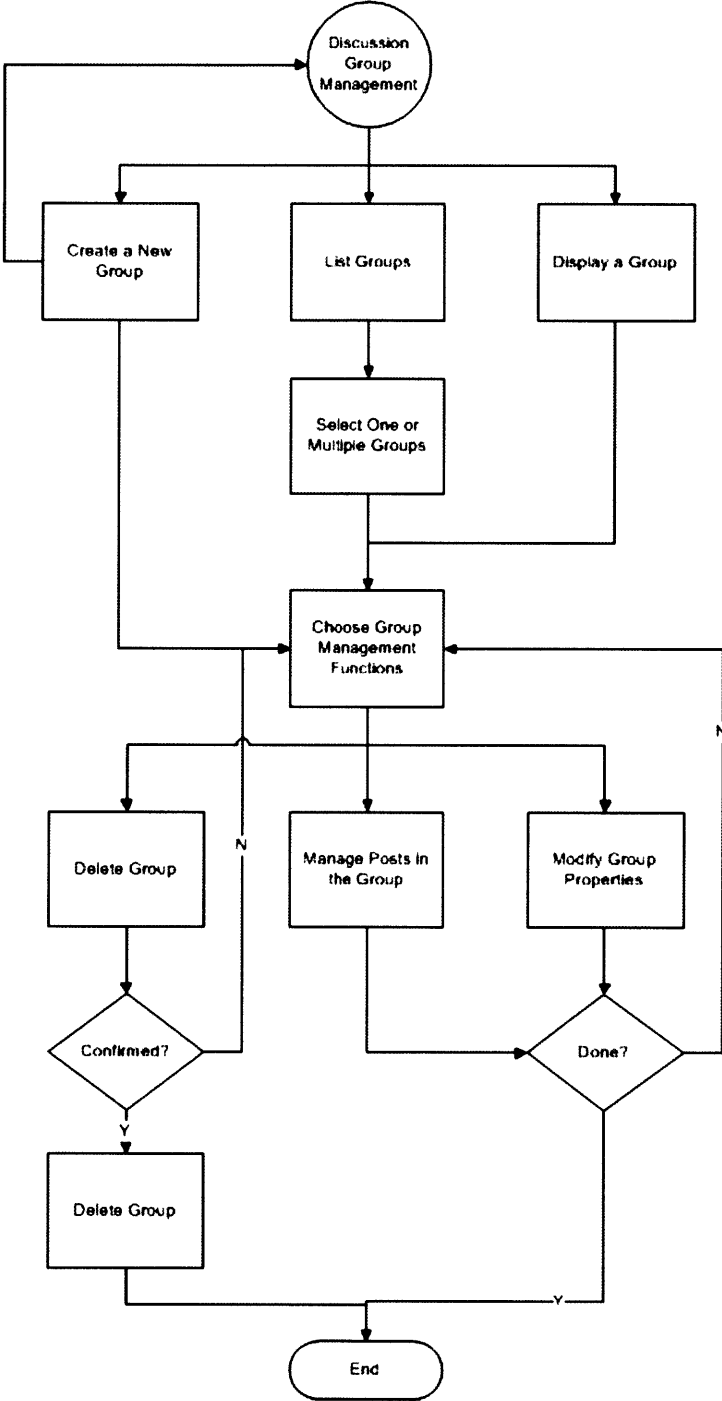
### 2.3. Project Portal Management



## 2.4. Admin Project Management

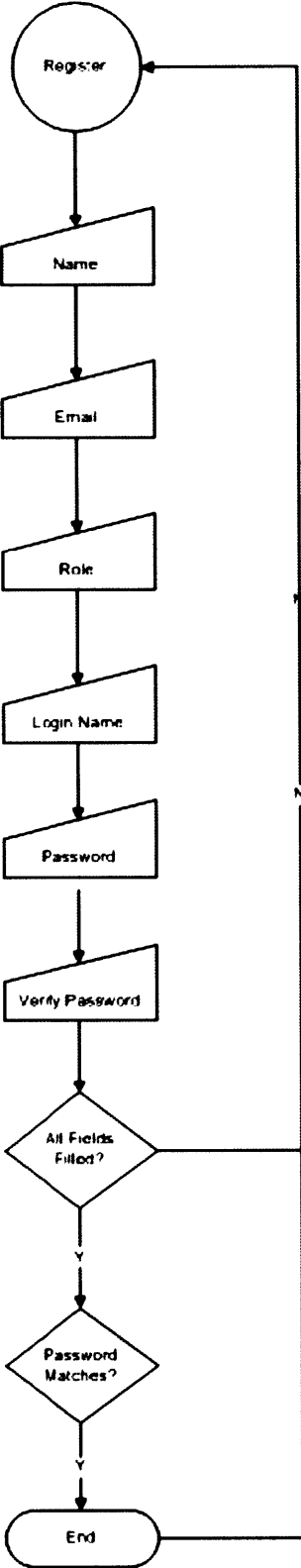


2.5. Discussion Group Management

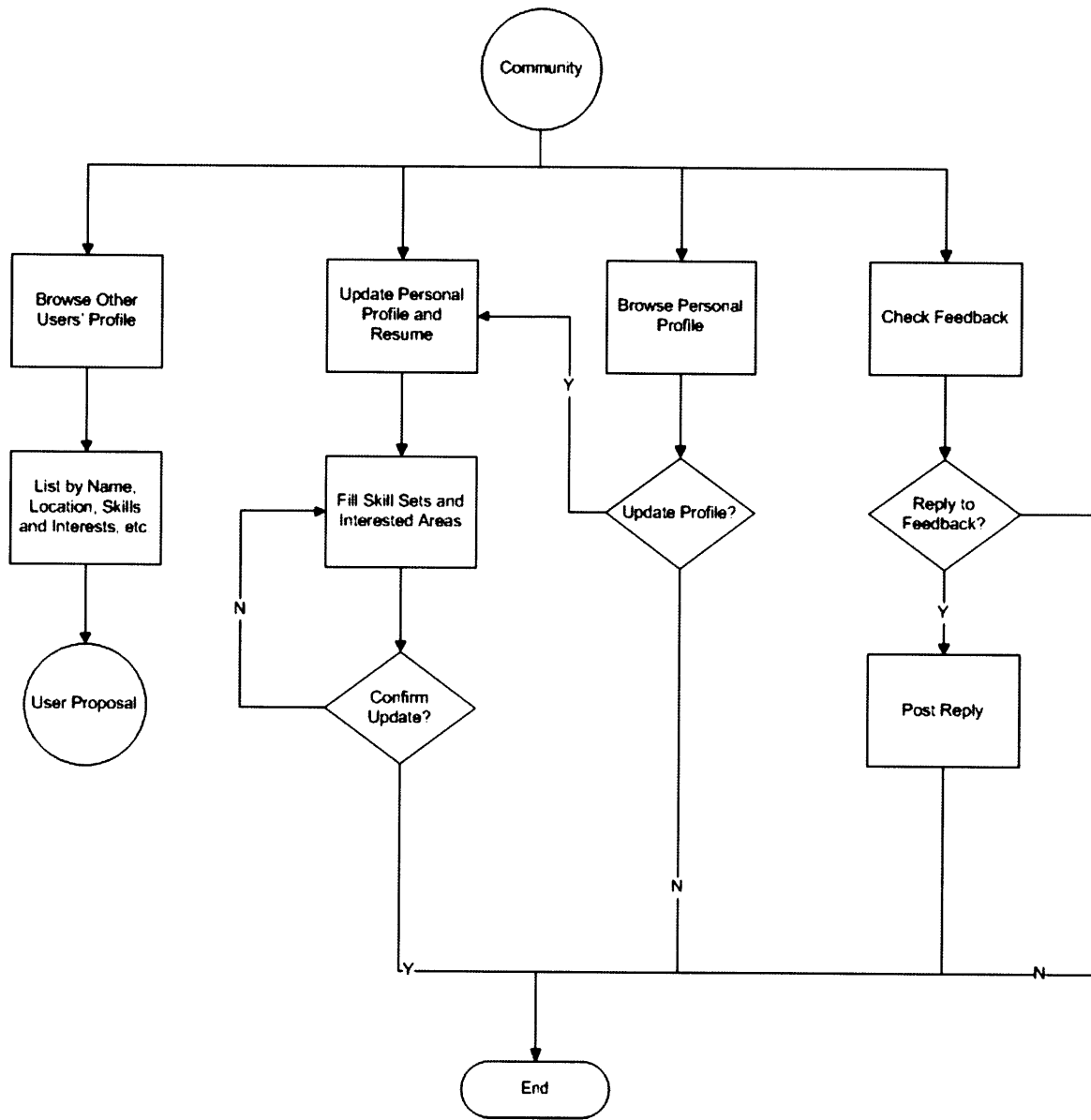




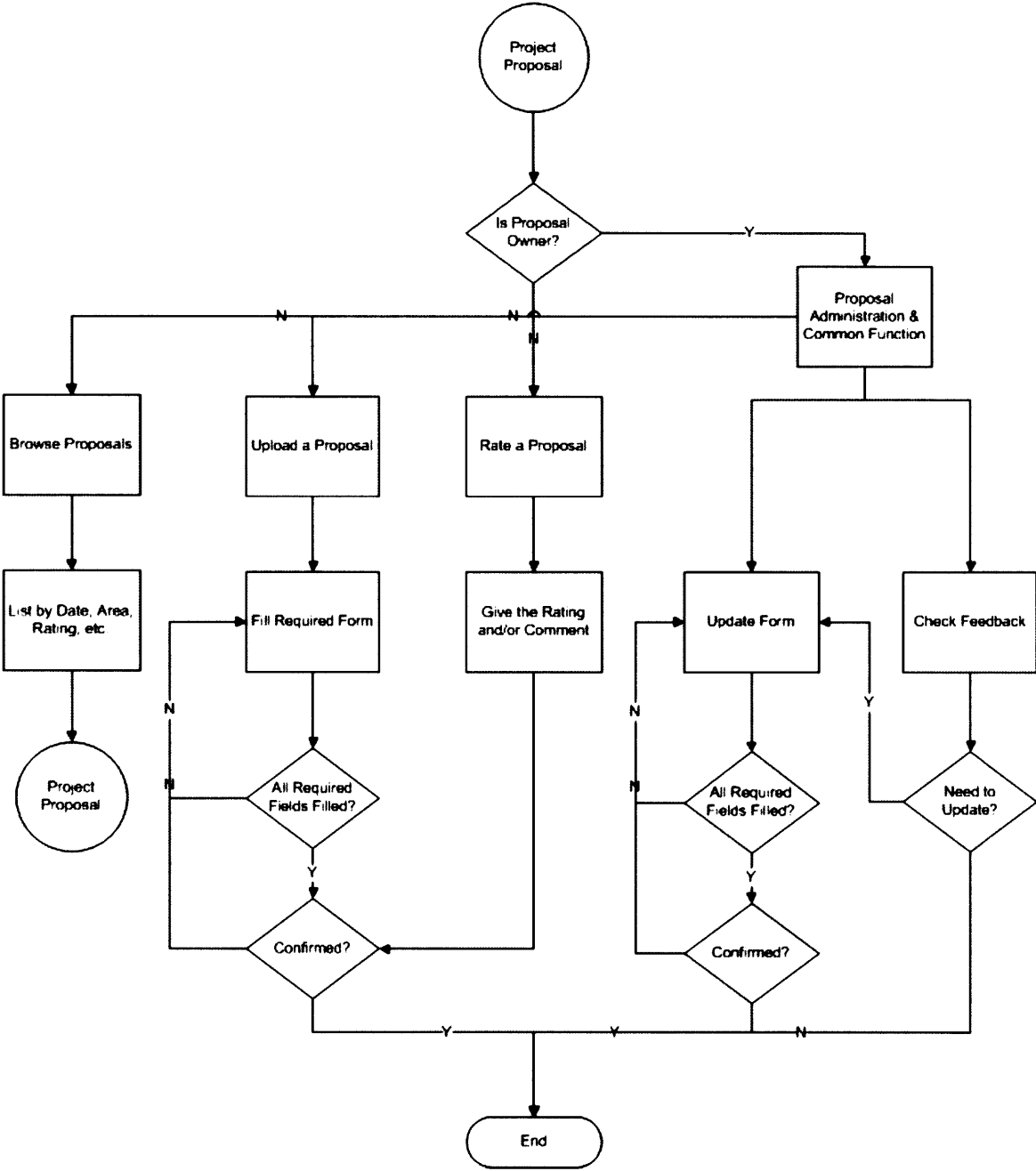
3. User Registration



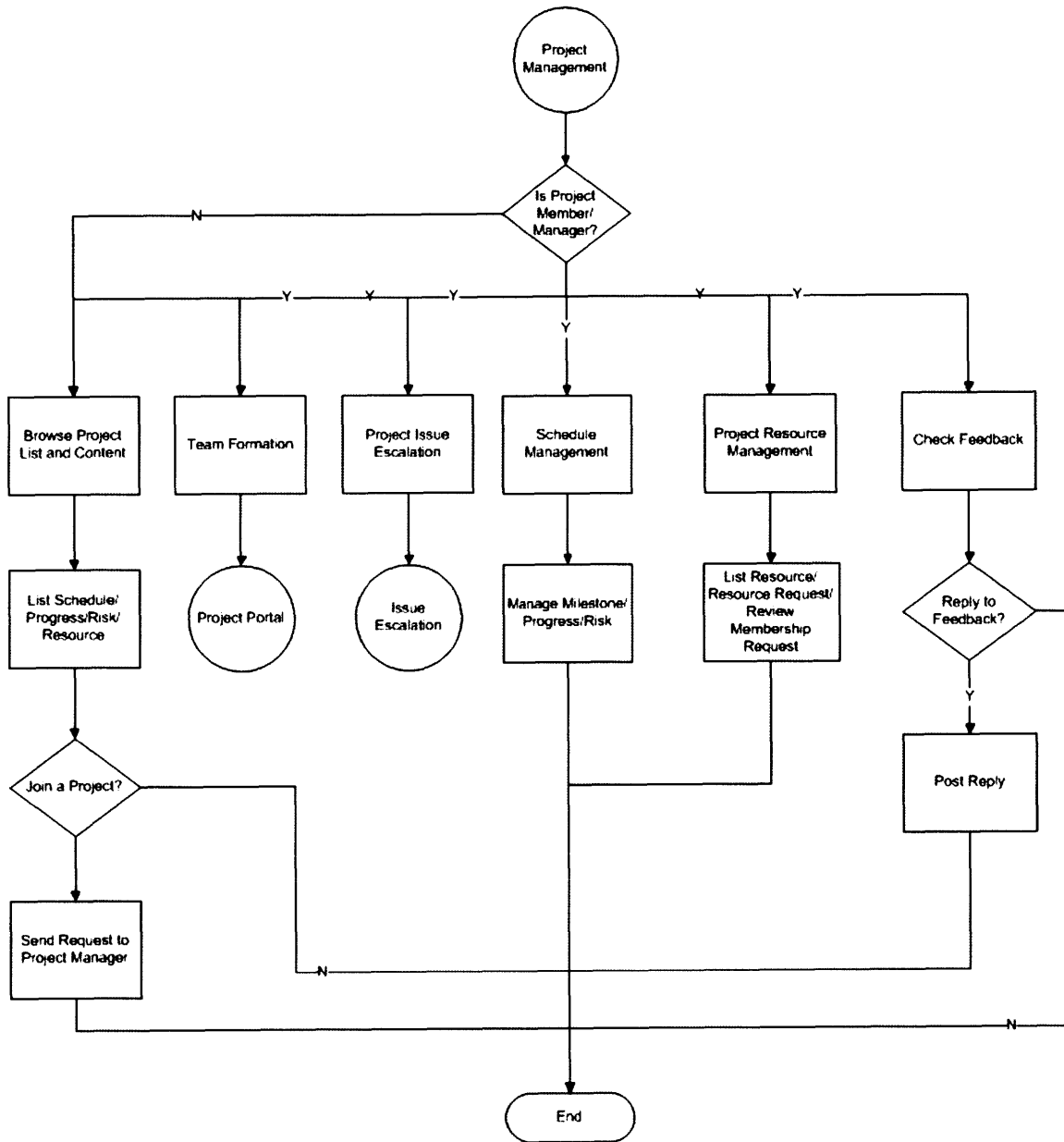
## 4. Community



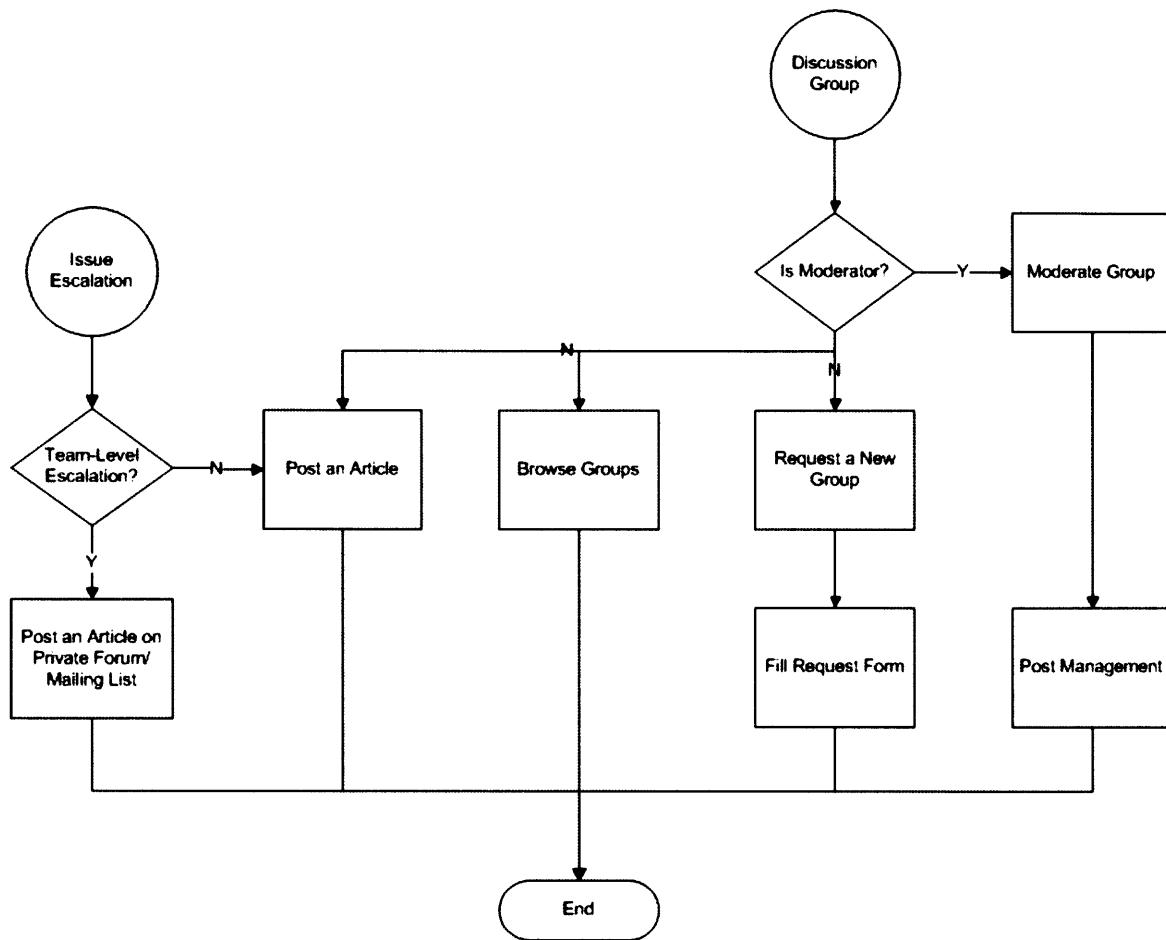
5. Project Proposal



## 6. Project Management



## 7. Discussion Group



## **Appendix 3 – The