Enabling superior m-health project success: a tricountry validation

Nilmini Wickramasinghe*

Center for the Management of Medical Technologies (CMMT)
Stuart Graduate School of Business
Illinois Institute of Technology
565 W Adams St., Suite 405
Chicago, IL 60661, USA
Fax: +1 312.9066549
E-mail: nilmini@stuart.iit.edu
*Corresponding author

Steve Goldberg

INET International Inc.
131 Glen Crescent
Thornhill, Ontario, L4J 4W4, Canada
E-mail: sgoldberg@inet-international.com

Rajeev K. Bali

Faculty of Engineering and Computing
Coventry University
Priory Street, Coventry
West Midlands CV1 5FB, UK
E-mail: r.bali@coventry.ac.uk

Abstract: The healthcare industry is facing increasing pressures to embrace new technologies that support greater patient access to, and higher quality of (but at the same time offer cost-effective), healthcare delivery. This pressure has spawned a plethora of initiatives to embrace the possibilities and potentials of technologies to develop and then diffuse new devices, new pharmaceutical products and support minimal invasive surgical techniques that will facilitate superior healthcare delivery. Pursuing such initiatives from idea generation to commercialisation and adoption, however, also necessitates new alliances between academe and industry to ensure rigorous research followed by rapid diffusion to support the realisation of these initiatives so that the patient becomes the ultimate beneficiary. This in turn requires new research methodologies for such applied research scenarios. The Accelerated Mapping-to-Realisation (AMR) methodology is used as an appropriate knowledge-based methodology to ensure academic rigour and validation and also facilitate rapid diffusion and commercialisation of m-health initiatives.

Keywords: accelerated e-business project; applied research; Accelerated Mapping-to-Realisation (AMR) methodology; knowledge-based methodology; m-health; wireless healthcare solutions; healthcare; services; standards.

Reference to this paper should be made as follows: Wickramasinghe, N., Goldberg, S. and Bali, R.K. (xxxx) 'Enabling superior m-health project success: a tricountry validation', *Int. J. Services and Standards*, Vol. X, No. Y, pp.000–000.

Biographical notes: Dr. Nilmini Wickramasinghe is an Associate Professor and Associate Director of CMMT at the IIT. She researches and teaches in several areas within MIS and specialises on the impacts of technologies on the healthcare industry. She is well published with numerous referreed papers and regularly presents her work throughout North America, as well as in Europe and Australasia.

Steve Goldberg is the Founder of INET International Inc., a technology management consulting firm in 1988. Today, he is the President of INET, overseeing INET online data collection services for global market research studies, and delivery of INET mobile e-health projects. He also produces an annual INET miniconference as an executive forum for wireless healthcare.

Rajeev K. Bali is a Reader in the Faculty of Engineering and Computing at the Coventry University in the UK. He is the Founder and Head of the Knowledge Management for the Healthcare research subgroup, which works under the Biomedical Computing and Engineering Technologies Applied Research Group (BIOCORE). His primary research interests are in clinical and healthcare knowledge management, clinical governance and medical informatics.

1 Introduction

Healthcare is facing tremendous pressure globally to significantly stem escalating costs and contemporaneously make dramatic improvements with regard to increasing the quality of healthcare delivery. Many believe global healthcare is facing a major crisis (National Coalition on Healthcare, 2004; Pallarito, 1996; European Institute of Medicine, 2003; World Health Organisation Report, 2000; Kyprianou, 2005; Frost&Sullivan, 2004; Plunkett, 2005; OECD, 2004; National Center for Health Statistics, 2002; Russo, 2000). The Chinese word for crisis is made up of two characters: the first meaning challenge, the second meaning opportunity. Both terms are most suitable to describe the current dynamics faced by healthcare.

As technology continues to advance at an exponential rate, we see evidence of more and more possibilities for innovative applications of these technologies in the healthcare domain. The opportunities for technology-enabled devices, more effective pharmaceutical drugs and new developments in minimally invasive diagnostic and surgical techniques represent the three primary areas for investment in R&D in healthcare (LAcroix, 1999; Lee *et al*., 2003; Blair, 2004; Kulkarni and Nathanson, 2005; Wickramasinghe and Silvers, 2003; Wickramasinghe and Mills, 2001). Ultimately, the challenge is to move from a good idea to commercialisation of the product so that the patient can be the ultimate beneficiary and the healthcare industry can address its current crisis. Integral to moving from idea to commercialisation is the development of new collaborations between academe and industry to foster applied research as well as new methodologies that ensure rigour and acceleration of potentially long test and trial periods. We illustrate the power of this approach with the example of the Wi-INET model for m-health.

