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ABSTRACT

To obtain a competitive edge, today every IT company is looking for a solution to stand strong in terms of financial ability, innovation, and IT operation to satisfy their customers effectively. Top companies with successful track records of innovation, however, have discovered a possible solution, by using “lean thinking” and “six sigma”.

Six Sigma is a defect reduction methodology that transforms organizations by forcing them to focus on the quality of the customer experience. The term sigma refers to deviations from an ideal level of operation, where each level of sigma, starting from one, allows for fewer defects.

Lean means creating more value for customers with fewer resources. A lean organization understands customer value and focuses its key processes to continuously increase it. The ultimate goal is to provide perfect value to the customer through a perfect value creation process that has zero waste.

In this study, the origin, benefits and methodologies of “Lean Thinking” and “Six Sigma” in software companies has been explored and explained effectively.

Keywords—Lean organization, sigma, Six Sigma Lean, lean thinking

1. INTRODUCTION

In today’s marketplace, increased globalization, constant technological advances and other competitive pressures are accelerating the pace of change CEO’s face. The resulting opportunities and threats have placed innovation near the top of CEOs’ priority lists. And yet, for many, innovation success has been sporadic at best. Our (IBM) research and experience shows that the right operations strategy can help companies make innovation a regular occurrence. Such a strategy, if focused not just on efficiency but also on growth, can serve as a foundation for innovation throughout an organization far beyond operations to products, services, markets and even a company’s underlying business model. Simply put, this sort of strategy is not about doing things better; it is about doing better things.

As part of the analysis, we examined several leading companies that are doing just that. They have implemented operations strategies based on a relatively well-known management philosophy which we will call here Lean Six Sigma. It is also sometimes referred to as “Six Sigma Lean”. And at some of the companies we studied, leaders still label their initiatives as Six Sigma or 6 Sigma even though, from our perspective, they have moved beyond Six Sigma’s original definition and scope by incorporating Lean features as well. Regardless of the term, the companies that have used this overall approach have established disciplined working environments focused on customer needs, detailed data analysis and facts, not theories. [1].

Applying ‘Lean’ principles originally designed in manufacturing and perfected by the likes of Toyota and Motorola better enables IT to identify and eradicate anything that is wasteful within IT management. In the words of ‘Lean’, anything wasteful is, work that adds no value to a product or service that organizations provide to their customers. And, since IT management underpins and orchestrates the production line of business services, identifying waste and removing it becomes a key imperative for business success. An Enterprise IT Management approach ensures success by pinpointing waste and reducing it across every phase of the business service lifecycle [2].

Six Sigma is a defect reduction methodology that transforms organizations by forcing them to focus on the quality of the customer experience. The term “sigma” refers to deviations from an ideal level of operation, where each level of sigma, starting from one, allows for fewer defects. Sigma six, the operational equivalent of nirvana, allows a mere 3.4 defects per million outputs. If you’re in manufacturing, that means 999,996.6 flaw-free widgets. If you’re in IT, that means fewer servers, faster call response times and better project delivery [3.1].

2. LITERATURE REVIEW

2.1 LEAN THINKING

Lean thinking originated within the Japanese automobile industry following World War II and is principally based on the Toyota Production System (TPS), which was developed by a production executive named Taiichi Ohno and was used to improve the quality and productivity within the Toyota Motor Company. Lean later increased in popularity
in the 1990s, after the publication of the bestselling book, The Machine that Changed the World: the Story of Lean Production which chronicled how organizations could transform their operations by adopting the lean approach developed at Toyota. Lean has since been widely adopted across every manufacturing industry ranging from automobiles to electronics, and it is being increasingly applied to a wide range of private-sector-service organizations, including some governmental entities. Lean is an integrated system of principles, Practices, tools, and techniques that are focused on reducing waste, synchronizing work flows, and managing production flows. The reduction of waste is the cornerstone to the lean approach. In lean, waste is also referred to as non-value-added activities. Value-added activities Thinking Lean in IT or Lean IT is the extension of lean manufacturing and lean services principles to the development and management of information technology (IT) products and services. Its central concern, applied in the context of IT, is the elimination of waste, where waste is work that adds no value to a product or service.

2.1.1 TYPES OF WASTE IN LEAN IT

Lean IT promises to identify and eradicate waste that otherwise contributes to poor customer service, lost business, higher than necessary business costs, and lost employee productivity. To these ends, Lean IT targets seven elements within IT operations that add no value to the finished product or service or to the parent organization (See Table 1).

Table 1

<table>
<thead>
<tr>
<th>Waste Element</th>
<th>Examples</th>
<th>Business Outcome</th>
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<tr>
<td>Defects</td>
<td>Unauthorized system and application changes.</td>
<td>Poor customer service, increased costs.</td>
</tr>
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<td></td>
<td>Substandard project execution.</td>
<td></td>
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<tr>
<td>Overproduction (Over-provisioning)</td>
<td>Unnecessary delivery of low-value applications and services</td>
<td>Business and IT misalignment, Increased costs and overheads: energy, data center space, maintenance.</td>
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<tr>
<td></td>
<td></td>
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<tr>
<td>Waiting</td>
<td>Slow application response times.</td>
<td>Lost revenue, poor customer service, and reduced productivity.</td>
</tr>
<tr>
<td></td>
<td>Manual service escalation procedures.</td>
<td></td>
</tr>
<tr>
<td>Non-Value Added Processing</td>
<td>Reporting technology metrics to business managers.</td>
<td>Miscommunication.</td>
</tr>
<tr>
<td>Transportation</td>
<td>On-site visits to resolve hardware and software issues.</td>
<td>Higher capital and operational expenses.</td>
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<td></td>
<td>Physical software, security and compliance audits.</td>
<td></td>
</tr>
<tr>
<td>Inventory (Excess)</td>
<td>Server sprawl, underutilized hardware.</td>
<td>Increased costs: data center, energy; lost productivity.</td>
</tr>
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<td></td>
<td>Multiple repositories to handle risks and control.</td>
<td></td>
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<tr>
<td></td>
<td>Benched application development teams.</td>
<td></td>
</tr>
<tr>
<td>Motion (Excess)</td>
<td>Fire-fighting repeat problems within the IT infrastructure and applications.</td>
<td>Lost productivity.</td>
</tr>
</tbody>
</table>

Whereas each element in the table can be a significant source of waste in itself, linkages between elements sometimes create a cascade of waste (the so-called domino effect). For example, a faulty load balancer (waste element: Defects) that increases web server response time may cause a lengthy wait for users of a web application (waste element: Waiting), resulting in excessive demand on the customer support call center (waste element: Excess Motion) and, potentially, subsequent visits by account representatives to key customers’ sites to quell concerns about the service availability (waste element: Transportation). In the meantime, the company’s most likely responses to this problem — for example, introducing additional server capacity and/or redundant load balancing software), and hiring extra customer support agents — may contribute yet more waste elements (Over provisioning and Excess Inventory) [4].

2.1.2 LEAN PRINCIPLES

Lean development can be summarized by seven principles, very close in concept to lean manufacturing principles:

1. Eliminate waste
2. Amplify learning
3. Decide as late as possible
4. Deliver as fast as possible
5. Empower the team
6. Build integrity in
2.1.2.1 Eliminate waste
Everything not adding value to the customer is considered to be waste (muda). This includes:
- Unnecessary code and functionality.
- Delay in the software development process.
- Unclear requirements.
- Insufficient testing, leading to avoidable process repetition.
- Bureaucracy.
- Slow internal communication.
- Partially done coding eventually abandoned during the development process.
- Extra processes and features not often used by customers.
- Managerial overhead not producing real value.

If some activity could be bypassed or the result could be achieved without it, it is waste. A value stream mapping technique is used to distinguish and recognize waste. The second step is to point out sources of waste and eliminate them. The same should be done iteratively until even essential-seeming processes and procedures are liquidated.

2.1.2.2 Amplify learning
The best approach for improving a software development environment is to amplify learning. The accumulation of defects should be prevented by running tests as soon as the code is written. Instead of adding more documentation or detailed planning, different ideas could be tried by writing code and building. The process of user requirements gathering could be simplified by presenting screens to the end-users and getting their input. The learning process is sped up by usage of short iteration cycles – each one coupled with re factoring and integration testing. Increasing feedback via short feedback sessions with customers helps when determining the current phase of development and adjusting efforts for future improvements. During those short sessions both customer representatives and the development team learn more about the domain problem and figure out possible solutions for further development. Thus the customers better understand their needs, based on the existing result of development efforts, and the developers learn how to better satisfy those needs.

2.1.2.3 Decide as late as possible
As software development is always associated with some uncertainty, better results should be achieved with an options-based approach, delaying decisions as much as possible until they can be made based on facts and not on uncertain assumptions and predictions. The more complex a system is, the more capacity for change should be built into it. The iterative approach promotes this principle – the ability to adapt to changes and correct mistakes, which might be very costly if discovered after the release of the system.

An agile software development approach can move the building of options earlier for customers, thus delaying certain crucial decisions until customers have realized their needs better. This also allows later adaptation to changes and the prevention of costly earlier technology-bounded decisions.

2.1.2.4 Deliver as fast as possible
In the era of rapid technology evolution, it is not the biggest that survives, but the fastest. The sooner the end product is delivered without considerable defect; the sooner feedback can be received, and incorporated into the next iteration. The shorter the iterations, the better the learning and communication within the team. This gives them the opportunity to delay making up their minds about what they really require until they gain better knowledge. Customers value rapid delivery of a quality product. The Just-in-Time production ideology could be applied to software development, recognizing its specific requirements and environment. This is achieved by presenting the needed result and letting the team organize itself and divide the tasks for accomplishing the needed result for a specific iteration.

2.1.2.5 Empower the team
The lean approach favors the aphorism "find good people and let them do their own job," encouraging progress, catching errors, and removing impediments, but not micro-managing. Another mistaken belief has been the consideration of people as resources. But in software development, as well as in any organizational business, people do need motivation and a higher purpose to work for – purpose within the reachable reality, with the assurance that the team might choose its own commitments. The developers should be given access to customer; the team leader should provide support and help in difficult situations, as well as make sure that skepticism does not ruin the team’s spirit.

2.1.2.6 Build integrity in
The customer needs to have an overall experience of the System – this is the so called perceived integrity: how it is being advertised, delivered, deployed, accessed, how intuitive its use is, price and how well it solves problems. Conceptual integrity means that the system’s separate components work well together as a whole with balance between flexibility, maintainability, efficiency, and responsiveness. One of the healthy ways towards integral architecture is re-factoring. The more features are added to the System, the more loose the starting code base for further improvements. As described above in the XP agile method re-factoring is about keeping simplicity, clarity, minimum amount of features in the code. Repetitions in the code are signs for bad code designs and should be avoided. The complete and automated building process should be accompanied by a complete and automated suite of developer and customer tests, having the same version, synchronization and semantics as the current state of the System. At the end the integrity should be verified with thorough testing, thus ensuring the System does what the customer expects it to. Automated testing should not be a goal, but rather a means to an end, specifically the reduction of defects.
2.1.2.7 See the whole

Software systems nowadays are not simply the sum of their parts, but also the product of their interactions. Defects in software tend to accumulate during the development process — by decomposing the big tasks into smaller tasks, and by standardizing different stages of development, the root causes of defects should be found and eliminated.

The larger the system, the more organizations that are involved in its development and the more parts are developed by different teams, the greater the importance of having well-defined relationships between different vendors, in order to produce a system with smoothly interacting components. During a longer period of development, a stronger sub-contractor network is far more beneficial than short-term profit optimizing, which does not enable win-win relationships. Only when all of the lean principles are implemented together, combined with strong “common sense” with respect to the working environment, is there a basis for success in software development.

2.1.3 BENEFITS OF LEAN

Finally, Lean philosophy stresses not making changes based solely on financial measures. This will cause inappropriate activities to take place. Instead, our experience is that success full organizations make changes based on operational measures, and when these operational measures perform well, the financial measures will follow suit. For IT, this could mean such operational improvements as:
- Shortened Lead Time between project inception and initiations
- Increased Customer On-Time Delivery Performance
- Increased Customer Satisfaction from Business teams
- Improved Quality of Products & Services provided to internal and external customers
- Reduced Cost of Quality of products and services provided
- Reduced Cycle Time between project start and completion
- Increased Capacity for other needed tasks that traditionally would be delayed
- Increased Employee Satisfaction
- Reduced Cost of Administrative Processes

2.2 SIX SIGMA FOR CUSTOMER SATISFACTION

2.2.1 Origin of Six Sigma

Six Sigma originated as a set of practices designed to improve manufacturing and eliminate defects, but its application was subsequently extended to other types of business processes as well. In Six Sigma, a defect is defined as any process output that does not meet customer specifications, or that could lead to creating an output that does not meet customer specifications.

