

Framework for Developing and Deploying Location-Based Services in Emerging Economies

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B.Sc Computer Engineering

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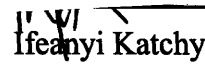
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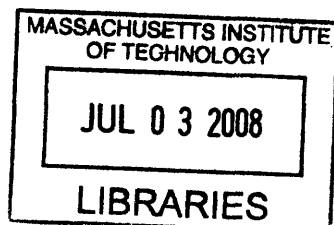
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Abstract

The general belief is that Location-Based Services (LBS) in emerging economies does not make much sense until there is widespread availability of geographic information system (GIS) data, broadband internet access, payment methods, infrastructure such as power, well developed advertising platform, etc.

There is also the belief that these deficiencies make it next to impossible to realize revenues from the existing revenue models such as mobile adverts, online adverts, subscription, etc.

This study shows how LBS services can be developed and deployed in emerging economies within these given set of constraints. It also adduces methods for overcoming some of the identified hindrances such as ways for creating effective and sufficient revenues from online and mobile adverts.

The central hypothesis for this work is encapsulated in a “change of mindset” from developing products comparable to those in developed world (United States, Western Europe) to developing products which meet the immediate needs of the local environment in emerging economies/developing economies (however crude these solutions may appear initially from the POV of the developed world) and make use of not only locally available technologies but locally available phenomena. These solutions are then refined as they are consumed by the populace and the populace becomes more “sophisticated”. This hypothesis is developed and fleshed out in a methodical manner using data and examples from developing countries – Nigeria (Africa), India (Asia), etc.

This study finishes with the architecting of an LBS service (routing/navigation service) for an emerging economy using the framework developed in this study.

Recommended future work includes developing more LBS services using this framework and deployment of the developed service, followed by a detailed analysis of the framework and possibly refinements to it.

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1 Introduction

1.1 Introduction

Location-based services have been described as the next killer application in mobile [1]. Developed countries have embraced them. Their adoption, even with the business and operational models not yet fully figured out has been astronomical. LBS is playing a huge role in the ability of residents to “get more” out of their locality and for visitors to quickly become comfortable in new locations. In fact for international graduate students coming to study in American universities, “LBS” is a must for easy integration into the society.

Unfortunately, LBS are for all purposes non-existent in developing countries/emerging economies. Where they do exist, they are still in infancy stage. This work attempts to layout a framework for the development and deployment of LBS services in emerging economies taking into consideration the characteristics of such environment.

The fundamental theory behind the framework developed in this work is

Basic —> Simple —> Complex

Simply put, this work argues that for developing countries, the development of LBS should not follow the “standards established” in the developed world but rather proceed from developing basic and simple services which meet the immediate needs of the locality, to more complex services (as the usage of the service increases and the society

improves). These basic needs may be seen as rudimentary and inadequate by the developed world but they will meet the immediate needs of the majority of the population in the developing economies who are the main target.

This work also canvasses for the change of mindset of LBS entrepreneurs in developing countries from short-term to mid/long term payoffs (just like those of pharmaceutical companies in developed countries who expect a pay-off in 5 – 10 years and not 1- 2 years). This means that LBS developers while targeting enough revenue to stay afloat (make some profit) should expect a delay in huge profits. This delay is to allow for the LBS services to develop in complexity and for the supporting services such as infrastructure (power), payment solutions, advertising, etc to become robust.

The framework developed in this study covers both the core LBS service and other supporting systems such as funding, revenue generation, online access (internet presence), payment systems, etc required for the successful operation of an LBS service.

1.2 Prior research

Generally, LBS are classified as a mobile service [1] i.e. they are seen from the context of being offered over a mobile platform. As such, most research in LBS has been done either alone or in terms of its relationship/characteristics of mobile systems/applications.

The architecture of LBS services has been researched and reviewed [2], so also has LBS strategy [1]. Even though not explicitly stated, these works can be said to have assumed

an environment where mobile systems are at an advanced stage, where infrastructure is available or easily made available and other supporting services (payment, advertising platform, etc) are available – all features of developed countries.

LBS adoption models have also received some attention. Per E. Pedersen, et al [3] has advanced the argument that LBS adoption process should not only be viewed as a “first purchase decision” but also as a “post-decisional behavior”. The difference is that the latter is geared towards integrated services closely related to the consumption of other physical goods [3]. This means that LBS providers have to base their strategy/business model on those of the goods for which their service is a complement.

Infrastructure of developing countries, especially with regards to financial transactions has also received some attention. Micro-Payment systems of 2 countries were analyzed [4] with a conclusion that there is a market for the “millions of forgotten users” who have access to limited cash, do not use a bank and are wont to make very small or tiny purchases. The report shows that mobile payment systems which work either via mobile-based JAVA applications or text-based SMS are effective in developing countries.

Statistics from International Telecommunications Union (ITU) shows there is an increase in number of mobile phone subscribers in developing countries compared to the number of internet subscribers there. This promotes the development of LBS services which can be accessed via the web.

Nothing much can be found of research which has focused on deploying LBS specifically in developing/emerging economies. This is not to say that no form of LBS exists in these regions. It however signifies a lack of concerted effort to examine LBS within the context of developing countries. This paper aims to do just that. It also aims to jump-start research into this area.

1.3 Layout

This work is laid out in 4 main sections – Chapters two to Chapter Seven.

Chapters two through four cover the topics of LBS, emerging economies and the link between the two. It deals with the components of LBS, how LBS works, current global trends in LBS, characteristics of emerging economies, challenges of LBS in emerging economies, and other links between LBS and emerging economies.

Chapter five covers the framework developed in this work. A high level design of the framework is first presented, followed by a detailed design of the framework. The framework is also discussed/examined using examples in Nigeria & India. This chapter also includes a critique of the framework based on general business principles.

Chapters six and seven focus on revenue generation and funding LBS service providers in developing economies. It discusses ways for LBS companies to generate immediate revenue while developing their service and allowing the operating environment to develop for the big pay-off day. Sources of funding are also examined. These sources can

in general be used by other service providers in developing economies, especially for non-health related services which are the easily the focus of a large proportion of NGO's.

Chapter eight uses the framework developed in this study to walk through the process of conceptualizing and designing a routing service using Nigeria as a case study.

The final chapter in this study is a conclusion and recommendation.

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2 OVERVIEW OF LBS

2.1 Introduction to LBS

Location-based services are services provided to a user depending on user's location.

They are services whose usefulness is dependent on a specific location.

They are also defined as services developed and distributed by wireless carriers and their partners, which provide information specific to a location [1]. If used in conjunction with automatic location identifier (ALI), there is the added advantage that users don't have to manually specify their location. However, ALI is not a requirement for LBS.

Another definition of LBS is "a wireless-IP service that uses geographic information to serve a mobile user. Any application service that exploits the position of a mobile terminal" [2]

Most definitions of LBS define it with respect to mobile devices. The Wikipedia entry/definition [1] implies a dependency on mobile carriers only. According to [3], an LBS user tells the service provider his actual context like the kind of information he needs, his preferences and his position. This helps the provider of such location services to deliver information tailored to the user needs.

Taking the phrase "tells the service provider" in general context, LBS can be extended from the domain of mobile devices to a wider area including static/stationary devices such as a personal computer. A typical example is when a user uses a local-search service

(Yahoo Local, Windows Live, etc) to search for restaurants in a specific city, from his notebook computer. He has provided his preference and his location via a non-mobile device. The key difference is that in mobile devices, the provision of location to the service provider can be done via ALI, whereas in non-mobile devices, this information is not provided automatically, (except where RFID tags are employed). The rest of this document discusses LBS in the wider concepts of both mobile and non-mobile devices.

Implicit in the definition of LBS is the existence of an accurate and robust addressing scheme (zip codes, street names, etc). This existence has been key for the effective deployment of location-based services in most of Western Europe & North America but is a deterrent in developing countries where this is not in existence. This problem is discussed in more detail later.

A very simple example of how LBS works is described below.

- User activates LBS Service.
- User's position is determined via the positioning device
- User requests a service. The request for service along with user's position is sent to the service provider via the communication network.
- The service provider processes the request and passes the results back to the user through the communication network.

For mobile phones participating in LBS requests, user's position can either be determined via mobile carrier networks (using GPS, Uplink Time of Arrival – TOA, Enhanced

Observed Time Difference, E-OTD) or independent of the networks [5]. The huge capital outlay required for using carrier networks is one of the hindrances to the deployment of LBS in developing countries (see chapter 5 for more details).

A cheaper but less accurate method of determining user's location can be performed independent of the networks (not using GPS which is useful for developing countries). The accuracy of this method is being improved upon to make it suitable for basic services such as information retrieval, navigation systems, etc. This method is known as Cell of Origin and is described in [5]. Google recently introduced this software as part of its mobile mapping services.

Examples of location-based services include

- Route-finding such as driving directions and bus routes.
- Location specific searches such as for restaurants, taxis, news, etc
- Information alerts such as weather, traffic density, emergency rescue units, etc
- Resource tracking such as car recovery, distribution network monitoring, etc

2.2 Components of LBS (from the user's point of view)

- **Requesting Device** – this is used by user to initiate a request. For example, a user will use a “requesting device” to request driving directions, weather information, search for services, determine his/her current location, etc. This device can be mobile or non-mobile. Examples include personal computers, mobile phones, personal digital assistants (PDA), car navigation unit, materials with RFID tags on it, etc.

- **Positioning component:** This determines the position of user. This can be done automatically using ALI (GPS, mobile carrier network, etc). Where this is not automatically determined, the user manually passes across this information to the provider. An example is when user indicates start location in a driving direction services, or target location in local-search.
- **Communication Network:** This is used to convey request from the device to the service provider and back to the requesting device. This is commonly the internet, and/or mobile carrier network.
- **Service provider:** The service provider processes the request from the user, and provides the requested service. Services can include getting route directions, finding places such as a restaurant, etc. Sometimes the user is aware of who the service provider is such as when a user uses Google Maps to get driving directions. Other times, the user may not be aware of the service provider especially if it comes bundled in as part of another service. For example a user who is able to get weather details from his cell phone service provider.

2.3 Components of LBS (from service providers' point of view)

- **Requesting Device** - This is used by user to initiate a request and response is usually sent back to this same device. The LBS service provider has to format the response to the service request to fit this device. Examples include personal computers, mobile phones, personal digital assistants (PDA), car navigation unit, materials with RFID tags on it, etc.

- **Communication Network** – Service provider receives requests and provides responses over this medium. This can be the internet, and/or mobile carrier network.
- **Data Source** - This is the source of the information which is provided to the user or used in satisfying a user’s request for LBS. This includes source of route information within a city, list of local businesses and their locations, etc.

Data source is key for the service provider. Without an accurate and economic data source, no service can be provided to users. If the data source is not current, service provider will lose customers.

- **Revenue Component** - This is the mechanism for generating and collecting revenue. It includes who is to be charged, how the billing will take place and how the funds will be collected by the service provider. This component is especially critical since for some services, the person being billed may be different from the person who is enjoying the service. For example most online “driving direction” providers do not charge their users but instead bill advertisers or users who have asked for special services.

2.4 Categories of LBS

LBS can either be categorized as “Push” or “Pull” services.

Pull services are only provided to the user upon request. The user is in complete control of what kind of service is requested and when this service is provided. For example, a user checking to find a route from point A to point B, or looking up a service provider such as a gas station in a specific location is executing a pull service.

Push services are provided to the user based on an event or a trigger. The user has either not directly requested the service or indirectly requested for the service through an action or event. Event notification when a user enters certain geography is an example of a push service. An example is traffic report, or knowing when your friends are around you. For push services, a user has to “opt in” before receiving these messages except in cases of emergency. In the United States for example, with the passing of the Cam Spam Act in 2005, it became illegal for an LBS provider to provide notifications to a user unless the user has expressly opted in [4].