LAcroix or Lacroix?

The paper is organised as follows. First, the Wi-INET business model is presented, which has been developed after compiling the results from longitudinal research starting in 2001. From this, the background to the INET-academe longitudinal study is given. The Accelerated Mapping-to-Realisation (AMR) methodology is then presented as an appropriate knowledge-based mapping methodology for the dynamic and complex healthcare context. Then a specific case study is mapped into the model using the AMR methodology. The mapping exercise illustrates the power of a knowledge-based methodology that is both robust yet flexible to ensure success in a healthcare setting. A further example from a different healthcare context in Europe is provided to illustrate the generalisability of this approach to any healthcare context. Finally, conclusions are drawn and recommendations made that AMR should become a standard methodology in the context of healthcare initiatives.

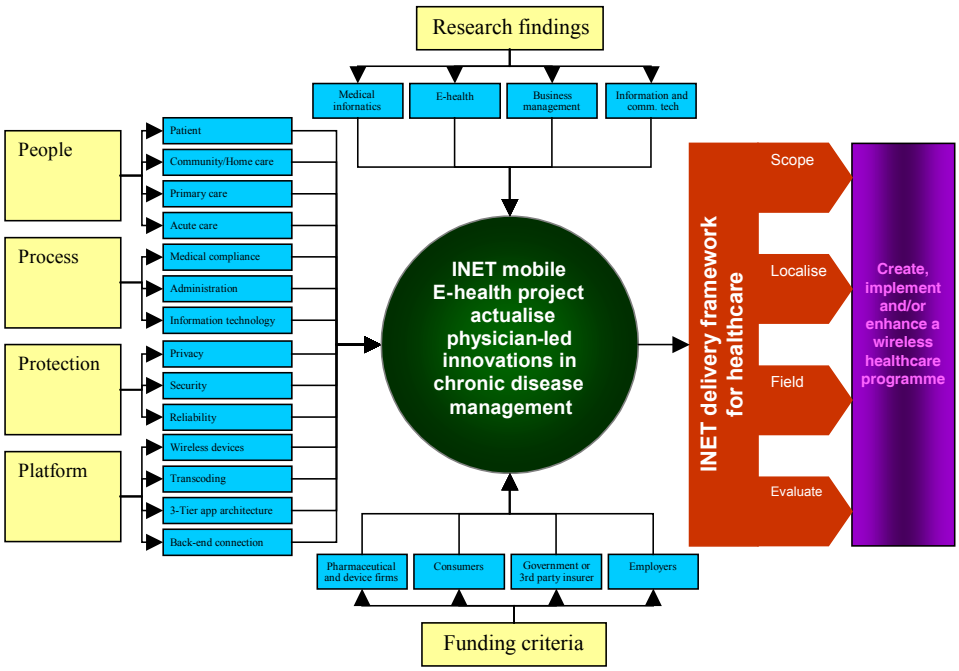
2 Wi-INET business model for m-health

Successful m-health projects require consideration of many components. Figure 1 provides an integrative model for all key factors that we have identified through longitudinal research commenced in 2001 as being necessary in order to achieve m-health excellence (Wickramasinghe *et al*., 2005; Goldberg *et al*., 2005a; Goldberg *et al*., 2005b; Goldberg *et al*., 2005c; Goldberg *et al*., 2005d; Goldberg *et al*., 2005e; Wickramasinghe and Goldberg, 2004).

2005 or 2006?

Please provide references.

Figure 1 Wi-INET business model



Specifically, the traditional sociotechnical components of people, process and technology served as the starting point (Nadkarni, 2004). However, when translated to a healthcare setting, the people component must include patients as well as the major types of cares setting such as acute care, primary care and home care. The process requires a depth of understanding of medical, administrative and IT issues as well as the confluence of these areas. In today's healthcare context with Acts such as the Health Insurance Portability and Accountability Act (HIPAA) in the USA, it is vital to have a protection perspective that addresses privacy, security and reliability considerations. Finally, the technology considerations are all found under the platform component, which makes up the fourth P in the model (Figure 1). For any healthcare initiative to move successfully from idea to realisation, it is also important to include two other components: the research and funding components. Without either of these, it is not possible to enjoy a successful result. Taken together then, the 4Ps plus the research and funding considerations make up the essential elements of the Wi-INET business model. This model enables and supports the delivery framework; *i.e.*, the wireless or m-health diabetes solution as depicted in Figure 1.