Architecture of the m-Logistics Service**

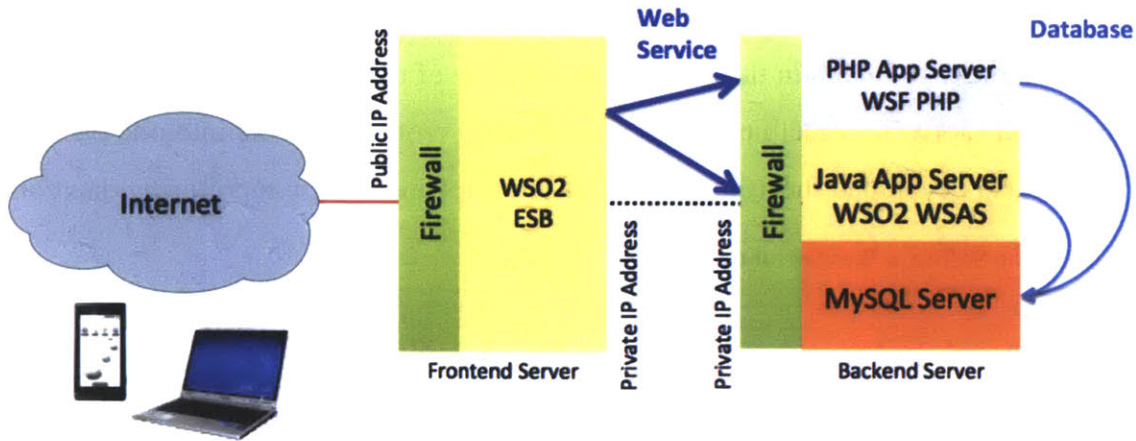
In this section, I discuss about the architecture of the m-Logistics service. As mentioned in the Chapter 5.1, the objective of the m-Logistics service is to build up mobile-enabled delivery system by using dynamic freelance couriers to deliver packages to people in rural areas, where courier companies charge users high delivery rate or don't provide the service. In order to provide the m-Logistics service, the NextLab staff and seven NextLab teams, introduced in Chapter 5.2, need to design and develop functions that support user profile and credibility management, the delivery route optimization, the Global Positioning System (GPS) tracking service, the mobile payment service, and most important of the application platform that can integrate all those functions into one service.

The concept of Service Oriented Architecture (SOA) that uses small, distinct and independent service logics to design larger and more complex service logics [30] was adopted for the m-Logistics service. When accessing service logics on the application server, the client uses the standard Simple Object Access Protocol (SOAP) to transmit the message content, so that even though service logics are developed in different programming languages, they can still be accessed by the same client or other service logics. The NextLab Platform was developed to integrate the SOA and Web Services with mobile interactive services.