2.5 Uncertainty in LBS

There is a great deal of uncertainty surrounding LBS. This is due in part to the mobile nature of LBS services (the mobile version of LBS). Mobile services are a major form of value-added services or post-decisional services and are thus prone to the ability of the major service to be adopted by the user. LBS are thus sometimes dependent on the attractiveness of the main service to the user and this can be unpredictable especially from the point of view of the LBS provider. Mobile services also have the potential over time to change, especially in their context.

Other sources of uncertainty have been grouped around 4 LBS dimensions – Marketplace, Service, Organizational Capabilities & Technical Capabilities [6]. Some of these identified uncertainties include

- **Marketplace** – LBS providers are still finding it difficult to quantify the market place. This is partly due to the “post-decision” nature of LBS i.e. the fact that the use

of an LBS service is usually dependent on an earlier decision to have purchased another service. For example, I have decided to eat pizza and so am now looking for pizza huts in my neighborhood.

The dependence of LBS on mobile technology and the disruptive changes taking place in the mobile sphere (emergence of VOIP, competition by mobile carriers, potentials of WIMAX) also leads to uncertainties for the LBS providers. The LBS provider has to carefully gauge and analyze the mobile market to be able to take strategic decisions for their firms.

The emergence and dominance of security and privacy watchgroups have also increased uncertainty in qualifying/quantifying the marketplace. The recent rise of terrorist attacks, and government effort to track terrorists down (leading to increasing demands for personal information such as asking telecomm providers to hand over browsing information and other personal data), has led to a sharp and concerted effort by privacy watch groups to prevent this seeming assault on privacy. This has also led to the populace being cautious of devices/services which can potentially identify or track their activities.

- **Services** – Technology today is moving towards making any and all devices “on” i.e. putting most devices online. Today, there are commercial products or prototypes such as refrigerators which automatically order items when the stock goes low, dog collars which track dogs and notify users, smart phones, wearable computers, etc. This means there is much diversity in devices whose location can be identified and which

can potentially access LBS services and this leads to increasing complexity in requirements definition for the LBS providers.

- **Organization Capabilities** – Today, LBS is no longer the purview of a separate group of experts or companies. Mobile carriers are also engaging in the business and there is thus great competition for the relevant skill sets and capabilities required for LBS organizations to function.

With the rapid changes in business models of mobile carriers, it is also becoming difficult for LBS providers to effectively identify potential business partners for LBS ventures and agreements.

- **Technical Capabilities** – Rapid advancements in technology is in itself a major source of uncertainty in LBS. While a service is being designed and built around a specific technology, it is quite possible that a radical technology may be released rendering the current technical capabilities useless. For example, while mobile phone companies (in partnership with some LBS companies) were busy researching cheap GPS enabled handsets, Google introduced a form of Automatic Location Identifiers (ALI) which did not require GPS capability.

2.6 LBS and Privacy Concerns

One of the major constraints to LBS adoption is privacy concerns. This is because LBS “Push Services” require the tracking of a user which in today’s world raises security & privacy concerns. In the United States & Europe, there are laws regulating this,

preventing the provision of personal data to third parties. However recent events have shown that government can obtain this data (telecommunication firms recently handed over browsing data of individuals to government) which has elicited widespread condemnation from the privacy watch groups.

In the last few months, there have also been widespread stories of hacker penetration of networks which had otherwise been considered very secure. These include the US DOD (department of defense), US Immigration, Credit-card agencies, etc. These penetrations have created a belief that user data on LBS providers networks is thus not safe and with Hollywood churning out movies such as “Most Wanted”, “Die Hard 5”, the potential damage of this information in the wrong hands, is left to user’s imagination.

2.7 LBS Providers

LBS providers can be generally split into 2 groups

- Primary LBS providers
- Secondary LBS providers

Primary LBS providers are those for whom LBS is the core and/or only business. These include companies such as hopstop (<http://www.hopstop.com>), MapQuest (<http://www.mapquest.com>), etc. The aim of these companies is not only to increase the adoption of their services/products but to increase revenues from these products and services. These companies in general generate revenue from adverts, and partnerships with other companies (for example hopstop allows business clients to provide maps to their users for a certain fee).

Secondary LBS providers are those for whom LBS is not their core business (even though they have invested huge resources in it). Instead LBS is seen as a means for branding (keep their name in the eye of the public), a way to maintain traffic to other services being offered on the site, and a means to increase adoption of their products. This can be summarized as saying “these companies see LBS as a means to becoming a platform or maintaining platform dominance”. Companies like Google, Yahoo and Microsoft fall into these categories. This group of companies may/may not be generating much revenue from these services. For example, there are no adverts served up on Google Maps but local search incorporates adsense and adwords.

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3 LBS – MAPPING/ROUTING SERVICE & LOCAL-SEARCH

The most common forms of LBS services today are mapping/routing services and local-search. These two groups of services are provided by both the primary and secondary LBS operators.

3.1 Mapping/Routing service (navigation/direction finding)

Routing service involves finding the route between 2 or more points. Such routes can be determined based on the shortest distance, the fastest time to transverse the path, the path/route with a specific set of attributes such as scenery, back-roads, etc.

In GIS (geographic information systems), routing is a subset of mapping services. A mapping service provides digital maps. A map is a portrayal of geographic information as a digital image file suitable for display on a computer screen. A map is not the data itself [1].

Web map services (WMS) provide map data online i.e. via a web browser. Users submit mapping requests via a standard web browser and the results are also displayed via a web browser. Two or more maps can be overlaid to create composite maps. This is useful for different scenarios such as looking at urban development, crime rate by region, etc.

Routes can be calculated or determined from the same set of data on which maps are built. The resultant route is then highlighted on a map which is produced for the user.

This is the way most WMS work. Examples include Google Maps, Yahoo Maps, MapQuest.

Routing service is common amongst LBS providers because of its cross industry applications. Consumers/individuals have a need for finding routes, companies providing tracking services need to know the route, parcel distribution and bulk delivery service providers need the service, emergency vehicle operators need to know the fastest way to remove an emergency victim.

Tourism is also another big industry which makes extensive use of routing service.

The wide and cheap availability of GIS data in the USA and parts of Western Europe makes it easy to implement routing services. Today, companies such as hopstop, have also ventured into providing routing services based on public transportation (bus, rail) which before was the purview of the government.

3.1.1 Current challenges in mapping/routing

- **GIS data unavailability** – GIS data is still not readily available for quite a number of locations. This is due to the high cost of acquiring this data both in terms of equipment and personnel required. Countries in parts of Europe and much of Africa and Asia fall into this category. For the African and Asian countries, the government has not stepped in to provide incentives or a soft landing for people to try to acquire this data. In Africa where a lot of services are not yet electronic, and there are other pressing needs, acquiring GIS data is the least of government worries.

- **Expensive GIS data** – Where GIS data is available, it can be quite expensive to lease. Data is currently being provided by the big data providers such as NavTeQ & TeleAtlas. Licensing data from these data providers requires a huge capital outlay. In some countries in Europe such as the United Kingdom, the government has contracted out the gathering of GIS data to third party providers who in turn charge a lot for licensing it out to others for use. The United States is an exception to the above because government invested in data gathering and put this data in the public domain. This means users either have access to free data or the cost of access via third party providers is reduced for US cities.
- Privacy concerns, unproven commercial viability, diversity of positioning techniques [2], data sharing limitations are also other challenges plaguing mapping/routing services in developing countries.

3.1.2 Trends in mapping/routing service

- **Open Source** - Due to the problems of data unavailability and high cost of licensing available data, there has been a move towards Open-Source mapping. This includes both open source data collection and open source mapping software. Some of the open-source organizations include www.openstreetmap.org, www.osgeo.org, www.openlayers.org, etc.

The primary aim of the open source community has been to enable individuals to collect mapping data via the use of GPS devices (handhelds, mobile phone-enabled GPS, etc). The data is cleaned up and put in a ready to use format by volunteers.

Open source applications are also available for people to use to render the data. Some of these applications include mapping server applications such as GeoServer – www.geoserver.com and routing applications.

The open-source group is also leveraging other open-source applications such as Post GRE SQL, a free SQL database.

- **Mashups** – Another trend in mapping is the use of mapping data in mashup applications. A mashup application is one which draws upon content retrieved from external data sources to create entirely new and innovative services [3].

Mashups are using mapping services/data to enable users visualize trends. It overlays maps with information such as hurricane movements, crime statistics, cinema locations, etc. Such sites include Live Sports Map - <http://fanbash.com/map/> which allows users to see sports scores across the world (mostly USA & Canada) on a map. Users can thus know which areas are strong in a particular type of sport. A hotel chain, Sol Melia Hotels & Resorts, is using Google Maps to give users a bird's eye view of their hotel locations.

Digital maps are quickly becoming a centralized tool for countless uses ranging from local shopping and traffic reports to online dating and community organizing, all in

real time and right down to specific addresses [4]. As of 2005, it was estimated that about 10 mashups are created every day, each providing data that pop up in info balloons from the digital pushpins dotting various online maps [4].

- **Better Routing** – This involves finding more things to do along a route such as routes with more scenery, planning a multi-leg trip thus arranging stops for the user (i.e. telling the user the sequence to visit his destinations for the best travel time).

3.1.3 Success factors for mapping/routing services

Mapping services can be considered a success today in developed countries due to a number of factors including

- Its cross-industry applicability
- Availability and low cost of GIS data
- Easy implementation due to availability of cheap data and supporting technologies

3.2 Local-search

Local-search provides the capability to find services, businesses and information about a specific location/geography. Not only does it return businesses/services for a specification geographic area, it also provides information about those businesses such as contact details (address, phone numbers), hours of operation, etc. Local-search is an extension of the Yellow Pages in online form.

3.2.1 Current challenges in local-search

- **Recommendation System** – users are not only interested in locating services in a specific vicinity but they also want a recommendation on which service provider to choose from the large number in the result set returned.

Local-search relies on consumers going back to rate the service which they have consumed. It is thus heavily user-dependent. Unfortunately, a large proportion of users do not provide this feedback. It is quite common to find users who only provide feedback in extreme cases i.e. when the service was exceptionally good or when it was exceptionally poor.

- **Search Technique** - Most search engines return results which match any of the words entered by the user. Thus, when a user searches for “famous hotels in Cambridge”, the word “famous” is meant to be a qualifier on the word hotel not a separate keyword [5]. However the search engine does not interpret it this way and returns a large set of results.

A user can also try to enhance his specification in terms of distance. For example, a user can search for hotels within 1 mile from Cambridge. Most of the big local search engines (Google, Yahoo, etc) do not provide for this fine limitation/data sorting. They have a predetermined distance for localizing data and user can not change this.

There is thus a discord between the search techniques and the natural language of users.

- **Data Source** - Local search has to aggregate information about companies providing a variety of services. A key to the effectiveness of local search is the size of its database (i.e. the list of companies/service providers it has) and the accuracy of provided information.

Most of the big search engines crawl the web for information about companies which they include in their local search version. They also use third-party data providers such as Acxiom, Amacai , GeoSign , InfoUSA. Google, Yahoo, Microsoft has licensed InfoUSA [6]. A common complaint from users is the lack of accuracy of the data from these data providers or the lack of local content in the provided data. Generally popular categories such as restaurants and hotels have a large number of listings whereas other categories such as plumbing, escort, dog-walking services have a poor number of listing. The problem can be summarized as deep coverage in selected categories but not across the board, or thin information but across a broad category

3.2.2 Trends in local-search

Current trends in local-search include the use of web2.0 phenomena (participatory database update) where the public and service providers are encouraged to provide data to the local-search engines (via directories) and to update their data.

There is also a move towards vertical search engines which combine both the ability to search for local businesses and the characteristic of focusing only on specific domains. For example, there are sites today focused only on searches for medical doctors, dentists, insurance, etc.

3.2.3 Success factors for local search

Some of the factors driving the success for local-search include the great demand for the service. This has thus spurred innovation in this area.