What makes this model unique and most beneficial is its focus on enabling and supporting all areas necessary for the actualisation of Information and Communication Technology (ICT) initiatives in healthcare. By design, since fundamentally this is a business model, the model identifies the inputs necessary to bring an innovative chronic disease management solution to market. These solutions are developed and implemented through a physician-led mobile e-health project. This project is the heart of the model to bridge the needs and requirements of many different players into a final (output) deliverable – a 'Wireless Healthcare Programme'. To accomplish this, the model is continually updated to identify, select and prioritise the ICT project inputs that will:

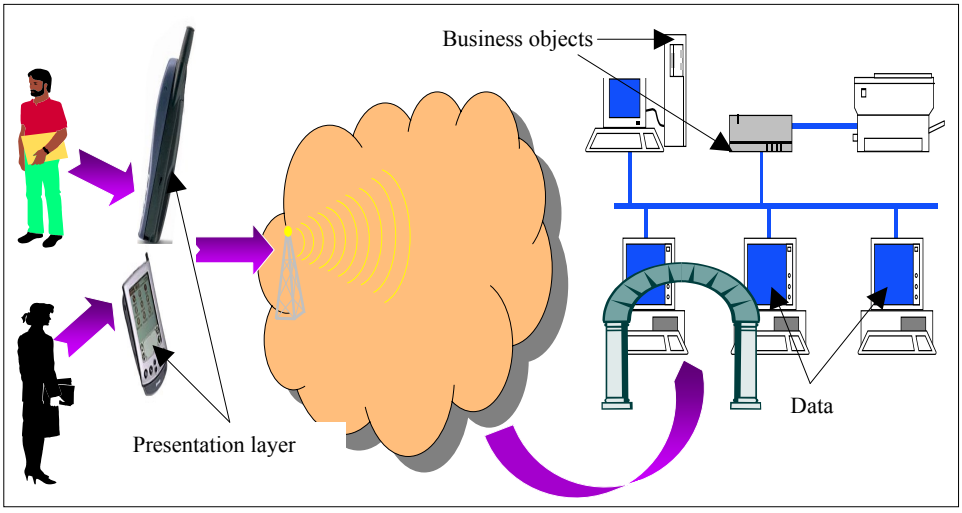
- accelerate healthcare system enhancements and achieve rapid healthcare benefits. The model identifies the key healthcare system inputs with the four Ps:
  - a *P*eople that deliver healthcare
  - b *P*rocess to define the current healthcare delivery tasks
  - c *P*latform used in the healthcare technology infrastructure
  - d *P*rotection of patient data.
- close the timing gaps between information research studies and its application in healthcare operational settings.
- shorten the time cycle to fund an ICT project and receiving a return on the investment.

2.1 IT architecture and standard mobile environment

By adopting a mobile/wireless healthcare delivery solution, it is possible to achieve rapid healthcare delivery improvements, which impact both the costs and the quality of healthcare delivery. This is achieved by using an e-business acceleration project, which provides hospitals a way to achieve desired results within a standardised mobile internet

(wireless) environment. Integral to such an accelerated project is the ability to build on the existing infrastructure of the hospital. This then leads to what we call the 3-tier web-based architecture (Figure 2).

Figure 2 Three-tier architecture



Source: Adapted from Wickramasinghe and Misra (2004)

In such an environment, Tier 1 is essentially the presentation layer, which contains the *web browser*; no patient data is stored within this layer thereby ensuring compliance with international security standards/policies such as the HIPAA. Tier 2, *business objects hosted on an application server*, provides the business logic including, but not limited to lab, radiology and clinical transcription applications, Messaging of HL7, XML, DICOM and other data protocols, and interface engines to a Hospital Information Systems (HIS), Lab Information Systems (LIS), Radiology Information Systems (RIS), as well as external messaging systems such as Smart Systems for Health (an Ontario healthcare IT infrastructure project). This latter messaging feature may also be included in Tier 3, which consists of the back-end *database servers* such as Oracle, MySQL or Sybase.

3 Collaboration between academe and industry

The Wi-INET project represents a longitudinal project that is striving to bring the benefits of m-health to several patient groups. The benefits of mobile or wireless healthcare are indisputable, however, much testing and compliance validation is necessary before the idea reaches commercialisation. To facilitate this process and ensure a high level of rigour throughout, a unique collaboration with industry and academe was formed. The key aspects of the collaborative rigour are detailed in Table 1.

Table 1 Collaborative rigour elements

Industry rigour	*Academic rigour*
ICT project experience	Data collection protocols
Standardised delivery practices	Research design and analysis
Creation of competitive advantages	Peer review process for publication of papers

4 Applied research

The Wi-INET project represents an applied research study. One definition fits INET practices extremely well. This definition is:

> "aimed at gaining knowledge or understanding to determine the means by which a specific, recognised need may be met. In industry, applied research includes investigations oriented to discovering new scientific knowledge that has specific commercial objectives with respect to products, processes, or services. [National Science Foundation, Directorate for Social, Behavioural & Economic Sciences, US definitions for resource surveys 1996]."