### **The NextLab Platform**

The author and the NextLab staff led the Cloud Maestro team to design the NextLab Platform that facilitates the integration of the seven m-Logistics components. The team utilized the open-source Service Oriented Architecture servers, the WSO2 Enterprise Service Bus (ESB), Web Service Application Server (WSAS) and Web Service Framework for PHP, to be the core of the SOA platform. The Apache

HTTP server and the MySQL Database Server are also integrated into the NextLab Platform. The Figure 51 shows the system configuration.



**Figure 51: The System Configuration of the NextLab Platform**

The Enterprise Service Bus acts as a messaging bus. When a Web Services client sends a message to the Web Services function on the backend server, it connects to the ESB first and ESB redirects the request to the backend server that has the function running on it [31]. In this way, the client side only needs to have the IP address of the ESB and the name of the function, and, moreover, for the system with large traffic, ESB can balance the workload of a group a backend servers. It can distribute the traffic to the backend server that has lower loading or send traffic to servers in a sequential order.

By using the SOA and Web Services architecture, developers can use their preferred programming languages to develop the Web Services functions. The integration of the WSO2 Web Services Application Server (WSAS) and Web Service Framework for PHP is to provide the application container and Application Programming Interfaces (API) for Java and PHP developers.

The Motorola Droid phone, which runs Android 2.2, is chosen to be the mobile client for the m-Logistics service. In order to support Web Services, the ksoap2-

android SOAP library is used to provide the API for the Android application development.

In order to maintain the stability and quality of the NextLab Platform, I released the software baseline [Table 3], packed all required servers into one package file and also developed the system installation script and system monitoring daemon.

**Table 3: The Software Baseline of the NextLab Platform**

Software	Version
CentOS	5.5 x86_64
Sun Java SE Development Kit	5.0 Update 22
MySQL	5.1.49-1.el5
WSO2 Enterprise Service Bus	3.0.0
WSO2 Web Service Application Server	3.2.0
WSO Web Service Framework for PHP	2.0.0
NextLab Installation Script	0.0.1
NextLab System Monitoring Daemon	0.0.1

The system installation tool is written by using Linux shell script. Before starting installing those software modules, the script checks the version of each software, including itself by counting the characters, lines and file size of the script. If all the version matching, the script creates the dedicated user account, nextlab, and installs and configures all the software by using the account.

The system monitoring tool runs as a Linux daemon that is activated after the operating system is booted. The tool checks the system and monitors all software modules every 30 second. All abnormal situations, e.g. high memory usage (>80%), high disk space usage (>75%) or software server crash, are recorded in a log file. It also tries to reactivate the crashed software server for three attempts with a ninety-second gap. If the affected server cannot be reactivated, a warning email would be sent to the system administrator. Along with the daemon, a text-based program is also developed to show the status of the System Monitoring Daemon, the server and software modules [Figure 52].



```

s@log-fes1.mit.edu          CPU Load: 0.16, Total RAM: 2GB, FreeRAM(%): 35
-----
Process Name                PID      CPU(%)  RAM(%)  Status
-----
ActiveMQ                    10196    0.0     7.7     running
Apache Server (httpd)      11371    0.0     0.6     running
WSO2 ESB                    10566    0.0     25.4    running
-----
sysmon daemon is on

```

**Figure 52: The Content of the Text-based System Monitoring Tool**

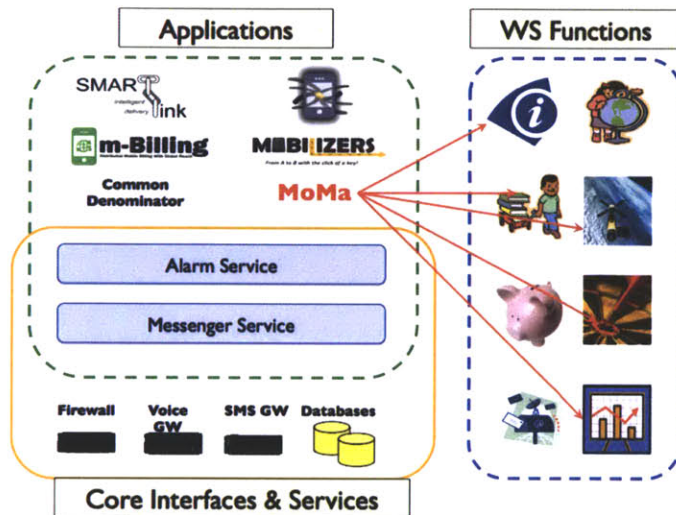
## System Architecture of the m-Logistics Service

With the support of the NextLab Platform, the seven project teams were managed to develop respective Web Services functions that can then be incorporated in the service flows of the m-Logistics service. The major features of each component are listed in the Table 4. Each component team was asked to list the breakdown function list and design the database schema in the project design phase.

**Table 4: The Major Components and Features of the m-Logistics Service**

Component	Application Feature
Information Sharing	<ul style="list-style-type: none"> <li>• User Management</li> <li>• Shipping Order Management</li> </ul>
Courier Supply and Demand	<ul style="list-style-type: none"> <li>• Courier Credibility Management</li> <li>• Courier and Job Matching</li> </ul>
Route Planning	<ul style="list-style-type: none"> <li>• Routing Algorithm</li> </ul>
Tracking and Tracing	<ul style="list-style-type: none"> <li>• GPS Tracking</li> <li>• Delivery Status Management</li> </ul>
Mobile Billing and Payment	<ul style="list-style-type: none"> <li>• User Credit Management</li> <li>• Payment Interface</li> </ul>
Mobile Marketing	<ul style="list-style-type: none"> <li>• Virtual Mobile Store</li> </ul>
NextLab Platform	<ul style="list-style-type: none"> <li>• Alarm and Messenger Service</li> <li>• Interfaces for mobile interaction</li> </ul>

The system architecture of the m-Logistics service is comprised of three components, the Core Interfaces & Services, the Web Service Functions, and the Applications [Figure 53].