The groundwork for this service has also been laid from the days of yellow pages. The basic information is thus already available. In addition, very powerful and big search engines like Google, Yahoo, etc already exist. The capability for scouring the web is already there, and an extra layer of filtering is what is required.

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4 LBS & EMERGING ECONOMIES

Emerging economies can be described as “countries with developing economies, often experiencing rapid growth and offering lucrative investment opportunities, but also characterized by instability and high risk” [1].

According to [2], the term signifies a business phenomenon that is not fully described by or constrained to geography and refers to countries which are considered to be in a transitional phase between developing and developed status. Political Scientist, Ian Bremmer defines an emerging market as "a country where politics matters at least as much as economics to the markets.”[3].

In this work, emerging economies is also broadly defined to include developing countries which are highly characterized by poor infrastructure, low economic standard of living (but highly available economic resources), and poor developed human capital/labor. In some of these countries, the human capital is highly developed but there is no structure to harness this knowledge and skill.

4.1 Characteristics of emerging economies

- Poor Infrastructure
- Poorly organized/developed local human capital
- Availability of human capital resident in developed countries
- Abundance of natural resources

- Initial political instability which is giving way to stability and increasing market awareness
- Low investment
- “Sachet Purchasing” or characteristic of purchasing goods in very small quantities [4]
- Preponderance of “pre-paid” mobile phone users versus “post-paid” mobile phone users
- Largely cash-based society transitioning to mobile-electronic payment systems

4.2 Challenges of LBS in emerging economies

LBS [typically] requires the following

- Digitized road data/map
- Proper street names
- Proper town planning
- Accurate zip codes/building addressing scheme
- Broadband internet access/Wireless access protocol (WAP)
- GPS enabled devices or other forms of automatic location identifiers
- Effective privacy laws

These are either lacking or poorly developed in emerging economies. This makes it difficult for location-based services which are add-on services to flourish since the basic platform is not available.

- **Infrastructure Challenges** – Challenges in infrastructure such as epileptic power supply and non-availability of human capital also affect deployment of LBS in emerging economies. Inconsistent power supply means that service providers have to provide standby generating sets. This increases the final cost of the product to the end user. Inconsistent power supply also means users can not always access the service, which leads to a reduction in traffic volume and thus negates the “free” market strategy of the service which is dependent on high volume of traffic.

For some types of infrastructure, the cost is falling but for emerging economies, it may be difficult to predict the timeline. This is due in part to frequent changes in policy of the government which may prevent a proper deployment plan and the ability to take advantage of falling costs. A service provider can potentially invest a huge amount of money to build out infrastructure only for political unrest to make the environment difficult for him to operate in. For example, a service provider could potentially spend money to acquire solar powered facilities due to its reduced cost and steady supply only to lose money when a new government places a ban on solar-powered technologies.

- **Unavailability of broad band internet access** - With the absence of broadband internet access, companies can not develop services such as local search, or online services since majority of the targeted audience will not be able to access it. This means internet access will first have to be made available (as Google is trying to do in Kenya by buying Satellite time & capacity and distributing for free to schools) or a

different approach developed for deploying LBS in emerging economies such as deploying over the mobile phone network (still expensive), using the approach developed by Last-Mile Solutions – www.firstmilesolutions.com .

- **Unavailable [digital] data** – This is one of the fundamental challenges to LBS services. Data is required to provide any form of LBS service. Mapping data is not available either in digital or paper format, business data (yellow book) is not available for local-search capabilities, etc.
- **Improper Town Planning** – This is a big challenge for mapping and routing LBS services. Due to the poor planning of cities, there are no proper street names, records of streets have not been kept, and changes have been made to the city structure without the knowledge of the relevant authorities. In truth some of these plans/data existed but urban growth has distorted these plans.
- **Marketplace sizing** – There is usually little or no data in emerging economies to estimate the size of the LBS market. This is due to LBS market inexperience in these economies and poor infrastructure.

LBS providers in these economies also suffer from inability to estimate/quantify revenue due to frequent changes in government regulation which can affect the market and thus affect LBS provider's planning and outlook.

High illiteracy levels and superstitious beliefs also create uncertainties in the marketplace for LBS in developing countries. For example if a story spreads that with

LBS, every single detail about the individual (including his medical history) becomes available to the service provider, it may become very difficult to correct this impression and this can lead to the LBS service dying prematurely. The probability of such stories spreading can not be estimated currently.

- **Organization Capabilities** – An LBS provider can only function when it has the requisite skill set and the right partners to interact with.

Availability of skill sets – Emerging economies have low number of GIS specialists. These economies do not see GIS as a professional course and so most people do not enroll to study it in colleges. An LBS provider is thus not sure of available manpower for his business.

Partners with right capability – Adverts are a major revenue platform for online LBS providers in developed economies. There are advert agencies and platforms which purchase the necessary advertising space on the LBS sites. However, this is not the situation in developing countries. Most adverts are sold directly by the website owners and bought directly by the advertiser. It is thus not easy to predict the size of the market and its ability to sustain an LBS provider. The same thing goes for mobile advertising.

Whereas venture capital firms abound in North America, this is not the same in developing economies. Potential LBS providers thus are not sure of the necessary funds to either kick off or to expand the business.

- **Low investment** – Low investment portfolio in emerging economies and high cost of doing business also affect deployment of LBS services. Some of these countries attract huge foreign investments in the area of Oil & Gas. Such countries include Nigeria, China, Middle-East. Other sectors do not see this same amount of investment. The local firms do not have the financial muscle for huge investment. This is however beginning to change but it brings its own attendant problems. For example, since the deregulation of the Nigerian Telecommunications market, there have been a series of large investments by foreign firms in this area because of the huge potential. However since the country is still considered a high risk venture, most of the capital brought in is at a higher cost resulting in higher cost of service to the populace. This means the populace does not use the service as much as they possibly could (though the consumption is currently high) and in return, the investors are not recognizing as much revenue as they could.
- **No clear source of revenue** – Online advertising is the dominant form of revenue for online LBS services, especially those offered for free. It is also becoming the dominant revenue model for LBS services delivered to a user over the mobile phone. However, emerging economies do not have high volume of online advertising due to the low internet density in the economies.

Subscription is also a leading form of revenue source but this is usually due to add-on services provided via broadband internet access.

- **Payment Systems** – For subscription or online advertising to work, a robust electronic payment system needs to be in place, which unfortunately is not the situation in developing economies. For example, it was only in the past 5 years that Nigeria implemented an electronic card-based payment system and that Visa & MasterCard services became available in the country.

This is a major challenge facing emerging economies. Some of them are still plagued by cash-based economies, and in others [international] merchants are still wary of connecting to the local payment systems. For example Google AdSense currently supports electronic funds transfer to one country in Asia, Japan. No African country is supported. They however support payment in local currency in India, and 2 African countries (Morocco & South Africa). China is not supported in either of the two transactions.

Things have begun to improve as financial institutions are beginning to come up with mobile payment solutions to address these. However there is still much to be done. For example, the local payment solutions need to be integrated into the international payment gateways.

- **Deliberate foot dragging** – Sometimes, due to the lax enforcement of laws, companies operate with sub-standard equipment in developing countries and deliberately refuse to upgrade or modernize equipment because they are getting maximum returns with little investment. Other companies which are dependent on these infrastructure are thus not able to plan effectively due to the absence of publicly available expansion timelines by these companies.
- **Other sources** - Other sources of uncertainty include absence of legal laws to protect both the service provider and consumer in the event of service failure. This creates a murky environment for the service providers who do not know if they have gone afoul of the law and are not able to effectively make a stand on some issues.

This same latitude also sometimes works against the consumers as the service providers exploit this to provide poor service. The consumers' only option is a boycott of the service thus leading to the fluctuations in service response and the inability of other service providers to estimate the market size. For example the repeated poor performance of some of the GSM companies in Nigeria, without responsive oversight functions by the regulatory agency, led to consumers planning a boycott of GSM services on a specific day.

This uncertainty in ability of the consumer to be protected can severely hamper the adoption of LBS.

All of the above are simply challenges. They are not insurmountable and do not mean that LBS can not be deployed. The key is to find a solution that works within these areas and then gradually build it out.

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5 LBS Framework for emerging economies

A framework can be defined as the basic conceptual structure used to solve complex problems [1]. It is the structure around which solutions are built. It governs the development of solutions and is generally independent of the specific solution.

Framework for location-based services is a structure for developing/deploying location-based services. There is the added constraint of emerging economies which is typified by absence or poor state of modern infrastructure including electronic systems, communication infrastructure, power infrastructure, collaborative businesses, lower purchasing power, etc

The rest of this document will cover the development of the framework and its analysis using one/more case studies. The case study will act as a guide for reviewing the framework and pointing out any problems/challenges with the framework. The case study will be architected using principles from Systems Architecture & Introduction to LEAN Classes, both courses which are offered in the Engineering Systems Division of MIT.

Systems Architecture views product (service) development from a systems point of view i.e. from a “holistic” point of view. As such, the framework will cover both the core product/service (LBS) and other supporting products needed for the service to work, such as payment systems, adoption mechanisms, etc.

5.1 LBS Framework – overview

The LBS framework developed in this work is built on 2 fundamental principles

- Identification of the basic services required in the locality versus what is expected in the outside world (developed countries).
- Emphasis of local technology/phenomena over imported technologies

Identification of the basic services required in the locality versus what is expected in the outside world (developed countries).

This simply means that the system problem statement or primary value delivered by the system should be defined within the current context of the environment. From the service provider's point of view, this can be stated as "given the current configuration of the organizational, technical & market place capabilities of the environment and service provider, what is the requirement for LBS?" An example is – the average man on the street simply wants to know how he can get from point A to B. A well documented text format will suffice till he outgrows it and starts looking for advanced options like graphical maps. The framework motivates the LBS provider to think of meeting the needs of the locals and not the needs of foreigners coming in to the local community.

The above point can also be restated as doing away with the belief that "LBS require map information" and instead changing the mentality to "LBS require location information". Based on this, the service provider tries to provide services with location and not maps. The map requirement can come later.

We can therefore say that the framework suggests starting small and rudimentary services which meet the immediate needs of the populace then building up to complex networks/services. If service providers wait for the big-bang (money, human capital, organization, infrastructure, etc), nothing will ever get deployed. This may be a longer route in the long run but it ensures that services which meet immediate needs are delivered and it helps reduce the cash required to roll out the complex services (revenue earned from initial services can be used to offset the cost of the more complex services).

Emphasis of local technology/phenomena over imported technologies

As earlier stated, emerging economies are characterized by unavailability/dearth of technical personnel and infrastructure. Due to this, a key piece of the developed framework is the use of local¹ components/technology without recourse to looking to import components/technology. Local components which fit less than 100% are emphasized over components which have a 100% fit but are not local. For example, the use of cell of origin to determine a user's location is a local technology [in Nigeria where mobile telecommunication network is the most prevalent means of communication] which is not 100% accurate. This technology is emphasized over the use of GPS which is not local to the environment and is expensive, but more accurate.

According to [2], in complex environments, solutions are often identified before problems i.e. designers look for problems to solve using a known solution. Based on this, the LBS framework developed here is looking at a solution (how the locals currently

¹ Either totally developed within the locality or a foreign technology which has been localized and thus exists within the locality.

solve their problems, for example asking motorcycle riders for directions in Nigeria, asking dabbawallas for directions in India, etc) and looking for problems which this solution can be applied to (how do we apply these solutions to finding routes on a large scale?).

This ties back to the earlier point of emphasizing locally developed solutions over foreign but maybe more accurate solutions which are however more expensive.

Store & Forward Technologies

Another key point in the framework is the emphasis of “store & forward” versus real-time. Real-time is ideal but in several situations (especially in developing countries), it is not a necessity but more of a luxury. Considering “store and forward” technologies over real-time technologies reduces the cost of deploying LBS and makes it more reachable for the developing world. An example of the “store and forward” technique is being used by FirstMile Solutions – www.firstmilesolutions.com to solve the last mile problem in villages in developing countries.