It is INET's goal to use applied research to accelerate the development of ICT products that can be commercialised, or at least made available to humankind for practical benefit.

Essential to the success of INET's goal was the development of the e-business acceleration project.

5 E-businesses acceleration project background

Understanding the need for an e-business acceleration project, starts with the core practice in ICT project delivery, the System Development Life Cycle (SDLC). Typically these are one- to five-year cycles that focus on reengineering large and complex business processes. When engaging in these projects, major changes occur in the way people work, the way they are compensated, and the way they engage others in the delivery of goods or services. Once an organisation engages in a SDLC project, they quickly formalise a change management team to prevent potential disruptions to delivery because of process, organisational and technology change. Unfortunately, even with this attention to rigour and taking into consideration the people issues, it is well documented that many of these SDLC projects fail.

The Standish Group International or Standish Group International?

A closer look at the reasons behind these failures can be found in papers, such as the Chaos Report (The Standish Group International, 1994). The scope and approach of this landmark survey provides expert comments on IT project failures. It was conducted among 365 IT managers from companies of various sizes and in various economic sectors.

Would you consider changing this to "factors for impaired projects" or "project impairment factors"?

Opinions about why projects are impaired and ultimately cancelled rank incomplete requirements and lack of user involvement at the top of the list. Please refer to Table 2 for a list of project impaired factors.

Table 2 Project impaired factors

Project impaired factors	*Percentage of the responses (%)*
Incomplete requirements	13.1
Lack of user involvement	12.4
Lack of resources	10.6
Unrealistic expectations	9.9
Lack of executive support	9.3
Changing requirements and specifications	8.7
Lack of planning	8.1
Did not need it any longer	7.5
Lack of IT management	6.2
Technology illiteracy	4.3
Others	9.9

Can this be changed to "Project no longer needed"?

To increase project success, INET created an e-business acceleration project to narrow down the SDLC project scope from meeting hundreds or even thousands of requirements to just a few high-impact requirements. As a result, INET projects:

- engage users very early in the project to identify, prioritise and select the right set of requirements the first time and apply internet and wireless technology to maximise user involvement.
- minimise the need for resources in technology, process and people by developing an ICT application that can be developed, tested and Quality Assured (QAed) within days.
- demonstrate results early with a pilot project to set realistic expectations to achieve executive sponsorship faster, and prevent changes to requirements once in field.
- release low cost, simple-to-use, pervasive and commercialised ICT solutions to make planning much easier and significantly reduce technology education costs and time cycles.

The purpose is to reengineer a large and complex delivery process in small manageable chunks, in a much shorter time cycles, with a minimum impact on the way people work. Once a couple of projects are successfully accepted by the user community, many INET projects can happen concurrently to scale results and accelerate SDLC achievements. This is presented in Figure 3: refocusing the SDLC.

On 10 May 1999, the INET method was first documented as an INET delivery framework. In this document it shows how INET realigns the systems development life cycle steps into concurrent e-business acceleration steps.

Today, the INET delivery framework has been updated with an INET mobile e-health project. A brief description of the mobile e-health project is presented in Figure 4. This is a more detailed look at one of the circles in Figure 3 labelled as e-business acceleration projects.

Figure 3 Refocusing the SDLC

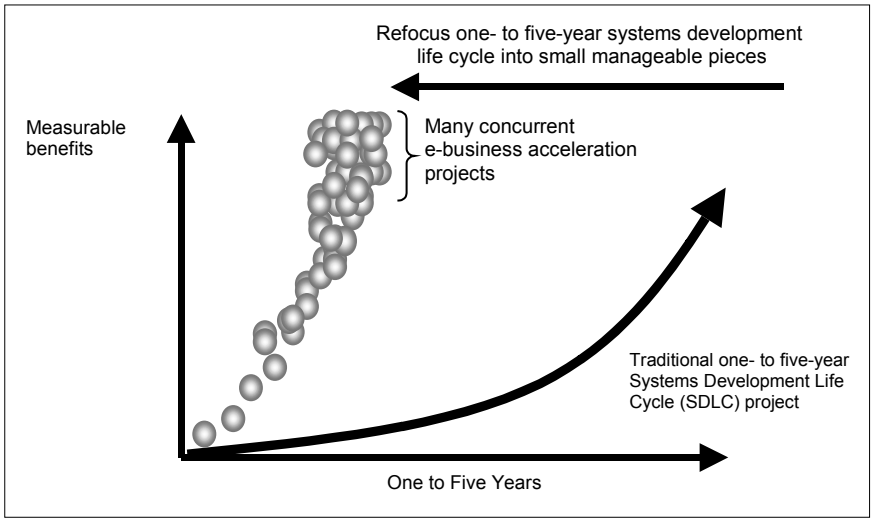


Figure 4 INET delivery framework for healthcare

"Physician-led"?