The idea of Six Sigma was actually “born” at Motorola in the 1970s, when senior executive Art Sundry was criticizing Motorola’s bad quality. Through this criticism, the company discovered the connection between increasing quality and decreasing costs in the production process. Before, everybody thought that quality would cost extra money. In fact, it was reducing costs, as costs for repair or control sank. Then, Bill Smith first formulated the particulars of the methodology at Motorola in 1986. Six Sigma was heavily inspired by six preceding decades of quality improvement methodologies such as quality control, TQM, and Zero Defects based on the work of pioneers such as Shewhart, Deming, Juran, Ishikawa, Taguchi and others.

Like its predecessors, Six Sigma doctrine asserts that:
- Continuous efforts to achieve stable and predictable process results (reduce process variation) are of vital importance to business success.
- Manufacturing and business processes have characteristics that can be measured, analyzed, improved and controlled.
- Achieving sustained quality improvement requires commitment from the entire organization, particularly from top-level management.

Features that set Six Sigma apart from previous quality improvement initiatives include:
- A clear focus on achieving measurable and quantifiable financial returns from any Six Sigma project.
- An increased emphasis on strong and passionate management leadership and support.
- A special infrastructure of “Champions,” "Master Black Belts," "Black Belts," "Green Belts", etc. to lead and implement the Six Sigma approach.
- A clear commitment to making decisions on the basis of verifiable data, rather than assumptions and guesswork.

The term “Six Sigma” comes from a field of statistics known as process capability studies. Originally, it referred to the ability of manufacturing processes to produce a very high proportion of output within specification. Processes that operate with "six sigma quality" over the short term are assumed to produce long-term defect levels below 3.4 defects per million opportunities (DPMO). Six Sigma’s implicit goal is to improve all processes to that level of quality or better.

2.2.2 Six Sigma for Software

Software today is responsible for most of the added value in products, and must be blamed for many of its failures. Even if the iron hook breaks, it may be the software embedded in the measurement instrument to blame for not having detected it in time. When in Germany the high speed intercity express train crashed into an overpass, it was software that didn’t detect the broken wheel ring well before the accident. Mobile networks are suffering from not being able to provide interconnection to the internet and interoperability between their own services. It is the software that fails. In e-Commerce and for making Web Services to work, security, reliability and fault tolerance are of essence. Software and business processes are not cooperating, as they should to make it profitable. Software is...
so ubiquitous that we must solve the software development problem to address a lot of other problems the society has. The Six Sigma approach is:

- Set the goal – Define
- Define the metrics – Measure
- Measure where you go – Analyze
- Improve your processes while you go – Improve
- Act immediately if going the wrong path – Control

Throughout this talk, we talk about "software development", however we not only intend writing new software, but also software integration, deployment, and maintenance, as long as it has the character of a project. This means that there is a goal that can be reached or missed. Using Six Sigma, we want to measure how much we are going to miss that goal [6].

The acronym FMEA stands for "Failure Modes and Effects Analysis". It represents a technique aimed at averting future issues in project processes and eliminating risks that may hamper a solution. Implemented within the Six Sigma methodology, FMEA, or Failure Modes and Effects Analysis, further identifies and evaluates defects which could potentially result in reducing quality of a product. Defects within the methodology are defined as anything that reduces the speed or quality at which a product or service is delivered to happy customers. While Six Sigma techniques are implemented to discover and reduce the variables in processes which cause non-random fluctuations, FMEA is used to discover and prioritize aspects of the process that demand improvement and also to statistically analyze the success of a preemptive solution [5].

2.2.3 FMEA for software (SW-FMEA)

In relation to hardware failure behavior and human error it is gradually becoming more important to view the failure behavior of software and its effects. FMEA is an established technique to avoid failures in technical systems. A timely performed FMEA is risk management instead of crisis management. By evaluating the individual risks a differentiation between high risk and low risk components, modules and functions can be achieved. This makes a risk-oriented development of software-intensive systems possible. It happen for example through improved processes of development or through planning of special test cases. The evaluation of components, modules and functions with more or less risks follows on the basis of the quantitative risk evaluation. Due to the manifold connection possibilities of components, modules and functions a SWFMEA should be carried out by the support of a FMEA tool.

2.2.3.2 Strengths

The SW-FMEA is simple and systematic. In an efficient way the SW-FMEA allows the structured analysis of software architecture or a software design. With the aid of the SWFMEA critical functions or modules and their risks will be identified systematically. This enables early a risk based development for example

- Through the organization of measures to avoid software faults,
- Through the initiation of measures for the detection of faults before the delivery or

A SW-FMEA is the consistent continuation of the FMEA of the system (system FMEA: SFMEA) for analyzing software-intensive components of the considered system. The SW-FMEA is a systematic, structured technique for the review of the software architecture or the software design with respect to technical risks (e.g. safety, reliability or availability). The SW-FMEA is used for knowledge transfer. The knowledge of different departments, for example system development, software development, test and service, is brought together and used during the FMEA in the team. So the number of views on or into a system and a system's software increases itself.

2.2.3.1 Procedure

The SW-FMEA is carried out as a supplement to a FMEA of a system. It is used for architecture or design review during the development. The SW-FMEA should be performed before the implementation of the software. It may not be executed on software source code. The SW-FMEA should also be executed in a team. This team has got members of different functional areas, like system development, software development, test and service. The SW-FMEA is carried out in following steps:

1. The software to be examined is divided in components, modules and functions. A tree similar structure develops.
2. For every component defined in the system structure the function has to be described. The function of a sub component represents a partial function of the super ordinate component.
3. Corresponding possible failures and faults are assigned to every function of a component. The failure effects can be found then in the super ordinate components. The failure causes are as a possible failure or fault listed in the subordinate components.
4. If a risk evaluation is supposed to be carried out,
   - The severity of the failure effects,
   - The probability of occurrence and
   - The detection probability of the failure causes will be listed.
5. Then the definition of measures for the improvement of the software through avoidance of possible faults or errors or the optimized detection of failures follows. This can
   - The initiation of measures for the detection of failures during the runtime and
   - Through the derivation of propositions for the optimization of the software structure.

Risk based and disturbance based test cases and the appropriateness of tests and tests evaluates as soon as critical development instruments are worked out or identified. In addition to that maintenance rules in order to guarantee the safe and reliable operation of the software-intensive system within the specified environmental conditions are worked out permanently [4].

3. RESULT AND DISCUSSION

Every company has two "factories:" one that creates and delivers your product or service, and a hidden "Fix-it" factory that cleans up all of the mistakes and delays that occur in the main factory. If you're a 3-Sigma company, the Fix-it Factory and those 30,000 defects per million (PPM) are probably costing you Rs25-Rs40 of every Rs100 you spend. If you're an Rs10 million company, that's Rs2.5-Rs4
million that could be added back to your bottom line using
the common science of Lean Six Sigma. In a Rs1 billion
company, that's Rs250-Rs400 million. From Statistics we
find that it's relatively easy to shift at least 10% out of your
Fix-it factory in 12-18 months. Whether it all flows to the
bottom line or you use it to grow your business is up to you.
Every one penny improvement in profits per share can
increase shareholder value by millions of dollars. Those are
the benefits of Lean Six Sigma. Motorola had 5 fold growths
in first decade, with savings of Rs14 billion and sales price
gain of 21.2% annually.

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Manet – Routing Techniques

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Abstract:
MANET (Mobile Ad-hoc Network) is an autonomous system of mobile nodes establishing ad-hoc or short live network without the intervention of any fixed infrastructure. The absence of fixed infrastructure poses number of different challenges in the area of routing. In order to invent an effective routing mechanism, which can suit the requirements of MANET, various frame works and methods are proposed by the research community. The proposed solutions can be categorized into the following types i.e., Table Driven, On-Demand, Hierarchal, power aware, geographical and multicast routing protocols.

This paper is an effort to provide the detailed analysis and discussion of the important protocols from the above-mentioned categories by presenting the description of their functioning. This paper also facilitate to arrive at an intermediate approach in comparison with table driven and on-demand routing protocols

1) Introduction:
Wireless, or single-hop networks, until recently were based on a fixed structure, basically network nodes communicating to fixed infrastructure. In situations where networks are constructed and destructed in ad-hoc manner, mobile ad-hoc networking is an excellent choice. There are currently two variations of wireless networks. The first is known as Infrastructure networks i.e. those networks with fixed and wired gateways. The bridges for these networks are known as base stations. As the mobile travels out of range of one base station and into the range of another, a “handoff” occurs from the old base station to the new, and the mobile is able to continue communication seamlessly throughout the network. Typical applications of this type of network include office wireless local area networks (WLAN).

The second type of mobile wireless network is mobile ad-hoc network (MANET) or infrastructure-less mobile networks. A mobile ad-hoc network is a collection of wireless mobile nodes dynamically forming a temporary network without the use of any existing network infrastructure or centralized administration [1, 2]. MANETs are deployed in applications such as disaster recovery and distributed collaborative computing where routes are mostly multi-hop and network hosts communicate via packet radios. Examples include infrared; wireless RF; Blue tooth, ad-hoc sensor networks or even wired based transceivers used when emulating ad-hoc networks.

The idea of mobile ad-hoc or packet radio networks has been under development since 1970s. Since the mid-90s, when the definition of standards such as IEEE802.11 helped cause commercial wireless technology to emerge, mobile ad-hoc networking has been identified as a challenging evolution in wireless technology. Nodes in mobile ad-hoc network are highly mobile which causes network topology to change rapidly and unpredictably, as you can see in the graphic provided in Figure 1.

Figure 1: The mobile ad-hoc network on the left constructs itself as needed. Moreover the connectivity among the hosts varies with time. In most cases, mobile ad-hoc networks operate on low power devices. Normally these devices have low CPU process capability and small memory sizes, thus affect the capability of the mobile ad-hoc network to reach other devices.

Routing in mobile ad-hoc network, means transferring packets from source to destination, is different than traditional routing in a fixed network. Routing in mobile ad-hoc networking depends on many factors, which includes topology, selection of routers, initiation of request and available bandwidth.

The emerging field of mobile and nomadic computing, with its current emphasis on mobile IP operations should gradually broaden and require highly-adaptive mobile networking technology to effectively manage multi-hop, mobile ad-hoc network clusters which can operate autonomously or, more than likely, be attached at some point to the bigger network such as the Internet [9]. Thus there is current and future need for dynamic ad-hoc networking technology.

2) Routing Issues:
To enable communication within a MANET, a routing protocol is required to establish routes between participating nodes. Because of limited transmission range, multiple network hops may be needed to enable data communication between two nodes in the network. Since MANET is an infrastructure less network, each mobile node operates not only as a host but also as a router, forwarding packets for other mobile nodes in the network [14].
Most of the existing Internet protocols were designed to aid routing in a network with fixed infrastructure. These protocols therefore are not considered good enough to support routing in an ad-hoc networking environment.

MANETs due to their dynamic nature suffer with frequent and unpredictable topology changes, moreover, in them not only limited network bandwidth is available but also in most of the cases mobile devices are operated on limited battery power [6]. One of the first routing solutions was based on the idea of considering each mobile nodes of an ad-hoc network as a router and running some conventional routing protocol. However this scheme was not very successful as mobile ad-hoc network suffers from frequent topology changes, which results packet loss or drop [14].

One of the highly desirable properties of a routing protocol for MANETs is that it should be bandwidth efficient. Thus all these issues make routing problem an interesting challenge of this area.

3) Routing Protocols Classification For MANETs:

3.1) Table Driven or Proactive Routing Protocols:
Proactive protocols follow an approach similar to the one used in wired routing protocols. By continuously evaluating the known route and attempting to discover new routes, they try to maintain the most up-to-date map of the network. This allows them to efficiently forward packets as the route is known at the time when the packet arrives at the node. Proactive or table driven protocols, in order to maintain the constantly changing network graph due to new moving or failing nodes require continuous updates which may consume large amounts of bandwidth. Some of the proactive protocols are DSDV and FSR.

3.2) On-Demand or Reactive Routing Protocols:
Reactive protocols determine the proper route only when required. Therefore, when a packet needs to be forwarded in this instance the node floods the network with a route-request and builds the route on demand from the responses it receives. This technique does not require constant broadcasts and discovery, but on the other hand causes delays since the routes are not already available. Additionally, the flooding of the network may lead to additional control traffic, again putting strain on the limited bandwidth. AODV and TORA are the reactive protocols.

3.3) Single channel Protocols:
Single channel protocols are those protocols that use one shared channel for communication. One of the famous examples is IEEE 802.11 DCF medium access method for shared channel link layer.

3.4) Multi-Channel Protocols:
These protocols utilize CDMA, FDMA or TDMA to from specific channels. Examples of some of these protocols are CGSR, ABR, DREAM and SSA.

3.5) Hierarchical Topology or Cluster based Routing:
In hierarchical topology or cluster based routing make use of clusters to introduce some structure into the dynamic nature of the network. A dedicated node called the cluster-head usually represents clusters. These nodes form the cluster and attached nodes use the cluster head to describe the cluster they belong to. Clusters can also be formed hierarchically such that there are multiple layers of clusters. Examples of some of these Protocols are CBRP, CGSR, FSR and ZRP.

3.6) Non-Uniform protocols:
In a non-uniform protocol some nodes may be assigned a special role, which needs to be performed in a distributed fashion. A uniform protocol does not assign any special roles to any node. Typically clustering protocols are non-uniform. Some of the non-uniform protocols are CBRP DST, HSR and LANMAR.