These principles of the framework are not an excuse for developing sub-standard products. They are rather a way of ensuring that

- The service meets the need of the intended audience
- The capability of the service is developed step-wise, growing in complexity as the need demands

Also implicit in the framework is the use of locally available personnel in the development of the solution/service. Apart from being cheaper on the average, local personnel have a first hand experience of the problem on the ground and are more conversant with the environment. They are thus better able to relate to the problems in the locality. It is not uncommon to find a situation where a European, resident in Europe is developing solutions for a country in Africa based on a one-time visit or an African who has not lived in Africa in a very long while and has not maintained strong links with the country is developing solutions for such a country. The requirements driving the solution are more often than not imprecise, and far removed from the reality on ground.

This framework also underscores the point that users needs/wants should drive invention and not company needs driving invention. For example, the average man on the street in a developing country wants to know how to get from Point A to Point B, and what is around him without spending too much money, if any at all. This should drive innovation in trying to deliver such a solution to a device he already possesses and knows how to use like a mobile phone. This is faster and more desirable to him than trying to make internet access cheaper so that he can afford internet access but he first has to go learn how to use a computer. A potential LBS provider should be asking – how can I deliver this information to my user over the phone? Can I standardize the phone keyboard [maybe to the QWERTY form] so that it becomes easier for my user to use it to access my service?

5.2 LBS framework – high level design

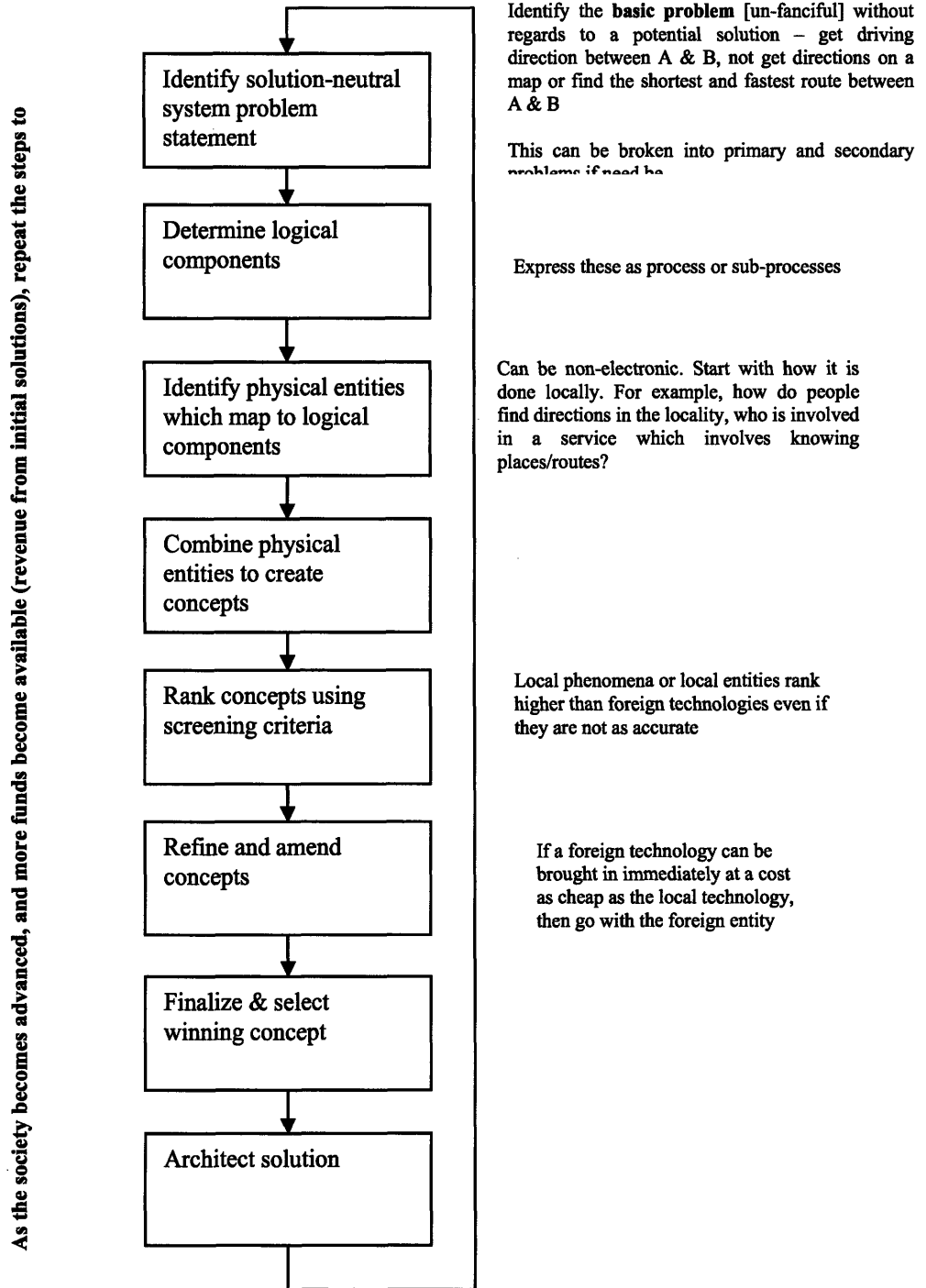


Figure 5.1 – LBS Framework

Figure 5.2 shows a high level design of the framework

- a. Identify solution-neutral system problem statement
- b. Determine logical components
- c. Identify physical entities which map to the logical components.
- d. Combine physical entities or instruments objects to create a concept.
- e. Rank the concepts².
- f. Refine & amend concepts
- g. Finalize & select winning concept
- h. Architect solution
- i. Repeat from step “a” if necessary

5.3 LBS framework – detailed design

5.3.1 Identify solution-neutral system problem statement

The aim of this first step is the identification of the immediate and “un-fanciful” need of the locality. Care is taken to identify the problem the system is meant to address without recourse to a solution (solution-neutral). For example the need of the populace should be stated as “get driving directions between points A & B” AND NOT “get driving directions on a map between point A & B”, or “see driving directions on a map between points A & B”.

² Concepts with local entities rank higher than those without local entities

By including the word “map” in the problem statement, the problem has been tied to a specific solution, and it is not the immediate need/problem of the locality. If the populace can get driving directions in a clear text format, then another pass through the framework can result in a problem statement which involves getting driving directions on a map. By going through this step-wise process, the solution is slowly built up with available resources. “Bells and Whistles” can then be added as the populace consumes the available solution and the problem grows in complexity.

5.3.2 Determine logical components of the service

The aim here is determine all the logical components required for LBS to function. The urge to look at the components in terms of physical products must be resisted. Doing this increases the possibility of limiting the field of possible solutions because one has chosen existing physical products. At a latter stage, the logical components will be mapped to physical entities.

One way of doing this is to break down the problem into constituent processes. For example to provide driving directions between two points would involve

- Capturing route data
- Determining optimal route
- Determining location (users’)
- Determination destination (users’)
- Displaying optimal (to user)

5.3.3 Identify physical entities which map to logical components

Identify different physical entities which match these logical components. At this point, the aim is not to determine the percentage fit of these physical components but just whether they can satisfy parts of the logical architecture. This is done in three different passes.

- Identify local practices/entities/technology – Identify local (could be non-electronic) practices or sources which can serve as a component. For example in Nigeria, a common practice or method of finding a route whilst on the road is to call a local motorcycle driver (motorcycles are a common and cheap means of transportation) and either ask for directions to a specific location or agree to pay a certain amount, and the driver leads you to your destination. These motorcycle drivers are usually locals in the different areas they ply and are very knowledgeable about the routes. This is a typical example of local phenomena which can for example serve as a physical component match to a logical component.

In India, Dabawallas are a group of people who engage in the trade of picking up food (usually lunch) from the homes of workers and delivering to the workers in their different offices for a fee. They have a network and deliver to all nooks and crannies of the city. They also have a reputation of 99.99% efficiency. They are a source of route information in India and can serve as a potential source of route data in a driving direction service.

The use of local concepts to satisfy the requirements for architecture has been validated by the recent launch of the Google improvisation for GPS services on phones which do not have GPS capability. This was one of the design principles originally thought of by the author i.e. the use of cell towers to determine a user's location versus using GPS. This is because of the non-predominance of GPS enabled handsets in Nigeria, the expensive cost of access to satellite systems to process the GPS data, and other factors.

Most recently, an entrepreneur in Arizona used the concept of floating balloons which are let up every morning by local farmers (they do this before heading off for their normal daily farming activity) to bring wireless services to millions of rural dwellers [4].

- Identify foreign technologies/practices which are widely available locally. This includes the cell phone which is more available in emerging economies than broadband internet access, or even dial-up access.
- Identify foreign components/technologies which can be imported/transferred to the locality.

The aim of the first two passes is to prevent a handicap of the proposed solution by adopting technologies from developed countries which may not work in the developing countries due to infrastructure constraints, or technologies which have not been localized to the developing country. It will also prevent the potential deployment of a solution

which will encounter adoption difficulties. For example, in the United Kingdom, there is currently a drive to get the populace to contribute GIS data captured by individuals, as part of an open-source GIS data collection exercise. Such an endeavor will be severely hampered in countries such as Nigerian, India, Pakistan, and other developing countries because it would require massive deployment of GPS devices (which most people do not have and can not afford to purchase), training of people in its use and the provision of internet access for data upload.

The last pass recognizes that there are existing technologies which with proper installation or further research into localization may be used in the emerging economies. An example is the web2.0 phenomena which encourages the authoring of content by a dispersed group of people. This last phase would look at the possibility of extending such a practice to the local environment i.e. how to get the local populace involved in participatory LBS.

5.3.4 Combine physical entities to create a concept

Create concepts by grouping different physical entities where each concept has one physical entity mapped to at least one logical component. Not every logical component has to be covered in all concepts i.e. the ability of these entities to satisfy 100% of the logical requirement should be ignored for now. Part of concept creation is seeing whether some logical components can be done away with, or temporarily ignored.

It is to be emphasized that the aim of a concept is to meet the identified solution-neutral system problem statement, not the subsidiary goals of the system. The aim also is not to create concepts which are a copy or meet the standards for services in developed countries. It is possible that some concepts will exceed this, but that is not the focus. Instead, the focus should be on creating concepts which meet the needs of the locality. Such concepts may have less requirements and functionality. As the locality advances, the components can grow in complexity eventually reaching the service available in developed countries.

The system architect has to be careful though not to ignore world standards or ignore examining the possibility of meeting criteria which surpass the current local requirements. One of the factors to be considered is timing. Is there any reason to believe that by the time the technology is deployed, the environment would have changed resulting in a more advanced environment, or is there the nearest possibility that advances in technology would have made the current concepts extinct? These are uncertainties which have been identified in the section “LBS & uncertainties”.

One of the advantages of concept creation in emerging economies is that due to the absence of legacy applications, radical technologies/concepts can be considered without the bottleneck of backward compatibility/integration with legacy applications.

Finally, the system architect or service developer should ensure that a mental ranking of the concept is not being done at this phase. This is to ensure that all possible concepts are identified.

5.3.5 Rank the concepts using a screening list

This is another very important step in the framework. Concept ranking usually takes time and is iterative in nature or is rarely done in just one pass through. This is partly due to the number of concepts involved. The larger the number of concepts, the longer it takes and the greater the certainty of more than one pass through the process.

A common method for ranking concepts is benchmarking against a reference concept. Using the Pugh Concept Selection Method, the reference concept is usually an industry standard or a straightforward concept with which all team members are very familiar with [3]. This is not the case here as the framework has almost certainly done away with the industry standard for the product in the hope of reducing the cost of the final and wide acceptability of the product.

The method chosen for concept ranking in this work is the use of a set of screening criteria (questions) and the matching of the concepts against these criteria. These questions are a set of Yes/No answers and are scored 1 or 0 i.e. 1 for yes and 0 for no.

The screening list/criteria is a major plank on which the framework is built as it helps determine which solutions will be discarded and which will be selected for possible deployment.