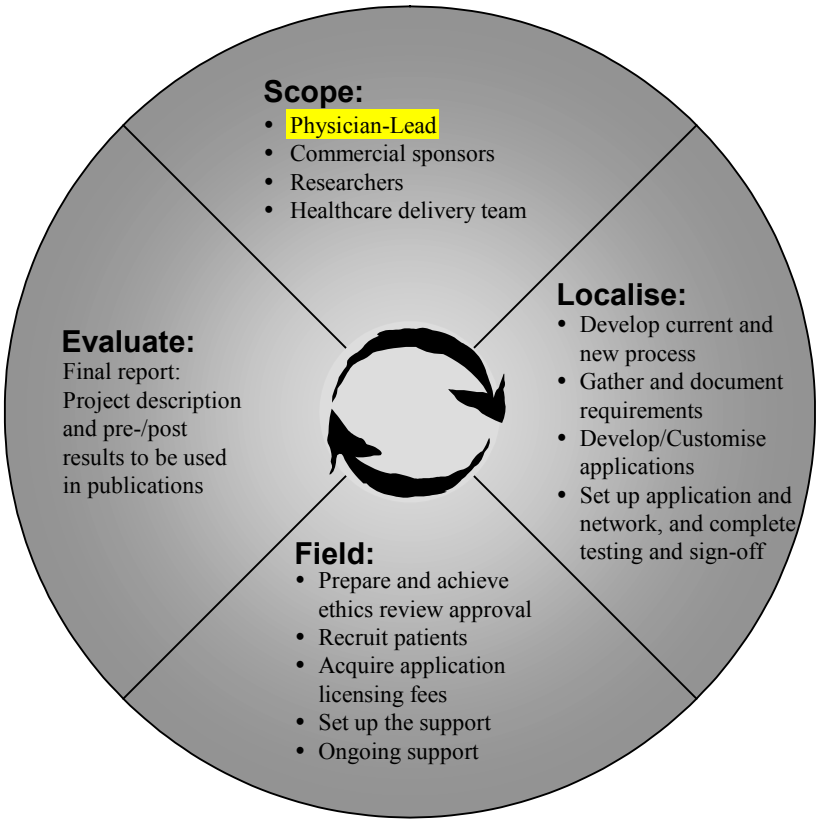


Table 3 INET delivery framework

SDLC (waterfall)	*INET mobile e-health project*			
	Scope	*Localise*	*Field*	*Evaluate*
IT role and responsibility	Project management Business analysis	Data analysis Technical tools expert Programmer Data administrator Network architect Database administrator Network administrator	Technical support	Account manager
Investigation	Problem definition Feasibility study – can objectives be met at a reasonable cost? Project definition			Document solution, data analysis of outcomes, benefits and next steps
Analysis (Logical design)		Define what the IS must do to fix the problem Less temptation to follow existing practices which may not be best Define the user's requirements and priorities analyse existing system Develop logical design for the new system		

Table 3 INET delivery framework (continued)

SDLC (waterfall)	*INET mobile e-health project*			
	Scope	*Localise*	*Field*	*Evaluate*
Design (Physical design)		Define how the new system will work		
		Detail schedule and budget		
		Produce a physical design showing system inputs, outputs, user interfaces		
Implementation		Research technology	User's manual	
		Product acquisitions	People changeover tasks	
		Test programmes, subsystems and systems	Data conversion	
		Acquire or develop software	Technical changeover tasks	
		Code programmes		
		Software developer manual		
		System operators manual		
		Purchase and install hardware and software package		
Maintenance		Fix problem/solution determination	Fix database, network and third party products	
			Fix security and access problems	
			Fix learning curve time disruptions	
			Fix collaboration problems	