3.7) Position based protocols:
Position based algorithms assume that no routing tables need to be maintained and thus no overhead due to route discovery and route maintenance is imposed. But they need to obtain position data of their corresponding destination either by an internal discovery process or by an independent positions service, which will then impose overhead to maintain the position information. GPSR, DREAM, LAR and GEDIR are some of the example of position-based protocols.

3.8) Hybrid protocols:
Hybrids are regarded as the combination of table’s driven and on-demand routing protocols. Example of some of the hybrid protocols is as follows. Adaptive distance vector routing (ADV); Terminode routing and Zone routing protocol also consists of a proactive Intra Zone Routing Protocol (IARP) and an on-demand Inter Zone Protocol (IERP).

3.9) Geographic Position Information Assisted Routing:
The advances in the development of Global Positioning System (GPS) make it possible to provide location information with a precision in the order of a few meters. Location information through such systems can be used for directional routing in distributed ad-hoc systems.

4) Routing Techniques:
In this section we discuss different aspects of Destination Sequence Distance Vector (DSDV), Ad-hoc On Demand Distance Vector Routing (AODV) and Dynamic Source Routing techniques and further explore the possibility of route discovery and data delivery at the same time.

4.1) Destination Sequence Distance Vector (DSDV)
Based on conventional routing protocol, RIP adapted for use in ad-hoc network, the destination sequenced distance vector routing protocol [9] is an extension of classical bellman ford routing mechanism. In DSDV routing is achieved by using routing tables maintained by each node. The main complexity in DSDV is in generating and maintaining these routing tables. DSDV requires nodes to periodically transmit routing table updates packets, regardless of network traffic. These update packets are broadcast throughout the network.
network so that every node in the network knows how to reach every other node. As the number of nodes in the network grows, the size of the routing tables and the bandwidth required to update them also grows. This overhead is considered to be the main weakness of DSDV.

4.1.1) Framework
Every mobile node in the network maintains a routing table, as shown in Table 1 in which all of the possible destinations New route broadcasts contain the address of the destination, the number of hops to reach the destination, the sequence number of the destination as well as a new sequence number unique to broadcast. The route labeled with the most recent sequence number is always used. In the event that two updates have the same sequence number, the route with the smaller metric is used in order to optimize the path. Routing is achieved by using routing tables maintained by each node. The main complexity in DSDV is in generating and maintaining these routing tables.

4.1.2) Review on DSDV
Besides number of disadvantages, loop free routing is considered to be one of the main benefits of DSDV. In DSDV Optimal values for parameters like settling time is not easy to determine. This might result in unnecessary bandwidth consumption. Moreover, use of continuous updates could trigger network overhead. Further more the protocol is not capable of supporting multicast routing. The size of the routing table is also a problem, as all nodes are required to maintain location information of the other nodes in the network; regardless weather or not this information is required.

4.2) Ad-hoc on-demand distance vector routing (AODV)
AODV[17, 18] is a reactive protocol, i.e. it creates route on-demand, as needed. Ad-hoc on demand distance vector routing protocol uses destination sequence number to offer loop free routing and fresh route to the destination. Unlike tables driven protocols, it does not maintain status of the network via continuous updates. This approach help in reducing the number of messages and the size of routes tables. AODV provides both multicast shown in figure 2, and unicast connectivity in an ad-hoc environment. One of the main features of AODV is to respond quickly whenever a link breakage in active route is found.

4.2.1) Framework
AODV is a combination of both DSR and DSDV. It inherits the basic on-demand mechanism of 'route discovery' and 'route maintenance' from DSR, plus the use of hop-by-hop routing, sequence numbers and periodic beacons from DSDV. When a source node needs a route to some destination node, it broadcasts a route request message to its neighbors including the last known sequence number for that destination. The route request is flooded in a controlled manner through the network until it reaches a node that has a route to the destination. Each node that forwards the route request creates a reverse route for itself back to the source node. When the route request reaches a node with a route to destination node that node generates a route reply that contains the number of hops necessary to reach destination and the sequence number for destination most recently seen by the node generating the REPLY. Each node that participates in forwarding the REPLY back toward the source of the route request creates a forward route to the destination. The state created in each node along the path from source to destination is hop-by-hop state, that is each node remembers only the next hop and not the entire route, as would be done in source routing.

4.2.2) Review on AODV
AODV operates on on-demand basis, nodes store only route that are needed. This approach not only reduced the size of the routing table but also helpful in minimizing the number of broadcast message which eventually directly related to the bandwidth usage of the network. More-over on-demand operation is also assist in memory requirements and needless applications. AODV adopts route error mechanism to find out link breakage in active routes. AODV Provides loop free routing and is scalable to large number of nodes.

4.3) Dynamic source routing
DSR is a reactive protocol. Unlike other routing protocols, DSR requires no periodic updates of any kind at any level within the network. DSR uses route discovery and route maintenance mechanisms to aid routing in mobile ad-hoc network. DSR uses source routing, which is regarded as one of the main feature of this scheme. The sender knows the complete hop-by-hop route to the destination. These routes are stored in a route cache. The data packets carry the source route in the packet header. DSR makes very aggressive use of source routing and route caching. No special mechanism to detect routing loops is needed. Also, any forwarding node caches the source route in a packet it forwards for possible future use.
4.3.1) Framework

The DSR protocol consists of two mechanisms, route discovery and route maintenance. Route discovery is the mechanism by which a node S wishing to send a packet to a destination D obtains a source route to D. Route maintenance is the mechanism by which a packet’s sender S detects if the network topology has changed such that it can no longer use its router to the destination D because two nodes listed in the router have moved out of range of each other. The key advantages of source routing are that intermediate nodes do not need to maintain up-to-date routing information in order to route the packets they forward since the packets themselves already contain all the routing decisions. Therefore, eliminates the need for the periodic route advertisement and neighbor detection packets. The main drawback of DSR is that it is not designed to track topology changes occurring at a high rate, two sources of bandwidth overhead in DSR are route discovery and route maintenance. These occur when new routes need to be discovered or when the network topology changes, however, employing intelligent caching techniques in each node at the expense of memory and CPU resources can reduce this overhead. The remaining source of bandwidth overhead is the required source route header included in every packet. This overhead cannot be reduced by techniques outlined in the DSR literature.

By using source routing dynamic source routing protocol can access to a significant amount of routing information. As for example using a single route request-reply cycle, the source can learn routes to each intermediate node on the route in addition to the intended destination. Each intermediate node can also learn routes to every other node on the route. Promiscuous listening of data packet transmission can also give DSR access to significant amount of routing information; especially it can learn routes to every node on the source route of that data packet. By making use of route cache, DSR is able to reply all request reaching a destination from a single request cycle. Thus the source learns many alternate routes to the destination. Route discovery in dynamic source routing is based on query and reply cycles, and route information is stored in all intermediate nodes along the route in the form of route caches.

Figure 3: Basic Model Of Mobile Ad-hoc On Demand Data Delivery Protocol

MAODDP introduced a new procedure ‘route discovery and data delivery’ for route discovery and data delivery simultaneously at the same time. MAODDP uses broadcast route discovery mechanism. To ensure fresh route and to offer loop free routing each ad-hoc node in MAODDP maintains an increasing sequence number counter. MAODDP relies on dynamically establishing route tables’ entries at intermediate nodes which recorded destination IP address, Destination Sequence number, hop count to destination and next hop for routes to other nodes in the network. New entries are placed in the route table following the reception of hello message, issued by the node on joining the network, route request and data packet package issue by the source node and acknowledge package issue by

4.3.2) Review on dynamic source routing protocol

Dynamic source routing is an on-demand routing protocol, which discover routes only when source node requires a route to the destination. Route discovery in dynamic source routing is based on query and reply cycles, and route information is stored in all intermediate nodes along the route in the form of route caches.

The current specification of DSR does-not contains any explicit mechanism to expire stale routes in the cache, or prefer “fresher” routes when faced with multiple choices. Route error packets delete some stale entries. But because of promiscuous listening and node mobility, it is possible that more caches are polluted by stale entries than are removed by error packets.

5) Mobile Ad-hoc on Demand Data Delivery Protocol (MAODDP)

Much effort has been undergoing to invent a mechanism for achieving efficient and reliable routing in MANETs. The efficient routing in mobile ad-hoc network could be achieved if route discovery and data delivery could occur at the same time. The algorithm presented here adopts an intermediate approach in between the two existing techniques i.e. Table driven and on demand routing and would be helpful in providing an effective solution for the routing problem of MANETs [8].

Mobile Ad-hoc on Demand Data Delivery Protocol (MAODDP) adopts an intermediate centralized approach by considering other related issues besides routing as shown in figure 3. The protocol inherits several characteristics from the existing tables driven and on demand protocols. MAODDP operates purely on demand basis i.e. a node does not have to discover a route to any other node until the two needs to communicate.
the destination node. Overall operation of MAODDP depends on three basic functions; Route discovery and data delivery process, route table management, and local connectivity management. Creating a route from a given node to destination node requires establishment of a sequence of links from the source to the destination. The method use to accomplish this is route discovery and data delivery process. Routing tables are used to maintain the information about other nodes in the network while local connectivity management is required to keep up to-date with the current status of all other neighboring nodes [10].

5.1) Route Discovery and Data Delivery Process

Route discovery and data delivery process is initiated whenever a source needs to communicate with another node for which it has no routing information in its table. Every node maintains two separate counters. Sequence number and a broadcast-id. The source node initiates the route discovery and data delivery process. Route discovery and data delivery process contains route request and data packet.

Source address and source sequence number in the route request are used to identify the source and to store the fresh information about the source node in the routing tables of other nodes. These store information is used to setup a reverse path back to the source nodes. Broadcast-id helps intermediate nodes to identify the fresh route request. When ever a node receive a route request and data packet it see in its routing table if it has received the same information i.e. source- sequence number and broadcast-id before. If so then it discards the packet and do-not forward it to other nodes.

Figure 4: Route Discovery and Data Delivery Process

In MAODDP only destination node is responsible to issue an acknowledged message similar to the ‘hello’ message back to the source node. On the other hand if the source node does not hear any thing back from the destination node within set time limit it considered the route discovery and data delivery process as unsuccessful. If the route discovery and data delivery is unsuccessful source node can reinitiate the route discovery and data delivery process with a new broadcast id or to postpone for later.

5.2) Route Table Management

In addition to the source and destination sequence numbers, other useful information is stored in the route table entries. In each route table entry the address of active neighbors through which packets for the given destination are received is also maintained. A route entry in the route table is recorded active if use by any other active neighbor which is followed by the acknowledge packet from the destination. A mobile node maintains a route table entry for each destination of interest. Each route table entry contains the following information.

- Destination address
- Next Hop
- Sequence number for the destination
- Active neighbors for this route
- Expiration time for the route table entry

If a new route is offered to a mobile node, the mobile node compares the destination sequence number of the new route to the destination sequence number of the current route. The route with the greater sequence number is chosen. If the sequence numbers are the same, then the new route is selected only if it has a smaller metric to the destination.

5.3) Local Connectivity Management

There are three possible ways for a node to know about other nodes in the network. In MAODDP each nodes issue a ‘hello’ message on joining the network. This message contains the useful information, which helps node to find out their neighboring nodes and hop counts to the neighboring node. Route request along with data packet is used as a source for all the nodes to update their routing tables with the fresh information about their neighbors. Acknowledge packet issue by the destination nodes helps receiving nodes to re-verify the already stored route information in their routing tables.

5.4) Feasibility of MAODDP

Mobile ad-hoc on demand data delivery protocol is an attempt to resolve routing issue by focusing on other routing
related issues. We believe without considering other issues besides routing it will be harder to cope with the specific environment of mobile ad-hoc network. MAODDP could be considered more feasible to adopt because of one of following reasons.

- It is not possible for all the routes in mobile ad-hoc network to be always valid, weather recorded in the routing table or by caching. So even if a source node has a valid route recorded (tables driven) or cached (on-demand) there is no guarantee that the route will always be available throughout the transmission. By giving freedom of choice to all nodes to transfer the packet to the destination with the route query packet eliminates the possibility of route invalidity.

- Route discovery creates unnecessary time delay thus affects the overall performance of the network, which make on demand existing protocols slightly unsuitable for real time communication. On the other hand MAODDP does not require route to be established before transfer the packet and thus gives the opportunity of having fast communication.

- Too many query packets for route discovery or error packets might results in bottleneck, which could possibly be, minimized in the case of MAODDP.

- Mobile ad-hoc Data delivery protocol minimize the bandwidth usage by eliminating the need of continuous updates as in tables driven protocols and by reducing the number of packets as in the case of on-demand protocols.

- Based on the availability issue some protocol such as global positioning system enable protocol requires use of global positioning system receiver for directional routing in mobile ad-hoc network. MAODDP do not require any extra hardware.