The screening criteria were drawn up to satisfy the 2 earlier stated principles on which the framework is built i.e. emphasizing local versus foreign technologies and ensuring that the service is initially developed to meet the immediate needs of the populace without bells and whistles.

The chosen set of screening criteria is outlined below

- i. Is the data free?
- ii. Is this a local technology (i.e. developed locally)?
- iii. Is this technology/solution widely available locally?
- iv. Is this a local phenomenon?
- v. Does the solution require non-specialist skills (personnel) for deployment?
- vi. Are the needed skilled personnel available locally?
- vii. Does the technology have a short deployment time frame?
- viii. Is the solution easy to deploy?
- ix. Is the solution easy to maintain?
- x. Does the technology or solution meet the system problem statement (or minimum requirements?) – extra points are not awarded for exceeding the requirements
- xi. Does the technology/solution meet some or all of the subsidiary goals?
- xii. Is the solution inexpensive to deploy?

- xiii. Is the solution inexpensive to maintain?
- xiv. Is this the best/most advanced solution technically? – this is used to keep track of currently expensive technology which can later be deployed when the costs fall

5.3.6 Refine and amend concepts

After the concepts have been ranked, some concepts (the higher ranking ones) are selected for refinement to create better concepts. This could be done by merging some concepts. Refining a concept can also include refining the individual components to fit the local needs of the location.

From a systems point of view, refining concept would include taking into account the timing of concept deployment as discussed in “concept creation”. Are there technologies being developed which will impact the concepts that have been developed? Systems view of concept refinement and amendment will also look at viability of the concept. Using the example of motorcycle drivers and route direction, what is the impact on the viability or otherwise of the route direction service provided by the motorcycle drivers?

Also to be considered in this stage is the question of the ease of accessibility of data. For example how easy will it be to convert the route knowledge possessed by Dabawallas to an easily accessible form, given the fact that most of them are illiterates? Will this be placed in electronic format or should they be in text which people can easily carry around? How can this information be extracted from those who possess it?

5.3.7 Finalize and select winning concept

In this step, a winning concept is chosen. The winning concept is chosen from the purview of “the whole product system” i.e. the product plus all supporting services which the product/service depends on to function, and the necessary leverages to get the supporting systems to play its role of support.

The winning concept is the one which has the ability to deliver value (the base value or the ability to meet the system problem statement, not necessarily the subsidiary goals) to the users at the lowest cost. The primary aim here is to deliver value. If the framework has been followed, cost will not be so much of a problem, because the preceding steps of the framework have taken care of this.

The winning concept is meant to meet the immediate and un-fanciful need of the locality. When this need has been met, bells and whistles can then be added. In fact we can argue that deploying LBS services in emerging economies consists of 2 distinct phases.

Phase 1:

- What is the immediate need of the locality (a solution neutral expression of the problem such as - get driving directions between points A & B, and NOT see the driving directions between points A & B on a map)
- What solution meets this immediate need?

Phase 2:

- What are the extra needs of the locality (subsidiary goals such as automatically determine user's location, view directions on a map, view directions on a mobile phone, view certain kinds of routes such as back roads, roads with more scenic beauty, etc)?
- What solution meets these extra needs?

Viewing the deployment in these 2 phases leads to a greater chance of LBS being rolled out in emerging economies. Where a company has very deep pockets, and can afford to subsidize the cost of the services, then it can combine both phases. Else the suggestion is proceed with phase 1 and allow funds from phase 1 to subsidize phase 2.

5.4 LBS framework – solution adoption

LBS services as earlier stated are usually value-added services and thus fall under the category of “post decisional phase of consumer life-cycle” [3]. They are integrated services which come after user has made a prior decision. For example, a user has already decided to eat Chinese food and so searches for Chinese restaurants around him (local search) and having found one, looks for directions to it (routing service).

The framework is thus geared towards this post decisional phase. This is done taking a systems point of view of LBS thus looking at other services that interact with the LBS

service being deployed, especially in a challenging environment such as developing countries.

By emphasizing adoption of existing means of solving problems (including non-electronic means), the framework avoids social resistance to new technology/solution.

5.5 Framework – critique

A detailed analysis of the framework can be carried out using a case study (i.e. developing a product from the ground-up based on the framework).

In the absence of this, a critiquing approach can be used to immediately analyze the framework. A critiquing approach uses the “what-if” approach i.e. if one were to create an LBS service, what are some of the issues that will be confronted).

5.5.1 Framework principles – critique

As earlier stated, the fundamental principles of the framework are

- Identification of the **basic services** required in the locality versus what is expected in the outside world (developed countries)
- Emphasis of **local technology/phenomena** over imported technologies

Critique

- Using local technology/phenomena raises the risk of backward compatibility of applications in future as technology improves. Why shouldn't a company simply deploy the latest technology now and do away with this risk?
- Wouldn't it be cheaper to work on localizing the latest foreign technology versus trying to understand a local technology which may take more time to deploy and may cost more money to maintain in the long run?

Response

It is true that backward compatibility of applications/technology can be a major determinant of final deployment costs. Sometimes, it can lead to such a huge increase in costs that deploying the technology becomes uneconomical. An example is the WiMax (Worldwide Interoperability for Microwave Access) deployment in the US which fell apart partly due to the compatibility issues and non agreement of standards. However, in Nigeria, where GSM communications was only deployed within the last 10 years, it has been relatively easy to deploy WiMax.

However, latest technology usually includes advanced functionalities which are more often than not, not required in the emerging economy. This ties in directly to the second point in the critique section above. An example is in the area of application packages for running business functions. PeopleSoft, SAP or Oracle HR are common applications used by businesses within Nigeria for payroll purposes. These foreign ERP applications are

constantly being updated with bugs, patches and new releases. Deploying these applications and migrating to newer versions require an army of expensive consultants, including foreign consultants. These cost a lot of money. It is not in doubt that these applications are robust. However on most occasions, a lot of the functionality within these applications are either not required in Nigeria (even for the multinational companies operating in Nigeria), or have to be customized to suit the country (expensive customization of foreign technology).

On the other hand, if local technologies/solutions are considered first, one will find that it is cheaper and simpler to deploy and maintain. For example in Nigeria, Payroll can be easily processed using a local application “HumanManager”. It is tailored for the Nigerian environment (local laws, tax law, local currency, etc) and does not contain extraneous functions. It is much simpler & cheaper to deploy, and also cheaper to maintain. The software is also compatible with other African economies. It is definitely not in the league of big five ERPs’ and may not serve in all situations but that is to be determined on an individual basis.

This same principle from the ERP domain can be applied to the LBS domain i.e. it is quite possible that the latest LBS technology might be too advanced for the local economy where it is to be deployed.

In addition, starting with a local technology allows an architect to avoid the mistakes that have already been made with developing/deploying the latest technology.

Another question to be asked is - what will be the cost of maintaining the latest technology in the future? Lowered cost of deployment does not necessarily translate to lower maintenance costs. And if innovation trends are used as a guideline then this latest technology will also soon become obsolete (first in the developed world) and there will be a rush to try deploying newer systems which are compatible with “world standards”.

Using the example of the motorcycle riders, how much is it going to cost to digitize the knowledge of these operators and use these as a street database/routing database versus investing money to train GIS personnel who will cover the whole country? Another option to consider would be to train the operators in the use of “GIS” devices/hand held tools, attach these to their motorcycles and have the data downloaded from them regularly. This is a local solution/technology which is much cheaper than coming in from day one with the plan to use satellite technology to map the city. Having deployed local solutions, it follows that innovation/advancement will be geared towards supporting these technologies and this will be cheaper than backward compatibility of foreign legacy applications. Government intervention (for example if government decided to bear the cost of the GIS data gathering) will most definitely change the equation but this is most unlikely in emerging economies where the government is trying to adopt a private-sector driven economy.

There will definitely be situations where the use of a foreign technology is much better but the fundamental principle should be to “first explore the possible use of a local solution” before choosing to use a non-local solution. Undertaking this exploration may

cost money (physical cash and time) but the potential savings far outweigh the cost incurred. Working with a local company or person(s) will make this even faster.

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6 LBS in emerging economies – Revenue Generation

A component of the systems view of the developed framework is revenue. Revenue can be described as income that a company receives in exchange for providing a service to customers. It is also described as income that a company receives in the normal course of its business activities. [1].

There is a general saying that “the end determines the means”. In this context, the final destination of the business determines the operating strategy and revenue generation models i.e. the long-term target of the business owners determine to a large extent how they will operate and run the business.

In general, developing economies require long-term investments and there are not so many quick & lucrative exits. This principle thus affects the different ways that LBS firms in developing economies are able to generate revenue. They are not only looking for how to generate revenue but how to generate these revenues in the long run and/or how to ensure that these revenue models are sustainable since changing revenue models (if not properly planned for) can be harmful to the business.

It can also be argued that it is reasonable to expect that entrepreneurs may be starting LBS services (especially in developing countries) to be in it for the long run. As such, there is no need to address exit strategies. However, this work is directed at both the local entrepreneurs who have no exposure to [modern] business practices and those who have

experienced western style education and business tutoring (where exit strategy is emphasized; more on this later).

This work thus takes the approach of discussing exit strategies first which will lay the ground work for the next section where immediate (short and mid term) revenue models are discussed i.e. Revenue for LBS in emerging economies will be examined from two points of view

- i. Large revenue, a.k.a. Pay-Off, or Exit Strategy
- ii. Immediate (every day) revenue to meet business expenses and generate some amount of profit, mid-term and long-term revenue plans

6.1 Large revenue/Pay-Off/Exit Strategy

Modern business plans, especially as taught by American and European business schools, include an exit strategy; how and when do the entrepreneurs plan to realize a huge pay-off from the business venture which has been created? How do the entrepreneurs plan to exit the business?

Venture capitalists also look for this component when evaluating business propositions. The shorter the exit-strategy time-frame, the more lucrative the venture sounds. The exception to this is in bio-technology/pharmaceutical industries where investors are aware that it takes time to recoup an investment (for example, reports suggest it takes about 10 years for a drug to hit the market).

Exit Strategy can and does affect the everyday revenue model. Most businesses in developing countries do not think about exit strategies. On the other hand, large investors from developed countries wishing to invest in developing countries think of exit strategies but with the mindset of what obtains in developed economies. This in turn limits their investment in developing economies especially in the area of LBS.

LBS providers in developing countries should have a medium to long term exit strategy time frame versus the short term time frame favored in developed countries. Put another way, LBS providers in emerging economies should develop the mindset used in the pharmaceutical industry i.e. the business is in for the medium to long haul, and base their planning on this “pharmaceutical type” mindset.

This longer time span is to enable consumption of basic LBS services by the populace leading to a demand for more complex services which will in turn create an impetus for the development of supporting infrastructure and for the infrastructure to grow. This longer time span does not have to be as long as 10 years – 5 years or more is suggested; also unlike the pharmaceutical industry, LBS service providers can still generate income/early profit right from day one of launch.

One may argue that there is no guarantee that the supporting services/infrastructure will be developed. This is true. However, most developing economies today are showing signs of recovery and progressive improvement in planning and standard of living. Also going this route enables the business to take the opportunity, if it arises, of an improved

supporting service infrastructure whilst having generated some regular revenue in the meantime versus not venturing into the business at all because of a wrong analysis of the absence of an exit strategy.

This longer-term view of the market is not only applicable to exit strategy, it is also applicable to how LBS companies operate in developing economies. An example is Google who have established a presence in Kenya as a means of cornering the African Market and developing and marketing their Maps product for the continent [4]. As a way of pushing their maps product, they have developed a strategy which is long-term.

As part of this strategy, Google has announced separate partnerships with the Rwandan Ministry of Infrastructure and the Kenya Education Network (KENET). As a result, Rwanda's educational institutions and government ministries, and Kenya's universities are starting to use Google Apps™ [3]. Also since the development of the market is hindered by the absence of an international cable offering cheap bandwidth, Google has gone to the extent of buying international bandwidth so that locals don't have to pay the a premium for internet access. All these actions are geared towards lining up users for their applications including the map products.