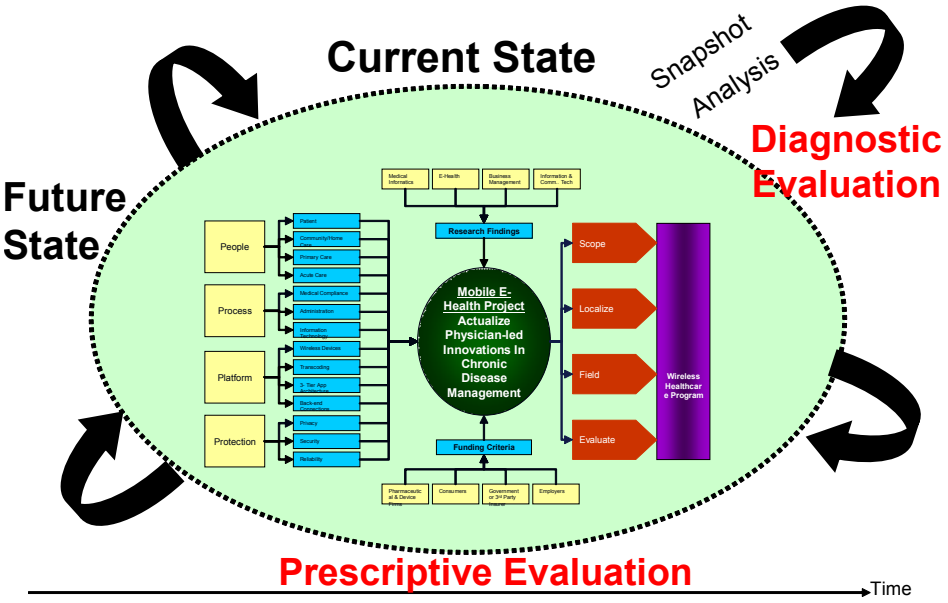
Table 3 'INET Delivery Framework'[1] shows how SDLC tasks are mapped to the INET mobile e-health project. This presents the mechanics on why the gradient is much steeper with the accelerated projects versus the SDLC in Figure 3. The mapping exercise in Table 3 shows where the realignment, by design, forces most of the SDLC tasks to be done concurrently. When reading the chart, the descriptions in the grid describes the typical SLDC waterfall tasks. Traditionally these tasks are done sequentially, with the possibility of each task taking many days or months to complete. For INET the key to success is working with independent technology players that have successfully completed these tasks for other clients, are highly responsive in meeting client demands, and with experience in completing tasks quickly. A good example are Application Services Providers (ASPs) that have the networks and application development systems installed and tested, and can prepare and launch new applications, securely over the internet within hours. Another key success factor for INET is having a rigorous process to identify, prioritise and select a couple of high-impact requirements at a time which breaks up the SDLC into much smaller chunks. As a result the overall impact dramatically shifts the SLDC time cycle into an almost vertical incline as shown in Figure 3 (the grouping of concurrent e-business acceleration projects, which today in healthcare are called INET mobile e-health projects).

The INET e-Business acceleration project success has been documented in healthcare (Wickramasinghe and Goldberg, 2004). It meets the need to enhance healthcare delivery, under a medical model, in making small incremental changes and scale success with international peer review and acceptance and provides an excellent practice delivery framework for all wireless initiatives.

6 AMR methodology

The final aspect from the applied research initiative was the development of the AMR methodology. In order to support the time frame of the e-business accelerated project, as well as ensure the highest possible rigour, it was necessary to develop an appropriate methodology that was both flexible and robust. Again, benefiting from the academe/industry collaboration, the AMR methodology was developed. The idea of the methodology was to apply a systematic rigorous set of predetermined protocols to each business case and then map the post–prior results back to the model. In this way it was possible to compare and contrast both *a priori* and *post priori* findings. From such a comparison a diagnosis of the current state was made and then prescriptions were made for the next business case. Hence each pilot study incorporated the lessons learnt from the previous one and the model was adapted in real time. The AMR methodology represents a procedure for applying expertise and lessons learnt directly to the next phase or iteration. The mapping that takes place to develop the Wi-INET business model and then from this to transform the business model to the delivery model requires continuous mapping of various data and information that has been gathered. It is the flexibility and ease of the methodology in enabling this accelerated mapping to occur that not only facilitates the realisation of mobile initiatives, such as the diabetes example discussed in this paper, but also represents a truly knowledge-based methodology, since at each new iteration, the extant knowledge base is always increased. Figure 5 depicts the power of the methodology.