- Nodes in mobile ad-hoc network have limited battery power. Requiring all nodes to be awake all the time as in the case of tables driven protocols reduced the battery life of the participating nodes. Mobile ad-hoc on demand data delivery protocol gives freedom to all participating nodes by making them awake only during the active transmission time.

- In some of the existing on demand protocol by the time a suitable route establish between a source and destination. There is a chance of link failure or topology changes between any of these two nodes or by an intermediate node which could results either in transmission failure or invoke route maintenance mechanism, Under this type of situation mobile ad-hoc on demand data delivery protocol could possibly offer a better solution.

6) Conclusion:

MANETs suffer with high mobility, frequent topology changes, bandwidth constraints, limited power and hidden terminal problem. Almost all of these issues are interrelated with the over all routing mechanism. Therefore for a routing mechanism to be good enough for such an environment, it should be able to address some or all of these issues at a certain level.

Efficient routing could be achieved if source invoke route discovery and data delivery process at the same time. This mechanism as shown in MAODDP can be utilized to minimize bandwidth, maximize the battery life and to achieve fast reliable transmission when required.

Some fundamental ad-hoc networking problems remain unsolved or need optimized solutions. Although various routing protocols are suggested and tested for MANETs, performance metrics like throughput, delay and protocol overhead in relation to successfully transmitted data need better optimization. This optimization would probably also depend on application type and desire to maximize the throughput or minimize the delay.

References:


the Convergence of telecommunications, Networking and Broadcasting. 2002.

Table 1: DSDV Structure of Routing Table.

<table>
<thead>
<tr>
<th>Destination</th>
<th>Next</th>
<th>Metric</th>
<th>Seq.Number</th>
<th>Install-time</th>
<th>Stable Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>F</td>
<td>0</td>
<td>F-670</td>
<td>002000</td>
<td>Ptr_F</td>
</tr>
<tr>
<td>G</td>
<td>G</td>
<td>1</td>
<td>G-780</td>
<td>004000</td>
<td>Ptr_G</td>
</tr>
<tr>
<td>H</td>
<td>G</td>
<td>3</td>
<td>H-890</td>
<td>006000</td>
<td>Ptr_H</td>
</tr>
</tbody>
</table>
Abstract – User experience is such a challenging art of inducting positive emotions on the consumer, not through words or flora, but by highly thought out software applications. Traditionally, for decades, waterfall development model experience has resulted in poor user experience. Months, sometimes even years, between writing the requirements and getting the final product to users. By then, user needs would have changed, enhancing the gap between the requirements and the needs. Adding to this, what users want and what users need are two different aspects to be carefully analyzed. The real challenge in the usability world is to get the designs evaluated by the users through mock-ups or proto-types. Agile has the solution to address the traditional systematic barriers to good usability experience. Agile’s biggest constraint is that it is a method proposed by programmers, mainly address the implementation side of system development. This paper elaborates the pros and cons of Agile methodology and recommends solution for enhancing user experience through Agile.

Keywords - Agile, user experience, work flows, sprint

I. INTRODUCTION

User experience is a challenging art to overcome in software applications. Significant thought process needs to go in for design of the application. Retaining customers through highly usable applications has been the secret for many organizations. Software applications cannot be developed without continuous collaboration of all stakeholders. Agile software development has been time tested for delivering products with high quality and user needs. In spite of addressing needs, researches indicate that many projects fail to achieve customer satisfaction, let alone delight. According to Nielson Norman Group Report “Agile, Scrum, and the like, simultaneously poses an opportunity and a threat to achieving a quality user experience”. It is agreeable that agility is customer inclusive. Trouble arises when what the customer calls as functionality is misunderstood for the end users view of usability. For example, while functionality means to login and buy tickets, usability is to first book the tickets and then save them by entering id and password. Does requirement specification include usability conditions or not? Should usability be considered during design or analysis? These questions are not answered by Agile software development methodology.

While Agile calls for putting off detailed design, User experience design calls out for drawing even the minute detail upfront. Also, test first development only warrants that the incremented code run to completion. But, how usable are the results of the testing determines usability. The measurement of an Agile project progress could be undoubtedly working software. But the end user’s satisfaction alone determines the project success. Only the act of marrying Agile philosophies with that of user experience (UX) brings user satisfaction. This paper discusses the practical tiffs faced in combining these methodologies and recommends solution. Their philosophies may not be completely contrary, but are different by perspectives.

II. AGILE IN USE

Agile practitioners define their work as iterative and incremental. Frequent measurement and ability to respond to dynamic changes led to the term Agile. It is the most popular rapid application development techniques. The challenge in the traditional waterfall model is, work flows down from requirements to implementation and is not iterative.

Key aims of Agile as a methodology
- Individuals and Interactions over process and tools
- Working software over documentation
- Customer collaboration
- Responding to change

The faster turn-around of small chunk of work provides more opportunities to redirect the project than in waterfall models, thus giving way for agility. Business benefits are seen faster. It is important that the team understands the concepts right. The effect of bad implementation of Agile can last a long time. Agile methodology requires a mindset change from all the stakeholders including the business teams involved.

Key concepts and terminology used in Agile projects are mentioned below
- User Stories – Story is the basic element in Agile development. It describes the key elements of the system in the form of user tasks.
- Backlog – All stories developed will be placed in the backlog. Prioritizing the backlog is an on-going task. Typically, it is a physical location where story cards are pinned.
- Sprint - Each two to four week development cycle is called sprint. Stories are extracted from the
backlog and worked on during the sprint. At the end of each sprint there would be an incremental version to the product.

- **Burn down Chart** - The burn down chart tracks work within the sprint and across sprints. The number of story points turned to code over a period of time is referred as velocity.
- **Quality Assurance** – The acceptance criteria is written behind each story card. It is the exit criteria for each story. These are the testable conditions.
- **Spikes** – It is an experiment to learn just enough about something unknown in the story. The need for a spike is identified during sprint planning.

## III. USER EXPERIENCE PRACTITIONERS CHALLENGES

User experience is about how a person feels about product, system or service. It is about affective, meaningful and valuable aspects of human-computer interaction. The focus is on perception on utility, ease of use and efficiency of system. It is subjective in nature. Individual feelings and thoughts about the system need to be explored well. User experience is very dynamic in nature. It is combination of user interface design, usability, human factors engineering, information architecture and user experience design.

In an Agile project, typically the user practitioner creates designs for sprint work, plans for next sprint, and help with current sprint work and validates previous sprint work. User experience practitioners have challenges in going the Agile way. Lack of time for upfront research in a typical Agile sprint is a constraint. Users in Agile world are loosely defined. Mixed interpretation of users in business and IT community exist. Agile is more development centric. Developers seem to have upper hand when compared to UX practitioners. The focus is on writing and developing the code. The availability of UX practitioners is a big challenge, getting the right input at the right time. There is also lack of deep integration considering the matrix environment.

Requirement baseline is a constraint. Significant effort is spent on re-tests based on customer feedback and iteration fixes. One of the main reason is that design is not done up front. There is not enough time spent on research. This causes an issue in delivering work to developers in time. Most of the time, feedback is collected from internal teams rather that actual end users. Hence the true feedback is lost. There is always pressure around timelines. There is not enough time spent on documenting the design. It is important to understand that the design has to cater to different stakeholders. The focus on usability is minimal. Usability is taken for granted; only high level issues are quickly discussed in sprints. Then there are developer attitudes as well.

## IV. INTEGRATION OF AGILE AND UX

Integrating Agile and user experience is a challenge based on the context discussed thus far. Understanding the constraints with Agile model and tweaking few practices to suit the intent of end customer would make a difference. Conceptualizing prior to development based on previous experience and research inputs would help. Iterations can be revisited based on previous iteration experiences. Domain knowledge like understanding the industry and market in detail would add lot of value while designing user screens. It is important to segregate complex interfaces and handle those as separate design only sprints. Management should also play an active role and understand that Agile might not give the product faster, it only helps to manage change well and have the right product delivered to the end users. UX practitioners can add value by bringing in lessons learnt from similar projects, acting as a catalyst in communication between end users, developers and management. Their research techniques would focus on which group of people want the product, what do they want, what is important in the list. Agile Scrum should ensure that every user research findings are captured and considered to product back log. UX practitioners should actually work one or two sprint ahead in parallel. Managing the UX practitioners for different sprints would be an important task.

Agile can be made flexible to accommodate user experience but it might not address all the issues. An issue or defect is again subjective and not easy to interpret. It is difficult to get experienced UX practitioners with strong domain and usability skills. Then there is eagerness to move forward than to fix all the defects and issues. User experience is subjective, the identification and quantification of usability issues is a challenge. Hence it is difficult to use the traditional process models to predict user experience in an Agile world. Product organizations focus a lot on usability. There are many tools like eye tracker that help in trying to understand what a user looks for when he looks at a product. These inputs are later collated, segregated, diced and inferences derived. Significant effort is spent on this research work.

Given the context, both UX practitioners and Agile practitioners need to strike a balance in their practice. Both can’t be independent. For the success of the product they need to go hand in hand. Each one has to understand the limitation of the other and work together to synergize and deliver the right product to the end user. This requires a mindset change between both the parties and the project manager should act as a catalyst and make it happen.

## V. CASE STUDY

Based on the above learning, an IT project in healthcare industry was selected to pilot the understanding. This was a typical Agile project intended to develop a new functionality for end users. Project charter was developed. User stories were created and updated in product backlog. Sprints were defined and sprint backlog maintained. Sprint planning, review and retrospective exercises were part of the project. The team had resources on onsite and offshore. There used to be daily huddles between onsite and offshore team members. Virtual task board existed to track the sprint progress. This was a typical Agile project and the work flow is shown in Figure1 below.
The case study highlighted the compatibilities and the incompatibilities and the union of these approaches that enhanced the user experience of one of the applications, the Agile way. Paper prototyping and light weight usability were carried out before development by this team. Usability team synchronized their sprint with that of the development team. The usability team was able to more effectively gather customer inputs when they worked with Agile teams. More than the visual design, user centered design guidelines and interaction design guidelines were imparted to developers during iterations.

Looking back and analyzing the project flow, it was interesting to note that initially with normal Agile model itself team was struggling. The methods of Agile were used but there was not much involvement in Agile. Respect comes from involvement. Project manager improved on communication with all the members of his team, sat with them, worked with them, gave them data and decisions which helped them in their daily work. It took 5 iterations for the Agile team to stabilize and generate confidence in the product developed thus far. But team faced the brunt of the users and they were looking for something different. While, they felt the requirements were already captured and based on that product was developed, still the end users were not happy. There was a gap between the need and want of the user. They realized it late that usability was missed out. Designers felt they knew what usability was, but their understanding was not right. It was then the team realized the lack of UX practitioners. Till then, they felt it was only a cosmetic overhead. UX practitioners were integrated into the team, both at the project management level and also the day-to-day development sprint level. Team’s preconceived notions of usability changed as they moved from one iteration to the other. UX practitioners joined the product teams with full enthusiasm and shared responsibility for managing the team and liaised with all the stakeholders in the team. They worked closely with the product owner to share responsibility for the product backlog and its prioritization.

Shared responsibility from different disciplines made a difference. Product team, UX team, development team, user group, management team all integrated to deliver the end objective. Prototypes, storyboards and lists of participants for different user studies were created. Repository of user information from all interactions with the team was captured and team started focusing on data than opinions. Small chunks of focused work were delivered to get the development started. Using the right user research methods to produce different types of information, thus adding value to business stakeholders helped. UX practitioners work was also factored in story points and workload was planned accordingly. The success was in the way Agile practitioners and UX practitioners were flexible to accommodate each other’s practices to deliver the end product.

VII. Conclusion

Customer centric organizations constantly look for improving user experience. Today, technology is growing so fast and we have new gadgets arriving in the market every other day. Client’s expectations are increasing. The basics of any application are the screen elements and workflow associated to these elements. The ease and purpose makes the difference in user experience. Graphical user interfaces are built for different situations. These design models might

Figure 1: Agile model piloted

There were initial hurdles as some team members were new to Agile. After 2 iterations, open communication was encouraged between team. Planning, huddle and retrospective meeting spirit was reiterater. More time was spent on code integration. It was reinforced that agility is not rush, but project control. This philosophy was getting imbibed. The manager was relatively new and finally figured the role he had to play for the team. After 5 iterations, the success criteria were met, stuck to commitment, unit and integration test were successful and team dynamics were improved. There was better level of automation. Auto build tools were used for seamless integration. Automated acceptance test tool deployed and Agile practices were enforced for better quality of code. Agility assessment and maturity models were deployed.

At this stage, the voice of users on the current development was sought. Inputs were documented to get the feel of users. User comments were critical, they felt words in the product were barely legible, they were not sure if that was the feature they were looking for. At times, they were lost in navigation, not knowing what to do next. Team immediately formed a huddle and tried to figure out what went wrong. Test users used it differently from how the developers intended. Attempts to improve always raised fundamental questions. Debate on scope, audience, purpose and functionality suddenly aroused within the team. What seemed certain suddenly became precarious. No understanding of the audience made the product appear bad.