If Google had concentrated on a strictly immediate view of the market/service, they would not have ventured into the region since the internet density is very low in Kenya, and their Map product is still being developed.

One may argue that Google has deep pockets and so can afford to have this long term view. This method should serve as a good strategy for other large companies wishing to enter the LBS market in developing economies.

For smaller sized firms, they do not have to go the whole hog of giving away everything for free. The next section will show how they can generate immediate or daily revenue whilst keeping their eyes on the longer term view of the business.

To summarize – have a longer term view of things rather than an immediate view for pay-off/exit strategy.

6.2 *Immediate revenue*

Whilst planning and waiting for the big pay-off day, LBS firms have to generate regular revenue to remain in operations and turn a profit to justify the venture into LBS services.

Revenue generation has to be planned for and this can fall into immediate, mid-term and long-term revenue generation plans – see Figure 6.1 below.

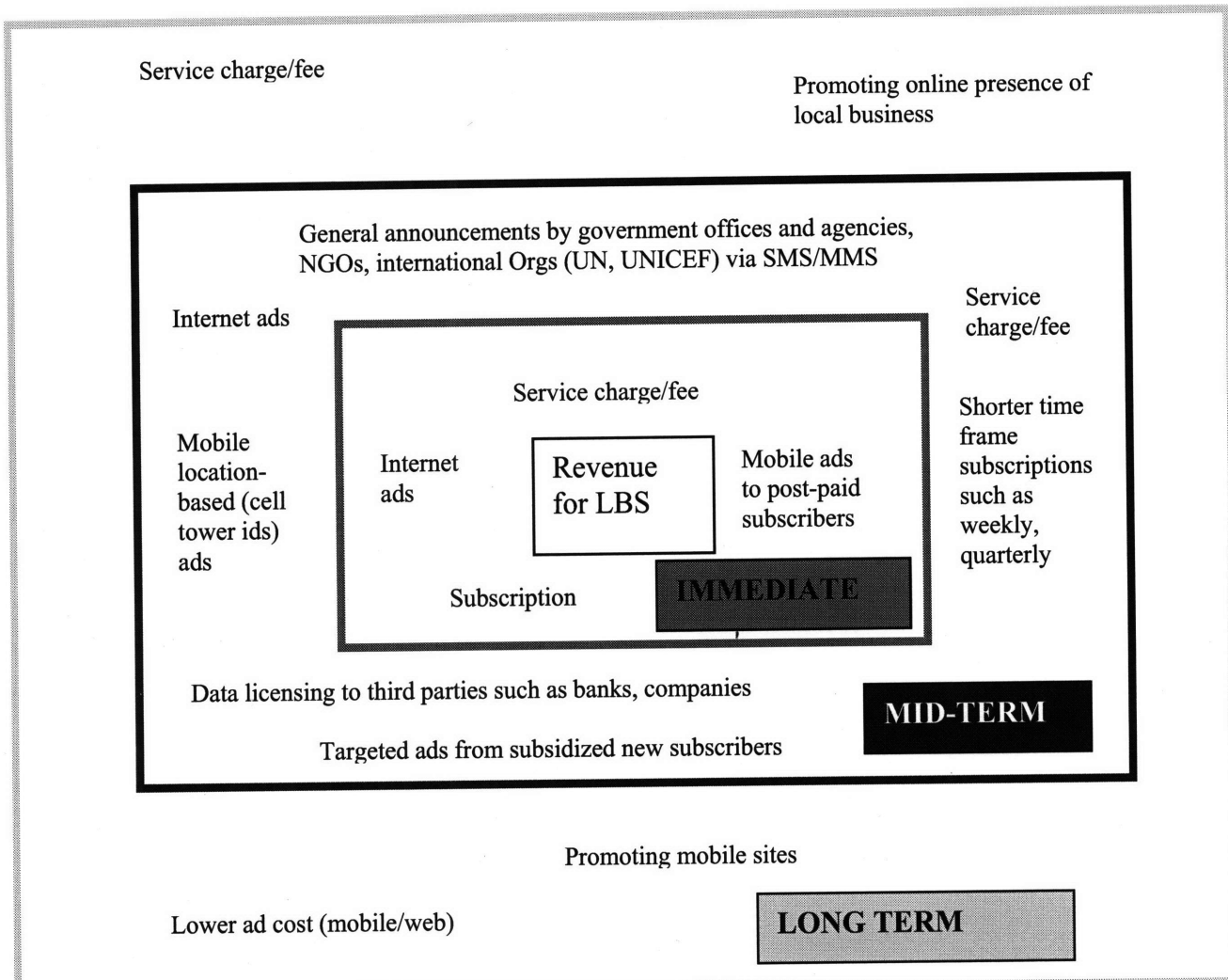


Figure 6.1 – LBS revenue model for emerging economies

The mid-term and long-term revenue streams are processes which will generate revenue for the LBS providers in the nearer future as opposed to the immediate future. Some of the activities here will only begin to generate revenue based on processes that have been initiated years earlier by the LBS providers. These stimulants/efforts/activities are geared to boosting revenues not just for LBS providers but ecommerce in general in developing countries. These are discussed in further details in the rest of the chapter.

Revenues for LBS firms have been linked to revenue models for m-commerce (as earlier stated, LBS are normally linked to mobile, hence the tie-in to m-commerce).

Common forms of revenue for LBS include adverts, subscription and service charge (i.e. a fee each time the service is used/accessed). These models are discussed below. Each model is discussed in terms of its applicability to developing economies (i.e. the current situation), followed by ways of increasing its effectiveness.

6.2.1 Online adverts

Adverts are a major form of revenue for LBS services especially in developed countries. Some of the big mapping and local-search providers provide their services at no cost to the end user whilst making money from selling adverts.

Online adverts in developing economies

The online advertising market in developing countries is still quite small compared to traditional media advertising. This is due to the low internet density in these countries.

Compared to developed countries, online advertising is also expensive. Unlike the practice of charging per click (CPC) or per thousand impressions (CPM) in developed countries, in developing economies, online adverts usually have a flat rate based on time. For example, a flat fee is charged for putting up a banner for a week.

Online advertising in these economies are also dominated by non-contextual adverts. For example, most of the websites of Nigerian online newspapers feature banner adverts paid for by companies such as banks and Oil & Gas Firms. These adverts are strictly banner adverts appearing on websites and not contextual ads.

Even websites with Google AdSense do not have many contextual ads or poorly targeted ads (they are usually dominated by adverts for “cheap tickets” or “dating websites”). This is again due to dearth of advertising campaigns by local firms.

Another limiting factor to online advertising in developing countries is the fact that a lot of businesses do not have a web presence. This is due to both the high cost of internet access and the cost of building and maintaining a website. There is also the fact that most business owners do not have the requisite skills to build a simple website or maintain one that has been built for them by a professional.

Boosting online advertising in developing economies

The quickest way to boosting online advertising in these economies is to reduce the cost of advertising and make it more affordable to small businesses, including those who do not have a web presence (customers with a web presence see the adverts and then go to firm’s premises to make their purchase).

Price reduction can be done by creating smaller sized options for banner adverts, reducing the minimum time for an advert to run for example from a month to a week, changing from a flat fee to a cost per click or cost per thousand impression advertising, and a general reduction in advertising costs. A general reduction in advertising costs apart from lower costs will encourage the advertisers to advertise more since they believe they are spending a little amount without an immediate empirical way of tracking the effectiveness of the adverts. Craigslist, (<http://www.craigslist.org>) used a reduced

advertising rate to attract users to its website when it first launched, and this strategy has remained one of its success factors.

A reduction in advertising charges would lead to an initial reduction in revenue but with the increased volume of transactions, over the long run, revenue will increase again as more advertisers come on-stream. This could also be seen as the low margin, high volume type of transaction. Theoretically the LBS provider should be able to bear this extended return on investment since their initial capital outlay has been greatly reduced by using the framework developed.

Another way of stimulating online advertising would be increasing the online presence of businesses in developing countries. This can be done by creating free web hosting packages which would also include tools (drag and drop) for quickly putting up a website. An example of such a package is the Microsoft Office Live Small Business – <http://smallbusiness.officelive.com>. This will encourage more businesses in developing countries to go online and thus stimulate online advert spending.

LBS companies can form a separate venture to offer such web hosting packages or form partnerships with established companies such as partnering with Microsoft Office Live Small Business to target the small businesses in their locality. Such a venture will not only increase web presence and hence advertising on the LBS website, but it gives the companies another source of income.

One can argue that one way of stimulating online advertising is to first increase the broadband internet density in developing countries. Ways of boosting the internet density

usage include subsidizing cost of internet access. Google has gone this route by buying international bandwidth and redistributing this in Kenya and Rwanda.

This can be an effective mechanism but should only be taken on a case by case basis. Some countries do not require a separate push for broadband internet access as dial-up access is becoming more available and cheaper. For example Nigeria is seeing an explosion in telecommunications deployment, specifically mobile phone deployment which is not hampered by legacy applications. The latest technologies like 3G is being rolled out aggressively and competition is forcing calling costs down and creating cheaper data rates/plans. Browsing over the mobile phones are still expensive, but dial-up access (connecting the mobile phone to a personal computer and dialing up to the web) is becoming cheaper. There may thus be no need to push for subsidized wireless access or mobile broadband by the LBS providers. LBS companies should concentrate on developing their products and enabling services and take advantage of the maturity of the telecommunications (mobile phone) technology.

6.2.2 Mobile adverts

To maintain the same model of free services to mobile users of their products, LBS companies [in developed countries] are also resorting to mobile adverts to support their services. The field of mobile advertisement is not as developed as that of online advertising but it is growing at a very fast rate. Mobile adverts do face privacy concerns. In fact, one can argue that privacy issues are much more prominent in mobile services

since a mobile phone is deemed to be more personal than a personal computer and users typically carry their mobile phone around.

Mobile advertising in developing economies

In some developing countries, mobile advertising is still in a developing phase, whilst in others it is practically non-existent. In India for example, it can be classified as being developed whereas in much of Africa it is not as advanced. In Nigeria, mobile advertising is text-based and is practically the exclusive preserve of the mobile carriers who use it to advertise their products or new promotions.

Mobile advertising in developing countries is critical because it has the potential to reach more people than online advertising because of the wider adoption of mobile phones compared to broad band internet access. However a key hindrance to its explosion in these economies is the non-targeting of mobile adverts. This is due to the high number of people with pre-paid phones for whom data/records [profiles] are not maintained by the carriers. This means the current form of mobile advertising is more of a blind advertising campaign and is invariably seen as spam by the receivers of the message. In Nigeria for example, most mobile adverts except for those by the mobile carriers are generally seen by the populace as spam and are usually deleted without being read, especially when they concern companies without a known brand name. Most individuals are receiving the advert without having opted- in nor after having enjoyed a service for free.

Boosting mobile advertising in developing economies

One of the cheapest and fastest ways to boosting mobile advertising is to reduce the price of mobile adverts. In most developing countries, news paper adverts are very expensive and buying a newspaper itself is not cheap. Most of these countries also do not have free papers like the ones distributed at train stations in America and Europe. A very low cost mobile ad would therefore easily create a demand for mobile advertising especially with the large possible targeted audience.

In most developing economies, governments followed by private businesses are the biggest spenders. LBS service providers (and other industries), should target the government as the initial set of customers for their mobile adverts (text-based or SMS adverts). Quite a number of government adverts are for the general populace and so this removes the pressure of advert targeting for the LBS providers. The aim will be to capture revenue from government and then use this to stimulate consumer LBS services.

The argument for targeting government is that mobile adverts will be able to reach a much wider audience and will be far cheaper for the government than TV adverts and radio adverts, which apart from being expensive, do not necessarily reach everybody because of power cuts.