Figure 5 AMR technology



7 Mapping case study to business model

During the past six years INET[2] has used an e-business acceleration project to increase ICT project successes (Goldberg, 2002a; Goldberg, 2002b; Goldberg, 2002c; Goldberg, 2002d; Goldberg, 2002e; Wickramasinghe and Goldberg, 2004). Today INET is repurposing the e-business acceleration project into a mobile e-health project to apply, enhance and validate the Wi-INET model. Such a model provides a robust structure and in turn serves to ensure excellence in the m-health initiative. INET's data provides the perfect opportunity to examine the components of our model (Figure 1) as it is both rich and longitudinal in nature. In mapping the data and specific business case, we have drawn upon many well-recognised qualitative techniques including conducting both structured and unstructured interviews, in-depth archival analysis and numerous site visits. Goldberg (2002a; 2002b; 2002c; 2002d; 2002e) and Wickramasinghe and Goldberg (2004) capture and substantiate the findings discussed while Kavale (1996), Boyatzis (1998) and Eisenhardt (1989) detail the importance and richness of the methodologies we have adopted in presenting the following findings; key criteria were established from the Standish Group International Report (1994), and Committee on Quality of Healthcare in America (2001).

Please verify if the revisions are acceptable.

A necessary first step in developing the Wi-INET model was to ensure it meets the objectives of an INET mobile e-health project, which include:

- Accelerate consensus building with an e-health solution that is focused on a disease state and driven by the medical model. With the primary objective to streamline communications and information exchange between patients and providers of community/home care, primary care and acute care.

- Acquire commercial funding early with a compelling business case. For instance, enhancing therapeutic compliance can improve patient quality of life with significant healthcare cost savings. It is well documented that in diabetes this will have immediate and high-impact benefits for healthcare consumers, pharmaceutical firms, governments, insurers and employers.
- Avoid risk by reengineering large-scale healthcare delivery processes in small manageable pieces. Today, organisations can harness a rigorous method to incrementally enhance a process one step at time – a way to achieve quick wins early and frequently.
- Rapid development of simple-to-use, low-cost, and private/secure ICT solutions. Achieve these benefits through a wireless Application Service Providers (ASPs). In addition to rapid development, a wireless ASP can easily connect and bring together many independent healthcare information systems and technology projects.

To enhance the delivery of mobile e-health projects, INET is looking to the Wi-INET model as an INET project engagement framework. For INET, this will support an INET mobile e-health Project Management Office (PMO) to manage the costs, quality, deliver many small projects and replicate projects for local and international distribution. As a first-case scenario to test the model, INET is proposing an INET Wireless Diabetes Programme with the leadership from a family physician. The INET PMO is provisioning a project manager to support this physician-led project to meet both research and commercial sponsor's interests and objectives in diabetes. INET uses a SDLC approach to deliver these projects. A SDLC is a rigorous process of developing and deploying ICT solutions through a multiple-step process. For INET this includes a six-step delivery process:

Step 1 Roles and responsibilities

Step 2 Investigation

Step 3 Analysis (Logical design)

Step 4 Design (Physical design)

Step 5 Implementation

Step 6 Maintenance.

INET had trouble defining a standardised set of roles and responsibilities in healthcare to build the Wi-INET model and support the delivery of INET mobile e-health projects. After a number of failed attempts, INET skipped the first step to try and discover the roles and responsibilities with the results from the investigation step of the SDLC. This second step of SDLC involves the problem statement, solution, and business case and project definition. For an INET wireless diabetes programme the investigation details are:

- Problem statement

  There are many communication and information exchange bottlenecks between patients and their family physicians that prevent the effective treatment of diabetes. As background, a fundamental problem today is the ability to have a private and secure way to manage, search and retrieve information at the point of care.

In diabetes, physicians cannot quickly and easily respond to patients with high glucose levels. They need to wait for people to come to the office, respond to phone calls, reply using traditional mail delivery, or never receive the patient information.

- Solution mandate

Implement a diabetes monitoring programme to enhance therapeutic compliance, such as, release a programme to enhance the usage of oral hypoglycemic agents (drugs), and/or the usage of blood sugar monitoring devices.

As background, everyone wins when enhancing patients' ability to follow instructions in taking prescribed medication. The patients' health, safety and quality of life improve with significant healthcare cost savings. However, it is well documented that many patients do not stay on treatments prescribed by physicians.[3] This is where wireless technology may have the greatest impact to enhance compliance.

One solution may be as simple as using a cellphone and installing a secure wireless application for patients to monitor glucose levels, and provisioning a physician to use a PDA (connected to a wireless network) to confidentially access, evaluate and act on the patient's data.

- Business case

In Ontario the cost savings may represent almost one billion dollars over three years.

INET uses a simple calculation to determine the one billion dollar savings. This can be found at www.inet-international.com. Select the INET mobile e-health project section to review the calculations.

The business case can be backed with additional data on how the cost of prevention (drugs) is far less than the cost savings associate of reducing the risk of complications associated with diabetes. For instance, the impact of a 1% decrease in A1C is significant. More data is available to support the business case for the prevention of Type 2 diabetes such as lowering the incidence of End Stage Renal Disease (ESRD).