Project Manager started analyzing the issues and identified that the team lacked usability inputs. UX practitioner was brought in. Now the team started analyzing and going through the process and polling all the required information. Agile practices were customized to accommodate UX practitioner inputs. Sprints were revisited based on new inputs and product backlog was updated. Iterations were re-planned.

After 10 iterations, reasonable time was spent with test users and feedback was sought. The product improved after the 5th iteration step by step and led to user’s delight. Better levels of success achieved with the test users. Product contained very minimal errors. Product contained exactly what the user must know and remember.

VI. SUCCESS FACTORS FOR THE MODEL
sound simple but the way it is used makes the mark. Our process and systems should be able to handle this dynamic change and able to deliver to the customer demands. Agile is the way of life for IT systems. User experience is the key differentiator for the clients to win more business. Though both are dynamic each has its own constraints, but it is important that a balance is struck between both the groups. UX practitioners need to go Agile way and Agile team needs to understand and appreciate the role of UX team. Full time UX practitioners are recommended especially for new start-up projects. It is important that the entire team understands the Agile model and collaborates for client success. In traditional Agile teams, members work on the same stories in each sprint. But this will severely limit the UX professional ability to give valuable input. UX team should work in parallel and look at one or two sprints ahead. This will help to gather research data and plan for user designs well in advance. This can be planned through spikes. Leadership commitment is another important parameter for success. Leadership team should be informed about the value that UX team and Agile team bring in. It is in the interest of the organization to nullify the politics between these teams and synergize to enhance the customer experience. To summarize, the solution lies in planning ahead for usability testing and not go by traditional Agile way. UX work is always one or two steps ahead and continuously enhancing on the user designs. Finally, the team culture should be such that everyone complements each other to reach the end target.

REFERENCES


How to Explore the Value added Impact of Intellectual Capital components on the Productivity, Profitability and Market Value of a Firm

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Abstract

This paper is a guide on the literature and methodological issues that are necessary to consider on for assessing the value added impact of intellectual capital components, primarily human and structural capital, on measures of productivity, profitability and market value of a firm by employing the Value Added Intellectual Coefficient (VAIC) technique. The importance of intellectual capital for improving firm efficiency and resources has been discussed, along with a review of intellectual capital components. The steps of calculating human and structural capital coefficients are illustrated, followed by suggestions on sampling and relevant methodological issues.

Keywords
Human capital, Intellectual capital, Structural Capital, VAIC

Introduction

Innovation and value creation, being seen as vital for sustainable competitive advantage, are a primary matter of interest for managers, investor, economic institutions and governments and are hence explored in both in the academic sector and the industry (Zeghal and Maaloul, 2010). According to OECD (2008), most companies invest significantly in employee training and development, R&D, customer relations, management control and administrative systems, etc. which is referred to as intellectual capital (hereafter IC) investments. These investments are growing as fast as capital investments, especially in the developed countries (OECD, 2007). This change in investment structure can be attributed to the emergence of the knowledge-based economy (Stewart, 1997; Zeghal and Maaloul, 2010) and are often considered as the main source of value creation in the present era (Edvinsson, 1997; Sveiby, 1997; Lynn, 1998).

IC is typically described as being composed of human and structural capital (Brooking, 1997; Bontis, 1998; Guthrie and Petty, 2000). Hence human capital and structural capital are referred to as IC components (Pulic, 1998). A firm’s performance is subject to an organization’s ability to acquire, manage and utilize IC resources in such a way that it develops sustainable competitive advantage (Walker, 2001). Firm performance can be evaluated in three dimensions—productivity, profitability and market valuation by employing Value Added Intellectual Capital (VAIC) methodology and taking sample from UK firms listed in the LSE. Each of these performance dimensions are expected to be positively influenced by both human and structural capital (Chen et al, 2006).

A greater human and structural capital efficiency signals higher growth prospects of a firms, and hence if markets are efficient, shareholders are likely to place higher values on firms with greater human or structural capital efficiency (Firer and Williams, 2003; Riahi-Belkaoui, 2003). In addition, the value creation from a company’s human and structural capital (hence IC) can be interpreted as indicators for subsequent business performance (Roos and Roos, 1997).

There can be two broad set of objectives for such a study. The first set of objectives seeks to examine if there are any relationships between human and structural capital, with the productivity, profitability and market valuation of the firm, and if so, to determine the nature of the relationship. Subsequently, the study would also like to investigate if there are any differences in the nature of relationships between the said IC components with productivity, profitability and market value between the three chosen industry groups, i.e. high-tech, traditional and service as classified by UK Department of Trade and Industry (DTI).

Given the above stated objectives, an ideal thesis statement can be stated as follows: “Companies with greater human and structural capital efficiency have proportionally higher productivity, profitability, and market value and hence overall better financial performance”.

Literature Review

Intellectual Capital and Its Components Broadly speaking, intellectual capital (IC) is a collection of resources which determines the value and competitiveness of an organization (Itami, 1991; Smith, 1994; Rastogi, 2003). Early scholars such as Galbraith (1969) defined IC as a type of brainpower activity that uses knowledge to create value (Shih et al, 2010). Itami (1991) defined IC as intangible assets comprising of technology, brand name, reputation, customer information and corporate culture that are invaluable to a firm’s competitive power (Choong, 2008). Subsequently, Brooking (1996, p. 13) stated that IC was composed of ‘market assets, human-centered assets, intellectual property
assets and infrastructure assets’ (Choong, 2008). Stewart (1998) defined IC as the knowledge, information, intellectual property, experience, etc. that can be put together to create wealth. More recently, Sullivan (2000) described IC as a form of knowledge that can be converted into profit (Choong, 2008). Petty and Guthrie (2000) asserted that IC indicates the economic value of two categories of intellectual assets of an economy—organization and human capital. Rastogi (2003) described IC as the capability of the organization to coordinate and deploy its knowledge resources, thereby creating value to attain future goals.

IC is composed of human capital and structural capital (Brooking, 1997; Sveiby, 1997; Bontis, 1998; Guthrie and Petty, 2000; Choong, 2008). Although the precise definition of human capital depends on the nature of the job and its associated situational factors (Appuhami, 2007), many early economic theories refer to it simply as labor (one of three factors of production), and consider it to be a fungible resource—homogeneous and easily interchangeable (Mohiuddin et al, 2006). The first hardcore business definition of human capital was proposed by Schultz (1961) and subsequently approved by Hermanson (1964) and Sackman et al (1989), all of whom described it as ‘the summation of knowledge, skills, innovativeness and capabilities of a firm’s employees to reach its target’ (Chen et al, 2006, p. 1325). Bontis (1998), Sullivan (1998) and Stewart (1994, 1998) further asserted that human capital was the ‘source and momentum of revolution and innovation for organizations’ (Chen et al, 2006, pp. 1325-1326), and it constituted employee’s innovativeness, experience, attitude, wisdom, capabilities and commitment (Grantham and Nochols, 1997; Ulrich, 1998; Elias and Scarbrough, 2004). Human capital is embedded in the employees and not in the firm, and can be developed through education and training (Miller and Wurzberg, 1995). Hence human capital will also evaporate from the organization when an employee leaves the firm (Edvinsson, 1997; Bontis, 1999; Zeti, 2005; Muhammad et al, 2006).

Structural capital constitutes enabling structures that allow the organization to exploit IC (Muhammad et al, 2006), which may range from patents, copyrights, trademarks, databases, software systems and processes to corporate culture, accountability, efficiency, and trust among employees (Seetharaman et al 2004; Muhammad et al, 2006). Some scholars have also suggested that structural capital includes a firm’s management philosophy, information and networking systems and financial relations (Sveiby, 1997; Guthrie and Petty, 2000; Lee and Guthrie, 2010). Ashton (2005) described structural capital as comprising of various types of internal value drivers of a firm including processes, routines, databases, customer files, work literature or manuals, and organization structures. As structural capital results from outputs, products or systems created by the firm over time they are not necessarily embedded within an individual or employee (Ashton, 2005). Hence unlike human capital, structural capital remains within an organization even after employees leave (Muhammad et al, 2006; Appuhami, 2007; Muhammad and Aida, 2007).

Other Constructs and Rationale The broad constructs of firm performance can be narrowed down into specific measures of performance (Walker, 2001). Three measures of firm performance can be employed—productivity, profitability and market valuation. First, the study intends to examine the firm’s productivity, which can be defined as the efficiency with which a firm converts its inputs into outputs. A measure of productivity is the ‘Value Added’ by a firm, which according to the Theory of Stakeholder View (Donaldson and Preston, 1995) is the difference between the outputs and inputs during a specific time period, i.e. VA = OUTPUT - INPUT (Pulic, 1998, 2004). Output represents the total income generated by the firm from all products and services sold during the period, while input represents all the expenses incurred by the firm during at that time except cost of labor, tax, interest, dividends and depreciation (Pulic, 1998; Riahi-Belkaoui, 2003; Zhang et al, 2006; Zeghal and Maaloul, 2010). Second, the study proposes to examine profitability, which is the firm’s revenue generating capability; the degree to which a firm’s revenue exceeds its costs (Walker, 2001). One of the most widely used measure of profitability is Return on Assets (ROA), which is the relative comparison of earnings during a specified period and the value of assets used to generate that earning (Firer and Williams, 2003; Chen at al, 2005; Shiu, 2006). Third, as Walker (2001) has predicted, if the firm is not performing well in its operations, the shareholders not expected to sell its shares as profitably as it values its assets in the book, hence its market value would be limited to the net value of its physical and financial assets. Hence excess market value can be conceptualized as a premium resulting from firm operations, and market-to-book value ratio can be considered as a measure of firm performance (Sullivan, 2000; Walker, 2001).

Given the importance of human capital in value creation and sustaining an organization’s competitive advantages, the following three propositions can be made:

*Ceteris paribus, the greater the value of human capital in a firm:*

- the greater is the firm’s productivity
- the greater is the firm’s profitability
- the greater is the market-to-book value of the firm.

Given the significance of structural capital in creating value and sustaining an organization’s competitive edge, the following three propositions can be made:

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- the greater is the firm’s productivity
- the greater is the firm’s profitability
- the greater is the market-to-book value of the firm.

In addition, although the focus is primarily on human and structural capital, physical and financial is also an important contributor to productivity and profitability, as the greater the physical and financial assets available, the higher is the likelihood that employee productivity would
increase. However, since this increased productivity is not a direct product of human capital, it should be differentiated in the theoretical model, and therefore is termed as capital employed.

The VAIC Framework

Value Added Intellectual Coefficient (VAIC) is an analytical tool for measuring IC to evaluate the performance of a company (Pulic, 1998, 2001, 2002; Bormann, 1999; Van der Zahn, et al, 2004). It was originally developed by Ante Pulic through a series of studies conducted from 1993 to 1997. VAIC is useful in measuring human capital, structural capital as well as physical and financial capital to create the value added by the company (Bormann, 1999; Zeghal and Maaloul, 2010). VAIC measures the total value creation efficiency of a firm (Pulic, 1998). Value creation is assumed to be derived from physical and IC resources, and is referred to as ‘Value Added’ in the VAIC framework (Kujansivu and Lonnqvist, 2005). The execution of VAIC is convenient as the data needed to calculate VAIC can be found in financial statements (Kujansivu and Lonnqvist, 2005). The firm’s ability of using the capital and IC for value added is termed as 'Intellectual Capacity’, while ‘Value Added Intellectual Coefficient’ is used to express the sum of capital value added coefficient and intellectual potential value added coefficient (Zhang et al, 2006). Since VAIC is calculated as the sum of capital employed efficiency, human capital efficiency and structural capital efficiency, a higher value for VAIC demonstrates a greater efficiency in the use of firm capital (Pulic, 1998, 2004; Muhammad et al, 2006).

There are three major benefits of applying the concept of VAIC which address the deficiencies stated in other methods. First, VAIC provides a standard and consistent basis of measuring the value of IC and thereby firm value, allowing effective conduct of an international comparative analysis using a large sample across various industrial sectors (Pulic, 1998, 2001; Pulic and Bornemann, 1999). Hence it facilitates both time-series and cross-sectional studies across different industries for firms of different sizes (Pulic, 1998, 2001). Alternative IC measures such as the balanced scorecard (BSC), human resource accounting (HRA) or economic value added (EVA) are limited in that they either exploit information related to a selected group of company or nations, such as stock data, or that they engage unique financial and non-financial indicators that can be readily pooled into a single comprehensive measure (Roos et al, 1997; Zhang et al, 2006). Second, all data used in the VAIC calculation is based on audited information taken from financial statements (Pulic, 1998, 2001) such as the balance sheet and the profit and loss account, and therefore, the calculations can be considered as objective and verifiable (Roos et al, 1997; Sullivan, 2000). Other intellectual measures have been criticized due to the subjectivity associated with their fundamental indicators (Sveiby, 2000; Williams, 2001). Third, VAIC is a straightforward technique that enhances cognitive reasoning and enables ease of calculation by various internal and external stakeholders (Schneider, 1999). Ease of calculation is a feature that has enhanced the universal acceptance of many traditional measures of corporate performance and market value such as ROA or market-to-book ratio (Sullivan, 2000). Alternative intellectual measures are limited as they only be calculated by internal parties or rely upon sophisticated models, analysis and principals. Finally, the VAIC method is increasingly used as it is receiving more and more research attention (Sullivan, 2000; Sullivan and Sheffrin, 2003).