For example the largest commercial state in Nigeria, Lagos, has recently (in March 2007) launched a new public transportation system called Bus Rapid Transit (BRT) System whose aim is to reduce the traffic congestion in the densely populated city. Government has spent huge sums advertising this new scheme via posters, newspaper adverts, radio shingles and other forms of adverts. This same thing could have been done at the fraction of the cost if a smaller percentage of adverts had been full posters and the rest sent out as

text messages to the populace. Residents of Lagos can be easily identified by their phone cell tower ids.

LBS companies also have a great opportunity of capturing revenue from NGOs which usually run campaigns which are either for the general populace or/and city dependent. For example, the Polio Vaccination exercise in Nigeria and India can be advertised via SMS adverts to residents through LBS companies who will send out these adverts to different locations based on when the vaccination is going to get to different locations. Developing countries (African countries specifically) are more receptive to unsolicited non-governmental adverts and will forward it on to others whom they think will benefit (viral marketing) without irritation [generally].

Non-governmental organizations also provide another source of general populace mobile adverts and easy revenue for LBS companies.

As earlier stated, one of the major hindrances to mobile advertising is the non-availability of profile information of mobile phone users due to the preponderance of pre-paid mobile line subscribers. Any effort to boost mobile advertising will thus have to figure out a way of capturing this data. According to [5], in Africa, 85.3% of mobile users are prepaid users. This makes capturing profile data critical for reaching a mass audience and for effective targeted advertising.

One way of capturing profile data [for new phone subscribers] is for LBS service providers to either independently or in partnership with mobile carriers, subsidizes the cost of new mobile lines in exchange for a buyer filling out some basic information/profile sheet. For example in Nigeria, this could involve some free airtime being given to the vendors to make available to new subscribers who buy SIM cards from them in exchange for some profile information. The LBS companies may not even have to pay for the subsidy itself since the mobile carriers already offer some free air time as part of their price war. The LBS companies can float the idea of the data capture and be able to have access to this data in exchange for increased business to the mobile carriers through the adverts which the LBS providers will send through the carriers.

This principle can be extended to getting users [new subscribers] to opt in to receive mobile adverts. That is users who sign an assent form to receive mobile adverts pay a lower than normal rate. This assent is thus obtained at the point of purchase.

To capture profile and assent of existing prepaid subscribers, LBS service providers should work with existing service providers whom the general populace largely interact with. Here again, users will be provided with an option to fill out a basic profile sheet in exchange for some free good like free airtime. Using Nigeria as an example, an LBS service provider could work with the banks with the largest branch network such as UBA or First Bank, and have profile forms available in these branches. Users who walk in to carry out banking transactions will then be offered a chance to put down some basic profile data in exchange for some free airtime.

One may ask, why can't the LBS providers simply buy profile data from these banks [or institutions]? Some answers include most of the demographic information required may are not readily available to the banks, it will require a lot of resources to sift and transfer the data held by the banks which are mostly offline to the format required by the LBS service providers.

Another way of boosting mobile advertisement in developing countries is the promotion of mobile web hosting (something similar to the proposal for online web hosting) sites – dot mobi sites. Today's free web hosting packages are not targeted at mobile applications. If this is done in a place like Nigeria, by the time 3G networks explodes, advertising will switch from online advertising not just to SMS (text based) but to MMS (message with a web link).

6.2.3 Subscription

Majority of the population in developing countries consume prepaid mobile phone service. This means that the subscription model as [currently practiced] will not work for this group of users.

Subscription should therefore be targeted at premium services which can be accessed/paid for by middle & high income populace (the provider should be careful here as one of the characteristic of developing countries is the practical non-existence of a middle-income group).

Another way that subscription could work is for the LBS providers to enable third party payment of subscription services i.e. allow Mr. A to pay for a service but specify Mr. B as the recipient. Allowing for this kind of service will increase purchase of the service as people in the urban areas (with more purchasing power) can buy it for their relatives in the villages (just as families in the Diaspora remit money home to relatives). The service providers can also brand this as a form of gift package, especially if the service is premium. This would be similar to one buying a Business Week subscription as a gift for a friend.

Creating smaller time-period subscriptions is also an effective way of promoting subscription services. Instead of having just annual subscriptions, 3-month subscriptions, 6-months, or even biweekly subscriptions should be introduced. The whole aim is to reduce the amount of money that an individual has to spend upfront for the service. This is the same principle behind the idea of smaller denomination pre-paid cards for mobile phone airtimes.

6.2.4 Service charge

This involves charging the user each time the LBS service is accessed/utilized. This is more applicable for services rendered via SMS. For example charging a user a premium amount for an SMS message user sends requesting the LBS service. This amount will cover the cost of user sending the SMS to the mobile short service code, the cost of the return SMS message and profit for the LBS providers. This form of revenue generation is commonly used in mobile services rendered to people in Africa. For example the annual

reality TV show “Big Brother Africa” uses this method when show viewers vote to eliminate contestants from the “Big Brother House”. The cost is sometimes as much as 6 times the cost of a normal SMS message. Going this route will involve the LBS providers working in conjunction with mobile carriers.

A way to apply this model over the web would involve the LBS provider creating a mechanism for users to create a profile and deposit money into their profile. Deductions are then taken from the balance as the service is consumed. This method is preferable to asking users to enter their credit/debit card details each time a transaction is to be carried out. This is because of the potentially small cost of the service which users find very distracting paying for with their debit card.

Another option would be to use “reverse SMS” where the cost of the transaction is tacked on to the user’s phone bill. This means this method will only be available to post-paid mobile phone subscribers, and the LBS provider will need to work with the mobile carriers.

The last two methods will be applicable to only a small percentage of the population in developing countries due to the requirement for the use of a debit/credit card, and access to the internet.

To remove the requirement for the use of a credit/debit card, the LBS providers could allow for the purchase of LBS cards (scratch cards) which essentially gives the holder

access to the amount paid for the card. Thus by entering the pin number of the card on the LBS website, the user has access to a certain amount of money. This can also be used via the mobile phones. Similar to the way users “top-up” their airtime, a user will buy a prepaid LBS card and top up his LBS balance via mobile phone by entering the pin number of the purchased card.

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7 LBS IN EMERGING ECONOMIES - FUNDING

In general LBS is a capital intensive venture, with a considerable amount going into GPS data sourcing. This huge outlay is one of the major factors limiting the development and deployment of LBS services in emerging economies.

The framework developed has a major aim of reducing the capital outlay required to kick-off LBS services. Funds received from these initial set of services can be deployed towards the development of future and more complex services.

In terms of external funding or the initial set of funds required to kick-start the venture, these funds can either be sourced locally or received externally (i.e. externally to the country).

Some developing countries will find it easier to attract external funds for business development from venture capital firms whilst others will not find it so easy. The recommendation is for locally-based entrepreneurs to try and tap into network of their nationals who are resident in the countries where these funds reside. For example Nigerian entrepreneurs looking for Nigerians resident in America, Europe, etc. Such residents even if they do not invest directly, will be able to steer the entrepreneur to groups/organizations which can effectively do this, and act as the middle man.

7.1 Venture Capitalists

In general, venture firms are not common in developing countries. They are more prevalent in some whilst in others they are totally non-existent. For example, there are venture capitalists investing in India, China, and Israel. Most of these firms are international (US-Based, and a few European-based) whilst a few are local. According to [1], the amount of VC and PE (private equity) investment in India in 2004 was \$1.65 billion US dollars, whilst in 2006, VC investment was 3 billion dollars [2]. Similar trends has been observed for the Chinese market where according to ChinaVenture's 2006 Venture Capital Report for the Chinese Market[3], venture capital investment into Chinese companies reached \$2.18bn in 2006, up from 1.43 billion in 2005.

In much of Africa, and the rest of the developing world, venture capital investment is either non-existent or is paltry at best. In Nigeria, there are very few venture capitalists and the few ones place their investments similar to the way Nigerian banks do. They either require the business owners to deposit collateral (which defeats the whole purpose) or they require that the business have been up and running for some years with the founders having invested a substantial part personally. One of such companies in Nigeria only invests where the business owners have personally put up half of the required amount.

In countries where venture funding is non-existent, nationals living in foreign countries can step in and play this role. One way of doing this is by running business plan competitions to identify potential business ideas and then forming a national vehicle to

channel money into the venture. Nigeria for example now has a local version of “The Apprentice” being sponsored by one of the very big banks.

A variation of the above model would be for potential LBS providers to partner with students (especially nationals of their countries) in foreign institutions to develop business plans around the LBS services which can be entered in university business plan competition. An example would involve a potential LBS provider from India working with some Indian nationals at MIT to participate in the annual MIT 100K competition. Another example is the MIT-based Pakistani business plan competition.

The students can also use the LBS concept in classes where they have to develop a project and there is the potential of meeting with VCs, for example MIT’s 15.390 – New Business Enterprises.

This can be distilled down into the point that LBS companies in developing countries should begin to work closer with higher educational institutions in their countries (and outside) as a vehicle to get access to venture capital monies.

7.2 Social enterprises

Funding for LBS services can be attracted from venture capitals, social entrepreneurs and non-governmental organizations such as United Nations, etc by tying the LBS service to a social service. The attraction of this model is that it serves a dual purpose of acting as a philanthropy (providing a basic and social service lacking in a developing community, improving the quality of life) and it can pay for itself. Modern social service ventures and

philanthropists are towing this line. Examples include EPals (www.epals.com), Catholic Relief Services (CRS), Google Charity (<http://www.google.org>), etc.

LBS service can be tied to social services by showing its link to safety – when there is an emergency, a person can be easily reached, health evacuation personnel like ambulances are able to easily navigate through the jam-packed roads (a characteristic of developing nations) to a hospital, nearest hospital can be easily found, etc.

With this link, LBS providers can easily get funds from charitable organizations that would otherwise be unwilling to fund strictly for-profit ventures. In fact Google uses this model, looking for investments that will turn a profit but whose aim is to provide a social benefit to the local community.

7.3 Government Funding

Another potential source of funding for LBS companies are direct government funds or government backed initiatives.

In developing countries, governments are trying to encourage businesses by providing funds for small and medium enterprises (SME) with the aim of these companies being able to provide much needed jobs to the populace. In some cases, government instead of providing funds directly, have created initiatives/policies which enable financial institutions to provide such funds.

For example Nigeria has a blue print on Small & Medium Enterprises (SMEs). This blueprint has led to the establishment of the Small & Medium Enterprise (SME) and Small Scale Industries (SSI) Scheme Initiative in 2001, by the “Banker's Committee, an

organization of banks in Nigeria”. The scheme requires all banks in Nigeria to set aside 10% of their profit before tax (PBT) for equity investment in small and medium scale industries [4]. Within the first two years of the operation of the scheme alone, Nigerian banks accumulated about 100 million US dollars in their respective SME Reserves [5].

By following the framework developed in this study, LBS providers are able to reduce the initial capital outlay required and thus will be able to qualify for the funds being given out by the SME & SSI’s. After having established a track record, they can then approach the bigger lenders for larger sums of money.

7.4 Funding from Multinational companies

The big firms in the US and Europe have come up with investment arms which not only invest in startups (like VC firms do), but also are looking to invest outside their ecosystem. For example, Intel Capital which invests in companies outside the area of PCs like in photography, etc based on the belief that an expansion in such a market could potentially lead to an increased/new demand for chips to power such devices. In April, Intel Capital announced a new \$500 million China investment fund aimed at wireless broadband, media telecommunications and clean technology companies [6]. In 2005, the fund was \$200 million [6].

Another example is Google whose philanthropic arm with a focus on India and East Africa has committed and invested about 75 million US dollars as at April 2008 [7].

LBS providers in developing countries can thus approach multi-national companies operating in their countries for investment in their businesses. For example, the 3 biggest oil companies in the world have huge operations in Nigeria. LBS providers in Nigeria can approach these companies for start-up funds either directly as a way to expand their businesses (show these companies how the LBS product will be of service to people especially their employees) or as part of the community programs which these companies offer to their local community.