**Figure 53: The System Architecture of the m-Logistics Service**

The Core Interfaces & Services are provided by the NextLab Platform. The core interfaces includes the firewall that connects the service to Internet, the Short Message Service Gateway (SMS GW) that handles incoming and outgoing text messages and databases that store service data. The NextLab Platform also provides the Alarm and Messenger core services that are developed as Web Services functions that can be re-used directly by other teams. The objective of the Alarm service is to have a general alarm management service that stores the alarms and warning messages sent by other Web Services functions. The Messenger service provides its Web Services function for other teams to send and receive emails, text messages and Twitter tweets.

The Web Service Functions are the breakdown functions of Applications shown in Table 4. After developing specific functions, project teams can compose their applications by using functions developed by each other. The red arrowed lines in Figure 53 shows how the MoMa project use functions developed by other teams to run their mobile marketing service.

## Service Flow

In this section, I use service flows, Web Services request and response messages, and the screen snapshots of the mobile clients to demonstrate the m-Logistics service. The role of each stakeholder is shown in Table 5.

The Figure 54 is the overall service flow of the m-Logistics service. The four people in the diagram are all registered m-Logistics users. Judy owns her store in the rural area, so that she decided to use the m-Logistics to send products to her customers.

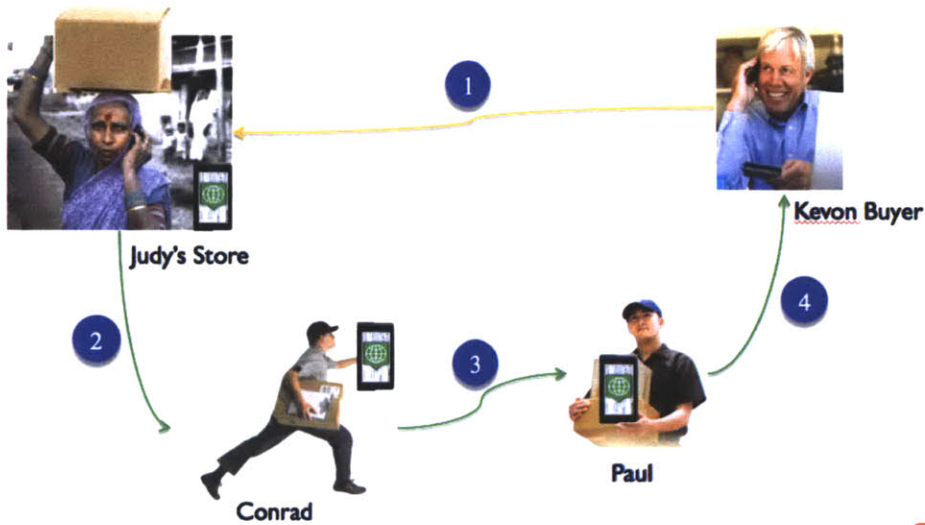
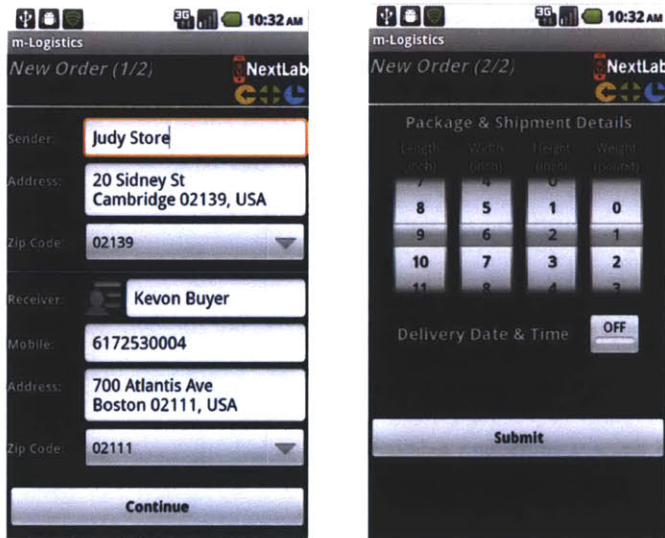


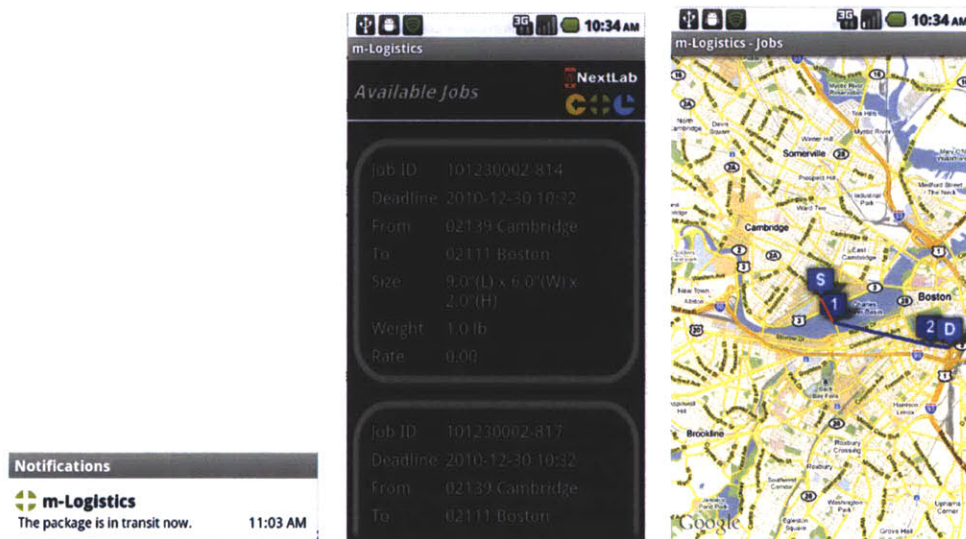
Figure 54: The Overall m-Logistics Service Flow

In the *Step 1*, the buyer, Kevon, called Judy, to purchase one product from her. Judy as a shipper submitted a shipping order with receiver's information and dimensions and weight of the package to the m-Logistics service and waited for couriers that can deliver the good from her store to Kevon's place.