Calculation of VAIC Components Using the Theory of Stakeholders View (Donaldson and Preston, 1995), Value Added (VAit) will be calculated by adding up the respective year’s total interest expenses, depreciation expenses, dividend, corporation taxes, profits retained for the period, and wages and salaries for the period:

$$VA_{it} = DP_{it} + W_{it} + I_{it} + D_{it} + T_{it} + R_{it}$$

(\text{where } VA_{it} = \text{value added for the period}; \; I_{it} = \text{total interest expenses}; \; DP_{it} = \text{depreciation expenses}; \; T_{it} = \text{corporate tax}; \; W_{it} = \text{profits retain for the period}; \; D_{it} = \text{wages and salaries}, \text{and other training costs for the period})

The IC component coefficients will be calculated following Firer and Williams (2003) and Zeghal and Maaloul (2010). First, Capital Employed Efficiency will be first calculated as follows:

$$CE_{it} = VA_{it} / CE_{it}$$

(\text{where } CE_{it} = \text{Capital Employed} = \text{Physical Assets + Financial Assets} = \text{Total Assets – Intangible assets at the end of } t \text{ period}; \; CE_{it} = \text{The value created by one unit of capital employed during the } t \text{ period})

Second, the Value Added Human Capital Coefficient will be calculated as follows:

$$HC_{VAit} = VA_{it} / HC_{it}$$

(\text{where } HC_{it} = \text{investment in human capital during the } t \text{ period or total salary and wages including all incentives and training schemes}; \; HC_{VAit} = \text{value added by one unit of human capital during the period of } t)$$

Third, the Value Added Structural Capital Coefficient will be calculated as follows:

$$SC_{VAit} = SC_{it} / VA_{it}$$

(\text{where } SC_{it} = \text{structural capital during the period } t \text{ calculated by the difference between Value Added and Human Capital (VA_{it} - HC_{it}); } \; SC_{VAit} = \text{the proportion of total Value Added accounted by structural capital})$$

Finally, the Value Added Intellectual Capital Coefficient (VAICt), which denotes corporate value creation efficiency on firm resources, will be calculated by adding the coefficients of efficiency for each of the three components:

$$VAIC_{it} = CE_{VAit} + HC_{VAit} + SC_{VAit}$$

Variables and Research Models The study will employ a multiple linear regression models to identify the relationship between share price denoting market value, financial performance and the three components of IC coefficient VAICt; capital employed efficiency (CEVAit), human capital efficiency (HCVAit), and structural capital efficiency (SCVAit). Two other control variables are proposed to be added, including firm size (measured by Total Net Assets) and financial leverage creditworthiness (measured by Qui Score), Value Added (VAit) is used as a proxy for productivity,
Return on Assets (ROA) as a proxy for profitability, and Market-to-Book Value Ratio (M/BV) as a proxy for excessive market value over the value of physical and financial assets. Consequently, the following multiple regression models are proposed:

\[ VA_{it} = \alpha_0 + \alpha_1 HC_{V/Ai} + \alpha_2 CE_{V/Ai} + \alpha_3 SC_{V/Ai} + \alpha_4 Size_{it} + \alpha_5 Lev_{it} + \epsilon_{it} \] (Model 1)

\[ ROA_{it} = \alpha_0 + \alpha_1 HC_{V/Ai} + \alpha_2 CE_{V/Ai} + \alpha_3 SC_{V/Ai} + \alpha_4 Size_{it} + \alpha_5 Lev_{it} + \epsilon_{it} \] (Model 2)

\[ M/BV_{it} = \alpha_0 + \alpha_1 HC_{V/Ai} + \alpha_2 CE_{V/Ai} + \alpha_3 SC_{V/Ai} + \alpha_4 Size_{it} + \alpha_5 Lev_{it} + \epsilon_{it} \] (Model 3)

Previous Applications of VAIC Although relatively new, VAIC has been occasionally applied in academic research over the past few years. For instance, Pulic (2001) identified that firm’s market value have been created by human and structural capital, and he further found a significant relationship between the average value of VAIC and the firm’s market value by using data of 30 UK companies from 1992 to 1998. Subsequently Pulic (2002) employed the VAIC model to measure the IC performance from Croatian banks for the period 1996-2000 and found significant differences in terms of bank ranking and performance. Williams (2001) discovered that companies with higher level of VAIC try top reduce their disclosure in respect of IC when the performance reaches a threshold level since it might reduce competitive advantages. Using a sample of 81 US multinationals, Riahi-Belkaoui (2003) documented a significant positive relationship between IC and financial performance. While investigating the impact of IC on traditional measures of corporate performance like ROA, ROE, turnover, and market to book value ratio using 75 public companies in South Africa, Firer and Williams (2003) found that the associations between the efficiency of value added (VA) and profitability, productivity and market valuation are mixed. Goh (2005) found that value creation capability of commercial banks in Malaysia is primarily attributed to human capital efficiency. Using a sample of listed companies in Taiwan, Ming et al (2005) found that IC has a positive impact on market value and financial performance and as well as positive impact of research and development expenditure on profitability and firm value (Ting and Lean, 2009). Saez (2005) conducted a study in Spanish banks and identified a clear positive relationship between human capital and market-to-book value ratios. Zeghal and Maaloul (2010) employed VAIC on 300 UK companies and found that IC has a positive impact on economic and financial performance but its association with market values was not clear.

Suggested Sampling Technique As VAIC is a standardized measure that can be used to make cross-industry comparisons regardless of the nature of firm operations; the study should take advantage of this attribute and include a relatively large sample from different industries rather than focusing any particular sector. For example, if the data is chosen for firms on London Stock Exchange (LSE), the data should include companies from an array of sectors such as banking and financial intermediaries, automobiles, pharmaceuticals, energy, information technology, construction, telecommunication, health services, food, etc. Considering that the contribution of IC to a company’s productivity, stock market or financial performance could vary by industry (Abdolmohammadi, 2005; Tan et al, 2007), the study should subsequently categorize all the firm into three groups of sectors—high-tech (e.g. heath or automobile), traditional (e.g. construction or telecommunications) and services (e.g. banks or food), as has been classified by UK DTI (2006, p. 49). Either simple random or convenience sampling could be used for choosing the companies.

Anticipated Results
Most prior studies have suggested a positive relationship between IC efficiency and financial performance, i.e. profitability (Chen et al, 2005; Zhang et al, 2006; Zeghal and Maaloul, 2010). However not many studies have been able to show a significant correlation between IC and market value of a firm, perhaps owing to the high volatility of the P/E ratio (Zeghal and Maaloul, 2010). Given the outcome of these studies, it is anticipated that a definite relationship between IC and financial performance would be established but there is some doubt as to whether the same result would be achieved for the relationship of IC and market values of firms. Since prior studies have not been conducted on the influence of productivity on IC components, the outcome is difficult to anticipate, but following the rationale stated behind hypothesis formulation, it is expected that a positive relationship could be traced between both human and structural capital and productivity.

Knowledge and Skills Required
In order to develop the research framework, sufficient knowledge on the nature and characteristics of human and structural capital is required. It is also important to understand their likely relationships with productivity, market value and financial performance, for which it is essential to review relevant research papers. The researcher needs to have prior working knowledge on software programs such as Stata, SPSS and MS Office, which is essential for conducting the study. In addition, a modest understanding of the chosen country’s capital market,
specially the high-tech, banking and automobile industry is essential for analysis and interpretation, and this can be acquired by reading relevant newspaper articles, and previous studies conducted on these three industries in UK, both of which sources can be obtained from the University’s library and electronic network.

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Banking Technology in India - A Stepping Stone for Financial Inclusion

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ABSTRACT

The Indian banking sector has seen several phases of transformation. However the real growth in the banking sector was observed post introduction of LPG (Liberalization, Privatization and Globalization) in 1991. The opening up of economy witnessed a sudden boost in the level of economic activity. The government and RBI had to take proactive measures to expand the Indian Banking platform so that it was capable of handling the load of the exponentially increasing financial transactions. The RBI was able to foresee that in order to increase the capacity and to bring Indian Banking at par with the Banking practices followed globally; infusion of technology in banking was a pre-requisite.

But the benefits of Banking Technology in India can be reaped truly if it leads to financial inclusion-the most pronounced objectives of the Government, the policy makers and Regulators in India. The various features of Banking Technology in India and how it can lead to Financial Inclusion is the purpose of this paper.

Key Words: Indian banking sector, Opening up of economy Banking Technology, Financial Inclusion

INTRODUCTION

A number of technology initiatives were introduced by Reserve Bank of India (RBI) and Government of India (GOI) over the past 3 decades in order to achieve the following objectives for the growth of Indian Banking:

1. To expand and develop the banking capacity to support the exponential rise in the quantum of financial transactions.
2. To bring the Indian banking (payment and settlement systems) at par with global standards and benchmarks.
3. To achieve the goal of ‘Financial Inclusion’ by taking the banking facilities to the ‘Bottom of the Pyramid’ citizens.
4. To take banking to the masses following the 5 A’s of a payment system viz. (Availability, Accessibility, Acceptability, Affordability and Awareness).

A number of Committees and Specialized Advisory Boards were constituted in order to take up this mammoth task of technology infusion in Indian Banking. The Public-Private partnerships in the areas of technological development and implementation further increased its pace.

Formation of the Rangarajan committees during 80’s, committee on ‘Technology Upgradation in Payment Systems’ in 1994, constitution of Institute for Development and Research in Banking Technology-IDRBT in 1996 as a technology subsidiary of RBI, Board for Payment and Settlement Systems in 2005, National Payment Corporation of India-NPCI in 2008, Collaborating with the UIDAI to introduce Aadhar Enabled Payment System(AEPS) are some of the key initiatives of the Reserve Bank of India (hence on RBI) and Government of India (hence on GOI).

The major efforts that have been taken in this direction, in order to strengthen the banking infrastructure of the country, are being summarized below:

1. Magnetic Ink Character Recognition (MICR) based cheque processing and clearing

Transactions by means of cheques still represent a very significant proportion of the overall fund transfer with 59% contribution in terms of volume and 10% contribution in terms of value*. http://www.rbi.org.in/scripts/BS_SpeechesView.aspx?Id=285

Earlier the process of cheque clearing was done manually which used to take a very long time in getting cleared. However the introduction of Magnetic Ink Character Recognition in India in the late 80’s completely changed the dimensions of cheque clearing. Now using automated MICR technology which the RBI had initially established at the 4 Metro cities of erstwhile Delhi, Bombay, Calcutta and Madras, the cheques can be processed and cleared within a couple of days. Seeing the success of MICR technology in these 4 metros, which resulted in huge increase in efficiency and decrease in processing time, RBI decided to expand the number of MICR centers across the country. As of now there are about 66 MICR centers in the country.

2. Core Banking System (CBS)

The automation of banks in India started in 1981. However actual branch level automation started only during 1984-87. Based on recommendations of the Rangarajan committee, ‘Total Branch Automation’ (TBA) which connected the branches using a Local Area Network (LAN) started being implemented. However high costs involved and unfavorable employee union attitude still posed serious challenges for large scale bank automation. However post liberalization; the RBI made it compulsory for the new Private Players to
go for full fledged automation in order to qualify for getting banking licenses. These private sector banks introduced the concept of ‘Anytime Anywhere Banking’ by 1994-96 because of their Wide Area Network (WAN) based centralized banking platform. It was a novel concept for the Indian Banking Customers who till recent times had to stand in queues for hours for performing banking transactions. This emergence of core-banking resulted in great time and cost saving both from customer as well as the banks’ perspective.

Seeing the success of CBS most of the public sector banks as well started automating their branches and introducing core banking solutions to their customers. As of April 2011, most of the 82,000+ (including RRB’s and cooperatives) odd bank branches have implemented CBS while the rest are also in varying stages of implementation. The introduction of CBS made an account holder, a customer of the Bank rather than a customer of some particular Branch. Now he could avail banking facilities using his account from any of the CBS enabled branch of that bank, across the country.


3. **Speed Clearing (SC)**

It is yet another initiative of the RBI to facilitate faster clearance of the outstation cheques. Here the outstation cheques are cleared at the local centre itself and hence the need for physical movement of the cheques has been eliminated. This is has been made possible by the advent of CBS and hence the facility is available only to the CBS enabled branches which are connected through core banking. As there is no need for movement of cheque from presentation city to the Drawee city, the realization time for cheques clearing goes down for these outstation cheques from earlier 7-45 days to 2-3 days currently². In terms of coverage this facility is available at all the 66 MICR centers and covers more than 50,000 branches across the country³.