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- [7] <http://google.org/projects.html>

8 PROTOTYPE – DEVELOPING A ROUTING/NAVIGATION SERVICE IN NIGERIA

Following the framework developed in this study, an attempt was made to develop an LBS application, specifically routing/navigation (driving direction) service for Nigeria. Nigeria was chosen since the writer has specific/intimate knowledge of the country. However, the principles can be applied in any other developing country with some slight modifications to suit the country.

The framework provided the background for conceptualizing and developing the product whilst Principles of System Architecture, as taught by Professor Ed Crawley in MIT was used in architecting the product.

8.1 Prototype – framework step-wise development

Below are the decisions taken for each of the steps of the framework

8.1.1 Identify solution-neutral system problem statement

- Provide users with routes between two points
- Provide users with driving and bus routes between two points

8.1.2 Determine logical components

- Data source
- New route determination/calculation
- Route location

- Route display
- Locate user
- User's destination determination

Expressed as processes

Component	Process
Data Source	Capture route data
New route determination/calculation	Determine new route
Route location	Determine optimal route
Route display	Display route
Locate user	Determine users' location
Users' destination determination	Determine users' destination

8.1.3 Identify physical entities (including phenomena) which map to logical components

- GIS data (owned, leased)
- User contribution via Wikis (web 2.0 phenomena)
 - Common practice today is for people to ask others for direction. This is equivalent to web 2.0 phenomena.
- User contribution via twitter
 - This will allow user contribution via text/SMS
- User contribution via Voice Call (phone call, voicemail)
 - most likely through toll-free numbers and where this does not exist, as is most often the case in developing economies, a way of making the calls free or providing an incentive for users to make this call will have to be worked out.
- SMS (short text messaging)
- GPS devices such as mobile phone

- Mobile Operator dependent location determination
 - Upload Time of Arrival (TOA), Enhanced Observer Time Difference (E-OTD)
- Mobile operator independent location determination such as “Cell of Origin”
- Algorithms

8.1.4 Combine physical entities to create concepts

Using the System Architecting Principles, this is equivalent to creating a morphological matrix³

Morphological Matrix

Logical components	Physical entity/phenomena						
	Wiki	Twitter	Voice call	SMS	Leased Data	GIS/GPS devices	MMS
Capture route data							
Determine new route	Algorithm	Wiki	Twitter	Voice call	SMS	Owned GIS data	
Determine optimal route	Algorithm	Voting					
Display optimal route	PCs (internet)	Voice Call	SMS (mobile phones)	Navigation Systems			
Determine user location	Manual entry	GPS	Triangulation				
Determine user destination	Manual Entry	Pre-stored					

³ Morphology in general shows the evolution and configuration of rocks. Here it depicts the evolution of the solution, showing how the different concepts came into being.

8.1.5 Combine physical entities to create concepts

Logical Component	Concepts						
	1	2	3	4	5	6	7
Capture route data	Wiki	Wiki	Wiki	Wiki	Voice Call	Leased GIS data	Leased GIS data
Determine new route	Wiki	Wiki	Algorithm	Algorithm	Wiki	Algorithm	Algorithm
Determine user location	Manual Entry	Manual entry	Manual entry	Manual entry	Manual entry	Manual entry	GPS
Determine user destination	Manual entry	Manual entry	Manual entry	Manual entry	Manual entry	Manual entry	Manual entry
Determine optimal route	Voting	Voting	Voting	Voting	Voting	Algorithm	Algorithm
Display optimal route	PC	SMS	PC	SMS	SMS	PCs	Navigation Systems

Logical Component	Concepts						
	8	9	10				
Capture route data	Leased GIS data	Wiki	Wiki				
Determine new route	Algorithm	Wiki	Wiki				
Determine user location	GPS	Triangulation	Operator Independent – cell of origin				
Determine user destination	Manual entry	Manual entry	Manual entry				
Determine optimal route	Algorithm	Algorithm	Algorithm				
Display optimal route	Mobile Phones	SMS	SMS				

8.1.6 Rank Concepts using screening criteria

This involved passing the concepts through the screening criteria developed earlier, and ranking them. Before ranking is done, scores (a “1” or “0”) were assigned to the individual components of the concepts.

Using the screening criteria, the following rankings were achieved.

First – Concept 1 & 3

This concept is made up of the cheapest components. It makes use of both local components (asking people for directions – user contribution), and widely acceptable and cheap phenomena (user contribution via web 2.0 phenomena). In terms of accuracy, it is less accurate than the other concepts. It is cheap, quick and easy to deploy.

The algorithm for determining new routes can be simple and fast and meet the immediate needs of the locality.

Second – Concept 2 & 4

Following concept 1 & 3 closely are concepts 2 & 4 which are only different from in terms of the display mechanism which is SMS. Users will question the system and receive answers via SMS messages which is common in developing countries.

Another designer may have decided to reverse the options i.e. rank concepts 2 & 4 before Concepts 1 & 3 since using SMS has the capability of reaching a wider audience. I chose the reverse because the web presence is required initially to kick-start the service and generate a minimum amount of interest before the SMS portion can kick in. Also, at the inception of the service, online submission of routes will be the medium for capturing route information/data.

Third – Concept 10

This is similar to the first two sets of rankings i.e. the concepts ranked first and second but it requires more effort and funds to implement the “center of origin” method of location determination. Sometimes this may become cumbersome because it would require driving/moving around to first collect a reading of the different cell-tower locations.

Fourth – Concept 5

This is similar to the first 2 concepts but will require more effort for implementation since voice recognition software will have to be installed. What makes this a tougher challenge in developing countries is the abundance of different dialects which not only affects the accent while English is being spoken, but also may require the customization to different local dialects.

However this concept is more likely to increase the user-contribution base since voice-call will be available to more of the population. If the voice call is made free (using toll free numbers), this will be even better.

Positions five ----ten

The remaining concepts share the positions of fifth through to ten.

These concepts are more accurate than the concepts which involve user contribution via a wiki/web 2.0 platform but will be more expensive to install in the local economies. Also the better precision offered by these concepts can be ignored for now in the local

communities i.e. the local populace can manage without the precision for now. This precision will be introduced at a latter stage.

8.1.7 Refine and amend concepts

Closer examination will show that there exists close similarities between concepts 1 – 5 and concepts 6 – 8.

These blocks of concepts can be grouped into two broad groups leaving a total of three concepts from the original 3

Concept 1: Originally concept 1 – 4

Concept 2: Concept 5

Concept 3: Originally concept 6 – 8

Concept 4: Originally Concept 9 & 10

Logical Component	Concepts			
	1	2	3	4
Capture route data	Wiki	Voice Call	Leased/owned GIS Data	Wiki
Determine new route	Wiki/Algorithm	Wiki	Algorithm	Wiki
Determine user location	Manual entry	Manual entry	GPS	Triangulation/cell of origin
Determine user destination	Manual entry	Manual entry	Manual entry	Manual entry
Determine optimal route	Voting	Voting	Algorithm	Algorithm
Display optimal route	PC/SMS	SMS	Navigation Systems	SMS

NB: Wikis are suitable for unstructured or very lightly structured data, but directions are structured information. Because of this, wiki engines will not be used but the wiki concept where users create and maintain information will still be used. This will thus involve creating such a software from scratch as against downloading and customizing one of the existing wiki engines such as media wiki.

8.1.8 Select winning concept

The final and refined concept selected is shown below

Process	Instrument
Capture route data	User contribution (emphasis on landmarks such as bank buildings, place of worship, famous building)
Determine new route	User contribution, simple algorithm, physical inspection
Determine user location	Manual entry (user enters his location)
Determine user destination	Manual entry (user enters his destination)
Determine optimal route	User contribution (voting, professional authority, etc)
Display optimal route	PC, SMS Message

In general, users will contribute information (route data) to the system over the web and query the system (to retrieve routes) either via a web interface or over the mobile phone (SMS message).

For both web and SMS based queries, users will manually supply their locations and destinations by inputting this data.

8.1.9 Revenue Source

Immediate source of revenue will include online adverts (very low rates to attract small businesses, CPM for the medium-sized businesses, flat rate for the multinationals)

8.1.10 Funding

Free and Open source technology such as MySQL Database and PHP scripting will be used. This has reduced the cost.

Initial development work is being done by the author so the cost is sweat equity. In the future, and if required, a professional developer from a developing country will be hired on a contract basis. This not only gives employment to someone from a developing country but the rates are lower due to the lower cost of living in those countries. Further reduction is achieved by having all arrangements done electronically, over the web.

The above factors have reduced the initial capital to a minimum and start off grant for BETA testing will be acquired from personal funds. The rest of the funds will come from adverts.

9 CONCLUSION & RECOMMENDATION

9.1 Conclusion

This study has identified a method by which LBS services can be designed and deployed within the existing constraints of emerging economies. The identified method is based on two principles

- Identifying the [basic] services required in the locality versus what is expected in the outside world (developed countries).
- Emphasizing local technology/phenomena over imported technologies

This method follows the line of argument that waiting for all the key enablers of LBS (GIS data, broadband internet access, payment methods, proper town planning, etc) as discussed in chapters 2 & 3 to be in place, may result in LBS not being rolled out in these economies in the foreseeable future. This is due to the inefficiencies of these environments as highlighted in chapter 4. These include poor infrastructure, low investment, initial political instability which is giving way to stability and increasing market awareness, poorly organized/developed local human capital, “sachet purchasing” or characteristic of purchasing goods in very small quantities, preponderance of “pre-paid” mobile phone users versus “post-paid” mobile phone users, largely cash-based society transitioning to mobile-electronic payment systems

The identified method for deploying LBS in these economies is based on a 7-step (and iterative) framework developed in chapter 5. The framework is summarized below

- i. Identify solution-neutral system problem statement

- ii. Determine logical components of the service
- iii. Identify physical entities which map to logical components
- iv. Combine physical entities to create a concept
- v. Rank the concepts using a screening list
- vi. Refine and amend concepts
- vii. Finalize and select winning concept

Step “v” is very important and is the embodiment of the two design principles earlier identified i.e. the screening list/criteria developed in step “v” inculcates the principles of basic services which meet the immediate needs of the locality and emphasis on local technologies over imported technologies.

Simply put, this work has developed a method of creating and deploying basic and simple location-based services which meet the immediate needs of the locality, and then increasing the functionalities (complexity) of these services as the environment consumes the existing service and the environment matures. This can be referred to as “just the basics” design principle.

“Just the basics” design principle is also taking effect in the developed world today. For example, the April 28 edition of BusinessWeek Magazine has a story about Flip, a bare-bones digital camcorder which shipped nearly 1 million camcorders out of a total of 6 million camcorders shipped to USA retailers in 2007. It is also instructive to note that Flip debuted in May 2007.

Yes, Flip is bare-boned and contains just the basic functions of a camcorder device but its price range, and going back to **just the basics** of a camcorder and its stylish design has helped it challenge global consumer giants such as Sony.

This is proof that basic and no frills does not equate to “no sale” and no-acceptance. If this is possible in societies who are already used to the frills, how much more societies which do not have any standard to benchmark against?

9.2 Recommendation for further research

This research drew heavily on environments in Nigeria and India as a representation of emerging economies. Further research can be done using other developing countries to either buttress the applicability of this framework to emerging economies in general or point out differences which may exist geographically and possibly modifications to the framework.

This study also attempted to create a routing/navigation service following this framework. Attempts to develop more location-based services (both routing and non-routing) should be made and the framework further analyzed using these services. It would also be particularly interesting to see how other supporting structures of location-based services such as recommendation systems (users ranking or rating hotels, restaurants, etc) and improving accuracy of location identification, can be developed in emerging economies.

Appendix 1 - Table of Social Enterprise Funders

1. Africa Enterprise Challenge Fund –
<http://www.africanenterprisechallengefund.org>
2. Ashoka – global association of the world’s leading social entrepreneurs –
<http://www.ashoka.org>