**Figure 55: The Shipping Order Forms**

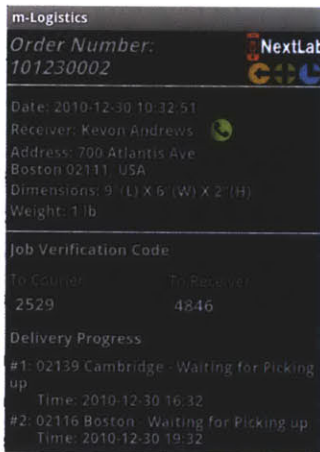
The m-Logistics service broadcasted this new shipping job to couriers, whose pre-defined service areas are between the store and the destination, by sending a push notification messages to the m-Logistics mobile application on their phones.



**Figure 56: The Notification Message, Job Selection and Job Map for Couriers**

After having enough couriers sign up for this shipping job, Judy selected the optimized route that had been signed up by two couriers to deliver the package for

her, and two verification codes were shown in her mobile application for activating and terminating the delivery process.



**Figure 57: The Order Information for the Shipper**

She had to give the termination code to Kevon before the courier delivered the package to Kevon's place. The two couriers were notified by a push notification message, and they could review the contact information, time and location of this shipping job via the m-Logistics mobile application. The detailed Web Services flow with functions developed by m-Logistics project teams are exhibited in Figure 58.

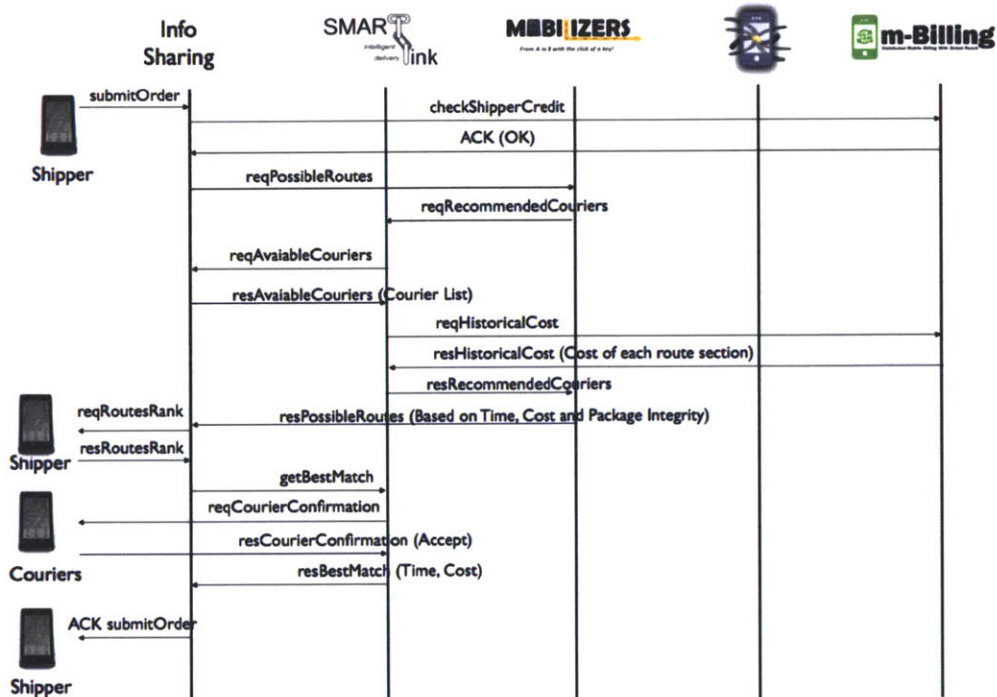


Figure 58: The Web Services Flow of Shipping Order Submission

If the Web Services function, submitOrder, is successfully processed, the shipping order ID is returned to the m-Logistics mobile application on the shipper's phone. The request and response message of the submitOrder Web Service function are listed below as examples of SOAP messages [List 1] [List 2].

**List 1: The SOAP Message of a Shipping Order Submission Request**

```

<v:Envelope xmlns:v="http://schemas.xmlsoap.org/soap/envelope/" xmlns:d="http://www.w3.org/2001/XMLSchema"
xmlns:i="http://www.w3.org/2001/XMLSchema-instance" xmlns:c="http://schemas.xmlsoap.org/soap/encoding/">
  <v:Header />
  <v:Body>
    <n0:submitOrder xmlns:n0="http://ws.mlogistics.ctl.mit" id="o0" c:root="1">
      <shipperid i:type="d:string">75</shipperid>
      <pickuppoint i:type="d:string">20 Sidney St, Cambridge, MA 02139, USA</pickuppoint>
      <pickupzone i:type="d:string">02139</pickupzone>
      <receivername i:type="d:string">Kevon Buyer</receivername>
      <receivermobile i:type="d:string">6172530004</receivermobile>
      <shippoint i:type="d:string">700 Atlantis AveBoston 02111, USA</shippoint>
      <shipgzone i:type="d:string">02111</shipgzone>
      <height i:type="d:string">2</height>
      <length i:type="d:string">9</length>
      <width i:type="d:string">6</width>
      <weight i:type="d:string">1</weight>
    </n0:submitOrder>
  </v:Body>
</v:Envelope>

```

## List 2: The SOAP Message of a Shipping Order Submission Response

```
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/">
  <soapenv:Body>
    <ns:submitOrderResponse xmlns:ns="http://ws.mlogistics.ctl.mit">
      <ns:return>101230001</ns:return>
    </ns:submitOrderResponse>
  </soapenv:Body>
</soapenv:Envelope>
```

In the *Step 2*, the first courier, Conrad, went to Judy's store to pick up the package. Conrad had to inspect the package and got the verification code from Judy to activate his delivery process. After entering the right code, the m-Logistics application on Conrad's phone activated the GPS function as a background service and started to update the GPS coordinates to the server every five minutes, and Conrad could see the contact information of the next courier on his mobile.