4. **Cheque Truncation System (CTS)**

The RBI is trying to replace Paper based clearing with electronic payment systems. However though the Paper based clearing accounts for only around 10% of the total value of transactions, it contributes close to 59% in terms of volume. As such at present, cheque based clearing cannot be whisked away and ignored. In order to enhance the cheque clearing process and based on RBI’s conviction to reduce the movement of cheques in paper format (which involves more time, cost and is also inefficient) RBI passed an amendment to the Negotiable Instruments Act, 1881 and came up with Cheque Truncation System (CTS). Under this method, a digital image of the cheque is generated and it is this image which is electronically transferred amongst the banks for clearing and not the actual physical-cheque. As of 2009-10 close to 12% cheques were being processed using CTS⁴.

It was initially introduced as a pilot project in the NCR region in February 2008. In the second phase NPCI will operationalize CTS in Chennai where it will be acting as a Cheque Processing Center (CPC) - collecting cheques from member banks and processing them. This Grid CTS at Chennai will allow member banks to present or receive cheques to or from various cities at a centralized clearing house.

The criterion for banks to become a member of the CTS centers are⁵:

1. They should be a member of the respective Bankers’ Clearing House.
2. They should have membership if the Indian Financial Network – InFiNet


However banks which do not have InFiNet membership can resort to either of the below mentioned ways⁶:

- a) Sub member banks can also participate through their respective member banks
- b) Indirect members can also participate by sending data and images for processing though they have to maintain separate accounts for settlement.

In essence this CTS results in time saving where in the earlier process of clearing, say a cheque from Kashmir had to physically move to Kanyakumari (in case of outstation cheques) which took lot of time and additional cost involved in transit, not to forget the delay in processing. However using the truncated cheque system, the digital image of the cheque is electronically transferred to the collecting bank through these CPSs and is cleared within minutes.

In order to address the security issues involved in the electronic movement of cheques in the digital format, RBI implemented the Public Key Infrastructure (PKI) which does cryptography using asymmetric key algorithms⁶. This encryption and digital signature ensures the security of truncated cheques in their digital format. Usage of secure user IDs and passwords along with smart card interfaces make this mode of clearing very secure.

5. **National Payment Corporation of India (NPCI)**

The Board of Payment and Settlement System (BPSS) established in 2005, recommended the establishment of National Payment corporation of India as a ‘Not-for-profit’ (Section 25) company. As such the NPCI was incorporated in December 2008. NPCI has been operating the NFS since October 15th, 2009. NPCI now oversees all the national retail payment system related issues and technology implementation like Speed Clearing, Cheque truncation, NEFT, RTGS, ECS, EFT, IMPS, ECCS, AEPS et al.⁷

6. **Express Cheque clearing system (ECCS)**

Currently the country has around 66 MICR locations which handle about 85% of the total cheques both by value and volumes. While the majority of around 1093 centers, are still using Magnetic Media Based Clearing Software (MMBCS) packages for automating their collection and settlement of cheques. On the demand by various banks for further
improving the cheque clearing process so as to handle multi-user inputs in a networked environment, graphic interface compatibility and core banking integration, RBI asked SBI to go ahead with the development of an ‘Express Cheque Clearing System’. This software package has been developed by an outside firm namely Image InfoSystems Private Ltd.

National Payments Corporation of India (NPCI) has been assigned the task of a full-scale roll-out of ECCS at all clearing locations (1093 centers), which must be achieved by September, 20118. Once implemented it will greatly boost the pace of cheque clearance and also lead to cost saving for the banks.

The new ECCS will comprise of features like9:

1. Speed Clearing from Day One
2. Full Unwinding
3. Encrypted Data Movement
4. Flagging duplicates
5. Return versus presentation

7. RBI Electronic Fund Transfer (RBI-EFT)

It is an initiative of RBI to offer account to account money transfer facility to the bank customers at any of the 15 EFT centers (Ahmedabad, Bangalore, Bhubneshwar, Kolkata, Chandigarh, Chennai, Guwahati, Hyderabad, Jaipur, Kanpur, Mumbai, Nagpur, New Delhi, Patna and Thrivananthapuram)10. Here funds can be transferred from an account of the depositor in one bank in a particular city, to an account of the beneficiary in the same or other bank, in the same city or in any other city- however both the cities must be an EFT center. RBI acts as an intermediary facilitating such transactions so that they can be processed faster. It facilitates fund transfer amongst any branch of the participating 27 public institutions (usually banks). It works on a Deferred Net Settlement (DNS) mode where transaction are allowed to accumulate and are then processed in bulk at particular times of the day viz. 6 times on normal working days and 3 times on Saturdays. So it offers 11 settlements on weekdays and 5 settlements on Saturdays which is done on an hourly basis for all the transactions accumulated in the past one hour. It was an advancement over the previous systems where the transactions were updated only at the end of the working hours of a day. Hence the accounts were adjusted and credited with money even during the working hours of the day. With introduction of NEFT, the State Electronic Fund Transfer was phased out and all banks earlier following SEFT were mandatorily supposed to shift to NEFT by January 2006. NEFT covers about 77,821 branches with the maximum number of per day transactions peaking at 1.4 million14.

Real Time Gross Settlement Systems (RTGS)

Launched by the RBI on March 26th 2004, RTGS is the mode of large value fund transfer from one bank to the other on a ‘real time’ basis i.e. the transaction is processed as it is transacted, without any waiting. It is done on a ‘gross basis’ which implies money transfer being done on a one-to-one basis and not waiting for the formation of a cluster of such transactions. Though no upper cap on the limit for RTGS has been specified, the lower limit is kept at Rs 1, 00,000.

The advantage of RTGS is that the funds are transferred on a near real time basis throughout the ‘RTGS service window’ for a particular day i.e. 9AM to 3PM on weekdays and 9AM to 12PM on Saturdays for customer transactions.11

RTGS as of June 2011, is available at around 77,093 branches across the country with 1.8 lakh transactions worth Rs 4 Trillion taking place daily12.

8. Next Generation real Time Gross Settlement (NG-RTGS)

Seeing the success of the RTGS model and the need to further improve upon the current transaction handling capacity of RTGS, the RBI on Feb 28th 2011 floated the Expression of Interest from parties for the implementation of Next Generation-RTGS. The existing RTGS Model had started in 2004 by handling close to 4,000 transactions per day which today handles more than 3,00,000 transactions on an everyday basis. While the proposed NG-RTGS will be equipped to handle 7 lakh transactions initially, escalate to 25 lakh transaction per day in next 5 years and ultimately to 50 lakh transactions a day by the next 10 years13. NG-RTGS is expected to be implemented within the coming two years and will prove to be a major boost in terms of providing a fast and efficient fund transfer mechanism to the country.

9. National Electronic Fund Transfer (NEFT)

Launched in November 2005, it is an online mode of transferring funds within India, amongst the financial institutions (usually banks). It works on a Deferred Net Settlement (DNS) mode where transaction are allowed to accumulate and are then processed in bulk at particular times of the day viz. 6 times on normal working days and 3 times on Saturdays. So it offers 11 settlements on weekdays and 5 settlements on Saturdays which is done on an hourly basis for all the transactions accumulated in the past one hour. It was an advancement over the previous systems where the transactions were updated only at the end of the working hours of a day. Hence the accounts were adjusted and credited with money even during the working hours of the day. With introduction of NEFT, the State Electronic Fund Transfer was phased out and all banks earlier following SEFT were mandatorily supposed to shift to NEFT by January 2006. NEFT covers about 77,821 branches with the maximum number of per day transactions peaking at 1.4 million14.

9- http://www.eccs.in/
11- http://rbidocs.rbi.org.in/rdocs/RTGS/PDFs/FAQs%20on%20RTGS.pdf
13- http://www.hindustantimes.com/Story/Page/Print/668575.asp
ECS is normally used for bulk fund transfers in the electronic format involving the service of a clearing house. Here either there are bulk outflows from a single account to several other accounts or fund inflow from several accounts into a single account. Common examples can be salary, pension, dividend, interest disbursement etc. or the collection of various bills (electricity; telephone), taxes (house; water; municipal) or fees (education; training etc). It causes both time and cost saving to the customers who can avail these services from the comfort of their home using Internet Banking or Mobile Banking and the amount gets debited or credited in a real time and one does not have to wait for documents to get processed. Banks also save money by saving time, effort and cost on the cumbersome document generation and processing. The average monthly volume of ECS transactions (Debit and Credit) is around 21.45 million which translates to Rs187.03 Billion 15

11. Institute for Development and research in Banking Technology (IDRBT)

Based on the recommendation of a committee on ‘Technology Upgradation in Payment Systems’ the Institute for Development and Research in Banking Technology (IDRBT) was established by the RBI in 1996. The main objective behind establishing it as a technology subsidiary of RBI was to streamline the efforts, on usage of technology in Indian Banking. IDRBT has been instrumental in introducing the much needed technologies like Indian Financial Network (INFINET), Public Key Infrastructure (PKI) based data transfer, Structured Financial Messaging System (SFMS), migration of INFINET to latest MPLS technology, Setting up of the National Financial Switch (NFS) to name a few. It is this NFS which today enables us to draw cash from any ATM of any bank at any location (even abroad) at any time- truly offering ‘Anytime- Anywhere’ banking.

Initially the IDRBT was providing ATM switching service to the banks through the National Financial Switch however in September 2009, the operation of NFS were transferred to NPCI.


12. Indian Financial Network (InFiNet)

Launched in 1999, INFINET forms the communication backbone for banking and financial services in India. All the banks (public, private and cooperative) as well as the Major Financial institutions are eligible to become members of this closed user group(CUG), IP VPN Layer 3 based, Multi Protocol Labor Switching (MPLS) network. It is a satellite based wide area network (WAN) which uses the VSAT technology. The Hub of INFINET is maintained by IDRBT at Hyderabad 16

The INFINET network will act as a gateway for providing services like ECS, EFT, POS NEFT, RTGS, AEPS etc. 17

13. Structured Financial Messaging System (SFMS)

It was launched in December, 2001 by IDRBT to provide a common messaging solution and to act as a platform for inter bank as well as intra bank communication. It is essentially a domestic financial messaging base which can be used for secure communication within the bank and between the banks. It is very useful in providing support to a number of applications like Electronic Fund Transfer, (EFT), Real Time Gross Settlement (RTGS), Centralized Fund Management, and Delivery versus Payment (DVP) 18 etc. Its user friendly Application Program Interfaces or the API’s enables an easy integration of the current applications with the future applications and their shared usage on the Corporate Intranet. Hence SFMS provides a safe and secure communication channel for the banks thereby reducing the risk, time and cost involved in otherwise performing such communication. The best advantage of SFMS however is that it is not limited to fully or partially computerized branches and can very well be used by remote branches of the banks. It works through PSTN/ISDN or through leased lines.


14. National Financial Switch (NFS)

NFS was setup by the IDRBT on august 27th, 2004 for facilitating connectivity between the Banks Switches and ATM’s and to function as an inter-bank payment gateway, authenticating and routing the financial transactions. Its key role was to provide interconnectivity to the ATM’s across the country so that ATM transactions could be processed and reflected in real time. It is because of this NFS that today we are able to perform ATM transactions other Banks’ ATM as well. Not only this we can use the ATM cards of Indian Banks and do fund transfer through ATM’s abroad. In 2009, based on recommendation of ‘Board for regulation and supervision of Payment and Settlement Systems’ (BPSS) the operations of NFS were handed over to NPCI. As of April 2011, the NFS connects over 75,178 ATM’s in India. 19

15. Electronic Benefit Transfer through Smart Cards

In order to motivate the banks to open accounts for the BPL citizens, which would be used for smart card based Electronic Benefit Transfer, RBI devised a plan under which it pays a bank, an amount of Rs50 for every such account opened. Such smart cards can be used by the government for electronic benefit transfer wherein payments of social security benefits, NREGA payments or other government benefits for the BPL citizens will be directly routed to these accounts. This model of Electronic Benefit Transfer through smart cards had been launched on a pilot basis in AP in 2008 and has been extended to states like Karnataka and Uttarakhand. Under this model the intermediaries involved in transfer of benefits from government to the recipients will be eliminated. This in turn ensures that the people get...
exactly the amount which is released by the government without any leakage and that they receive it much faster\textsuperscript{20}.

The government wants to provide multi-application smart card systems which will serve as a repository of personal information, biometric data for identification, which can be scaled up as social security cards, and at the same time also help in performing financial transactions.\textsuperscript{21}

20-\text{http://finmin.nic.in/the_ministry/dept_fin_services/banking/banking_financialincl.pdf}
21-\text{http://www.hindu.com/2006/09/03/stories/20060903057113 00.htm}

16. Mobile ATM’s

Technology has enabled usage of Automated Teller Machines (ATM’s) which have largely decreased the burden of day to day financial transactions of the banks. Popularly called ‘\textit{Any Time Money}’, these kiosks have gone a long way in widening the reach of financial services across the country. Introduction of National Financial Switch (NFS) has interconnected the network of ATM’s across the nation and enabled real time updating of the accounts and interoperability of banks ATM’s. As per the recent data, the Total volume of transactions through our network of 82,000+ ATM’s is 4.7 million which translates to 2.5 billion worth of financial transactions\textsuperscript{22}

It is a result of this that bank customers who were earlier restrained to only one branch, later by CBS started baking with any branch of their bank and now, can transact with an ATM of any bank within India (even abroad). Not only this, nowadays one does not even need to visit an ATM; rather ATM machines mounted on mobile vehicles will themselves reach you. These mobile vehicles may prove useful in expanding the reach of banking in the rural un-served areas.