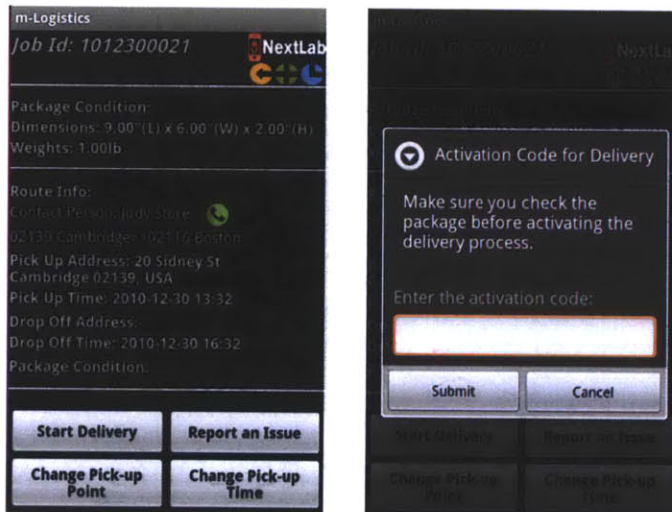


Figure 59: The Job Information and Activation Code Request Form for Couriers

In the *Step 3*, Conrad met the next courier, Paul, and gave the package to him. Like what Conrad did with Judy, Paul had to go to the pickup location to check the package and get the verification code from Conrad to activate his own delivery process. After Paul entered the code, Conrad got a push message saying, "The next courier has activated the delivery process and you can terminate your delivery process now." After terminating the delivery process, Conrad's delivery job was accomplished, and he can wait to get money in his account when the package is delivered to the receiver by the last courier.

In the *Step 4*, Paul arrived Kevon’s place. After receiving the package to Kevon gave the termination code to Paul, so that Paul could accomplish his job and terminate the delivery process of this shipping order. After entering the code, Judy got a push message that indicated Kevon had received the package. The Web Services flow that covers the Step 2 to 4 is shown in Figure 60.

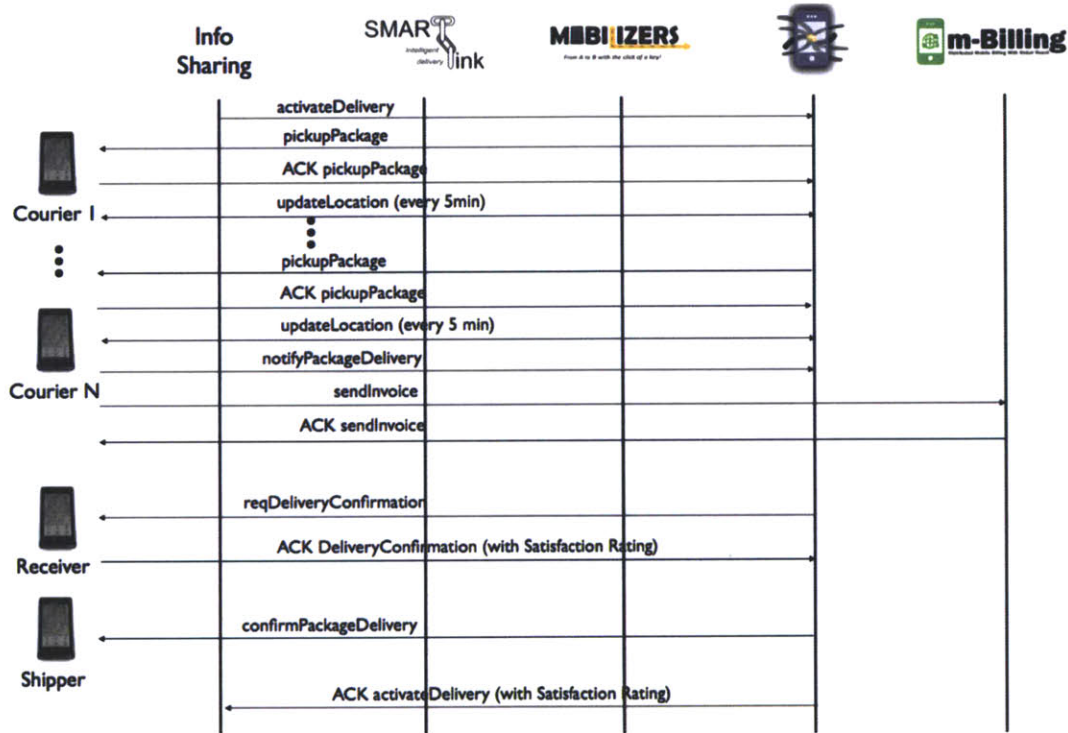


Figure 60: The Web Services Flow of the Delivery Process

By using the m-Logistics service, a shipper can deliver a package to and from a rural area with freelance couriers, and a mobile phone user, who has time and needs a job, can earn money by delivering packages for the shipper. The author and NextLab staff are still enhancing the functions of the m-Logistics service and integrating the Mobile Marketing component to it. In the future, the team aims to develop the interface for the mobile payment to interact with the banking service, and then deploy the service in Mexico and train people in the rural area to use it.



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