Hence introduction of Mobile ATM’s has lead to considerable time and cost saving for the Indian customers, while at the same time proving helpful in realizing the governments dream of Financial Inclusion.

17. Mobile Banking

Considering the boom in the usage of Mobile phones across the country, and the deep penetration Mobile telephony has achieved even in the far flung rural areas, RBI is seriously considering the option of providing banking facilities to the customers through mobile banking. As of June 2011, the total number of wireless mobile subscribers is 851.70 million of which 289.57 million mobile subscribers are from rural areas which presents a huge possibility of taking baking to the rural India through mobile telephony\textsuperscript{23}.

Mobile banking will help customers in availing banking services like fund transfer, account enquiry, giving specific account related instruction etc. RBI in India has focused on providing mobile banking from Banks point of view and not from the Mobile Operator Point of view. The bank customer may activate his account for performing mobile banking. He may have to download specific application through which he can interact with his bank using GPRS or SMS as supported by the application. Another form of Mobile Baking is by the usage of 3\textsuperscript{rd} party applications like ‘\textit{atom, ngpay}’ et al.

22-\text{http://www.rbidocs.rbi.org.in/rdocs/Speeches/PDFs/FIBAC 250811.pdf}
23-\text{http://www.trai.gov.in/WriteReadData/trai/upload/PressRele ases/835/Press%20Release%20June11.pdf}

18. Plastic Money (Credit and Debit Cards)

The advent of technology has given us a very powerful tool for performing our day-to-day financial transaction without having to rush to the nearby banks or carrying large amount of cash with us. The credit card and debit card are linked to a persons account and the daily withdrawal limit for each of them is specified.

While credit cards enable us to make POS purchases or even withdraw cash even if there is not enough balance in our accounts (in the form of a loan) the debit card works on the principle of direct debit of the amount from the account. With the growth of private sector banks in India, we also witness a rapid growth in the usage of debit, Credit and ATM cards. As of June 30, 2011, the total number of Credit cards in 1.76 crore while the total number of debit cards equals 23.95 crore. Similarly there was a surge in the value of transaction performed during June 2011 compared to June 2010 where credit card transactions amounted to 5,538.75 crores and debit card transaction for the month amounted to 3783.88 crores a rise of more than 45\textsubscript{o}.

Credit and Debit cards have become an integral part of the wallet of Indians today where most people prefer to move about light (carrying low cash). Hence these offer a safer alternative to people who earlier had to carry cash can now simply carry a small plastic card for performing their financial transactions. It results in cost advantage, time advantage as well as an advantage from security point of view. These cards can also be used in performing POS purchases, online purchases or mobile baking.

19. RuPay Cards

Across the World, Master and Visa cards are the two global payment gateways and they more or less operate as a duopoly. In china, the government recently introduced there own version of the payment network called ‘\textit{Union Pay of China}’. On similar line the GOI in collaboration with NPCI intends to launch RuPay cards (the domestic version of Master/Visa) which will provide a secure, national payment network and in due course all the credit and debit cards across the country will be migrated to the RuPay network. The rationale behind this is that each year the countries banks have to pay a hefty sum of approximately 400-500
crores for their services extended. While on the other hand the service charge for RuPay network based cards will be a nominal 0.3%. RuPay based cards have already been launched on a pilot basis for 4 smaller RRB and Cooperative banks.25


20. Inter bank Mobile Payment System (IMPS)

Launched in November 2010, IMPS offers 24x7 interbank electronic fund transfer using mobile phones. The transactions are routed using the National Financial Switch managed by NPCI. Desirous customers of the 28 participating banks need their Mobile Money Identifier (MMID) and MPIN for performing their transactions. They IMPS can be accessed either by sending an SMS to the designated numbers or it can be done through GPRS using the downloaded application. Currently Axis Bank has issued the largest number of MMIDs which gross to around 44.8 lakhs.26

Banking facilities on the fingertips, benefits the people who are always on the move and have time constraints, as well as the people residing in remote areas with limited banking infrastructure (branches) in their vicinity.

21. Core Banking Solution in RBI

In April 2011, the RBI chose Polaris Software Lab to implement intellect Core Banking System across the RBI branches. This will facilitate better coordination amongst the 22 regional offices of RBI spread across the country and speed up the reconciliations of transaction between RBI with other banks or the GOI itself. The contract for the same has been awarded to Polaris Software Labs Chennai for a sum of $55 million. The contract is for system integration and maintenance for a period of 10 years. The main objective behind switching to CBS is to align their current and future IT initiatives.

22. Stored Value Cards for Public Utility Payments

In such cards the monetary value (money) or data is physically stored on the card and can be accessed using the magnetic strip on the card. These cards can come handy in day to day business like purchasing platform tickets, metro or local transport tickets, while crossing toll booths etc.

We can make used of RFID technology to provide contactless payments wherein the money will automatically be deducted from these stored value cards once they pass a detector which detects the presence of an RFID enabled Stored Value cards. It can bring a revolutionary change in terms of time saving for people who have to spend hours in queue just to purchase items like entry tickets for availing public utilities. Examples of similar stored value cards are Octopus Card, Hong Kong; Oyster Card, London; FeliCa, Japan; NETS, Singapore et al.


23. Near Field Communication (NFC)

Its an upcoming technology which is expected to dominate the way we make retail payments in the future. Say for example after purchasing grocery from a superstore you bring your Smartphone which has NFC chip embedded in it, close to an NFC reader at the counter and the mobile which is already linked to your bank account acts like a credit card and the amount will be deducted from your account. The NFC based payment system may be used for buying transportation system tickets, entering amusement parks, or simply accessing a vending machine.

FINANCIAL INCLUSION THROUGH TECHNOLOGY

The government of India’s ambitious project ‘Aadhar’ under the purview of UIDAI headed by Mr. Nanadan Nilekani aims to provide each Indian citizen with a unique identification number. In the process some biometric data of the person will also be captured. This biometric data (say finger print) forms the basis for identity authentication as and when needed.

RBI’s goal of Financial Inclusion has been aligned with the project Aadhar so as to come up with a model that can take banking to the masses. As already pointed by several scholars and economists, Financial Inclusion cannot be brought by merely opening up of more branches. It is more important for the providers of banking facility (both banking and non-banking organizations), to earn the trust of customers. This can be done by educating them and providing them with a banking solution which is based on the 5 A’s of Banking.

Availability: relates to the presence of banking network which provides an array of products and services to customers.

Accessibility: is about increasing the reach of the banking network to reach the poorest of the poor, i.e. the bottom of the pyramid so that financial inclusion can be realized in its true sense.


Acceptability: Another critical aspect of this is that the banking offering we make to our rural customers should be acceptable to them in the same form. They should not have any inhibitions with regard to the understanding, security or reliability issues relating the offering (for example the technical details of the AEPS)

Affordability: Again it is important that our approach to reach out, to those who have not yet been exposed to the facilities of banking, should be uniquely positioned so as to
offer a clear cost advantage to the customers. The services should be inexpensive but reliable.

Awareness: it implies that our target customers should be made aware of the minute details of this new fund transfer model (transparency) and also to make them aware of the need to integrate this model as a way of performing financial transactions in their lives.

In this regard the UIDAI introduced AEPS as a tool to take banking to the masses.

24. Aadhar Enabled Payment System (AEPS)*

The expert committee of IDRBT under the guidance of Mr. Nandan Nilekani, Chairman UID Aadhar Project, proposes a very efficient and inexpensive model for bringing banking to the remote rural areas. The model involves the use of Business Correspondents belonging to a bank, who will be carrying handheld mobile units and a fingerprint reader (or any other biometric device). They will act as authorized agents of the bank, performing the banking transactions for the rural Indians just like MicroATM terminals and provide the users with (no-frills account), basic financial transactions like withdrawal, deposit, fund transfer and balance enquiry. The identification infrastructure for an individual will be provided by the Unique Identification (UID) program. The BC will in turn transact with the banks using the existing channels like ATM, mobile or Internet banking. An added advantage of the service is that the customers will get the transactions performed in real time and will be given transaction confirmation receipts for record.

This unique Indianized model will go a long way in realizing the goal of Financial Inclusion by bringing banking to the masses. As of now, 3 major banks namely ICICI Bank, Bank of India and Union Bank of India are members of the pilot testing team for implementing AEPS. The Model has already been launched in Jharkhand for Pilot Testing by the NPCI.

The government aims at having at least 2 MicroATMs in each village of India which translates to around 14 lakh MicroATMs. Already over 60 banks have enrolled themselves to be a part of the AEPS. 28


The in order to perform an AEPS based transaction; the remitter needs to input his details like*:

1. IIN (to identify the bank to which the customer is associated)
2. Aadhar number (to identify the account holder)
3. Fingerprint of customer (captured during enrollment), for authentication.
4. Amount

And also the beneficiary details like:

1. His Aadhar number
2. ISO IIN (Issuer Identification Number)

It will be implemented in 2 phases. In the first phase the customer of Bank A needs to visit a BC of Bank A only, through whom the fund can be transferred to a customer of any bank.

In the second phase of introduction, a customer of Bank A may go to a Business Correspondent center of any bank and have funds transferred to another customer of any bank.

However some of the challenges and recommendations that can be identified from this model are:

1. Clarifying the roles and responsibilities of the Business Correspondent (BC). Also to give clear guidelines about taking their services (as an agent) by the principal banks.
2. Motivate banks to focus on lending to the low profitable BOP customer base.
3. Set targets for large private sector commercial banks for the implementation of AEPS
4. Weave the framework of Banking by big Corporate Houses around financial inclusion so that Indian Banking can leverage on their capital and technology, for penetrating far flung unbanked areas

"http://www.idrbt.ac.in/publications/brochures/annul_report_09-10.pdf
"http://m.timesofindia.com/PDATOI/articleshow/9751045.cms-
25. POSTAL BANKS

In consultation with RBI the GOI intends to harness the network of post offices across the country, to provide banking services to the customers. The huge existing infrastructure of more than 1.5 lakh post offices which reach the far flung corners of the country, shall prove to be a very efficient model towards achieving financial inclusion. Post Offices have been dealing with financial instruments like ‘kisan vikas patra’, ‘post office deposits’, ‘public provident funds’ etc. even in the past. However now the focus is on converting each of these post offices into full fledged banking centers.29

To quote the then telecom minister Kapil Sibal “The State Bank of India can’t build branches all over India, but there are post offices across India. The branches are already there, so infrastructure expenditure is not required. So you can actually give banking facilities at relatively lower costs, which would be extremely beneficial to people.” 30

In this manner the infrastructure of post offices will be able to support banking and hence also increase its profitability by diversifying into a newer business unit. The savings bank accounts will be connected by core banking and provide a whole range of services to the customers.

However despite the good intentions and policies in place, the idea of using of post offices as banking service providers is not gaining popularity. There appears a need to educate the customers with respect of the same through a well designed marketing campaign. Also the issues of integration of Postal and Banking Services, division of task among the employees, psychological reluctance on part of customers and employees also need to be addressed.

29- http://www.indiapost.gov.in/Netscape/Banking.html

Here again the role of technology in simplifying the processes using CBS, micro or Full Fledged ATM installations within Post office premises may prove cost and time effective. This can also serve as a channel for the government to reach out to the rural population for disbursement of benefits in the form of subsidies, micro credits, NREGA payments etc. Besides it also provides the rural population an alternative to borrowing money from the exploitative informal lending channels.

CONCLUSION

Directly linked to the growth of the country is its growth in the quantum of financial transactions taking place, internally as well as with the outside world. In order to support the growing needs of a faster, cheaper and efficient banking service to the Indian Citizens, several steps were taken by the RBI.

The focus however has been on the deployment of latest technology in the Indian Banking so that we can take banking to the masses in an efficient manner. It is important to resort to technology considering the scale of operations of Indian Banking which can only be supported by a robust and time tested technological platform. Over time the RBI has introduced several IT related initiatives either directly or through its Research and Technology wing IDRBT. It is important to keep track of the happenings which are currently occurring in the global scenario, in terms of retail payment and settlement so that the benefits can be passed over to the multitude of Indian customers in faster and more economic manner. Certain developments like use of ’Stored Value Cards’ or Near Field Communication which are gaining popularity abroad need to be infused in the Indian Banking as well.

The Vision of GOI to attain Financial Inclusion has not only social but also immense economic importance. The true mettle of the country can only be realized when each and every citizen contributes to the process of ‘Nation Building’. The technology initiatives which have been highlighted in this report are some of the measures taken by RBI and GOI to attain the same.

At the same time, India can also present worthy examples of implementation of banking technology before the world by means of its ambitious projects like Aadhar Enabled Payment System (AEPS)

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4. Department of Information Technology, June 2007, Financial Sector Technology Vision, RBI
5. UIDAI, 2011, “FAQs for Customers by AEPS”