In summary, there is plenty of data today to quickly build consensus, fund and implement a national and international wireless diabetes programme to enhance patients' quality of life with significant healthcare cost reductions; *i.e.*, meet the objectives of access, quality and value.

- Project definition

Use an INET mobile e-health project to scope, localise, field and evaluate an INET wireless diabetes programme led by a physician. Each project can easily and simply customise a programme to quickly meet the unique needs of a rural and urban healthcare delivery setting, age, ethnicity, income, language and culture. These are small manageable projects. Each project collects data on patient/healthcare provider relationships, wireless medical informatics, therapeutic compliance business case, and ICT usability to accelerate acceptance of a wireless diabetes programme using wireless technology. The programme may include cellular network and application usage, support, healthcare provider PDA, consulting fees for family physician and other healthcare providers. However, it is expected that the costs may not include items, such as consumer cellphone, medication or blood sugar monitoring devices/supplies. It is recommended that commercial and/or research sponsor(s) pay for an INET project, and help subsidise the user costs.

After the investigation was completed, the roles and responsibilities where not well defined enough to engage an INET mobile e-health project. INET then proceeded to dive deeper into the SDLC by completing the next three steps: (1) Analysis, (2) Design and (3) Implementation. The idea was to determine if the players involved in these steps could be applied to a general project engagement model.

In June 2005, INET continued to supply input for the Wi-INET model with the implementation of a wireless diabetes programme. This was a pilot project, with the objective to decrease diabetes-related complications with better control of glycemic levels, measured by HA1C.

The core component of the programme is the relationship between family physicians and patients supported by a wireless diabetes management protocol.[4] This protocol describes how patients can enter their glucose readings into their cellphones and transmit the results to their family physicians. The protocol further details how the physician, in turn, is able to monitor any number of patients on his PDA, such as a Palm Treo or RIM Blackberry device. A physician, if required, can take immediate action with a message electronically sent to the patient's cellphone. The programme was tested through a pilot project with four patients, led by Dr. Sheldon Silver and was completed in July 2005. The pilot project lasted ~ 3 months. The preliminary results are significant as shown in Table 4.

Please verify if this should be "lasted three months" or "lasted less than three months".

Table 4 INET wireless diabetes programme results

Patient	*Change in HAIC levels*		*Reduction in HAIC*
	Prepilot	*Postpilot*	
1	0.082	0.069	–.013
2	0.090	0.071	–.019
3	0.108	0.050	–0.58
4	0.113	0.084	–029

Please verify if this should be "–0.29" or "–.029".

With the completion of the pilot project, INET was able to flush out the roles and responsibilities for the SDLC in healthcare. Using this last INET mobile e-health project, a graphic representation of the Wi-INET model was finally developed, as shown in Figure 1. To show how this works, please review the mapping exercise below. The bold text in black defines INET SDLC players and the bold text in [] parentheses relates to the sections of the Wi-INET model presented in Figure 1:

- Physician mobile e-health project-led – ['Mobile e-Health Project' in Figure 1]

  Physicians provide the linkage to the medical model to enhance disease management programmes that enhance patient care and safety, improve research and education, increase healthcare quality and reduce healthcare costs. For INET's use-case scenario, the final outcome is a Wireless Diabetes Programme ['Wireless Healthcare Programme' in Figure 1]. And the mobile e-health projects are led by Dr. Sheldon Silver, MD, Staff Physician, Credit Valley Hospital.

- Commercial sponsor(s) ['Funding Criteria' in Figure 1] – The project delivers information and communication solutions for:

a consumers wishing to improve their quality of life through an enhanced relationship with their healthcare providers, *i.e.*, family physicians

b pharmaceutical firms looking to increase revenues with e-compliance programmes

c government/insurers investigating ways to significantly reduce administration and healthcare costs, and shorten healthcare delivery time cycles (wait times)

d employers wanting to increase productivity and avoid absenteeism with a healthier workforce.

- Researchers ['Research Findings' in Figure 1] – The project applies the latest research findings in the fields of:

  a patient and healthcare provider relationships

  b wireless medical informatics

  c therapeutic compliance business case

  d wireless information technology usability.

An INET mobile e-health project delivery team:

- Healthcare delivery team ['People' in Figure 1] – For a wireless diabetes programme the players may include:

  a Healthcare consumer – people with diabetes

  b Community care: nurse specialising in diabetes

  c Primary care: family physician

  d Acute care: endocrinologist and diabetes education/management centres.

- Business process analyst ['Process' in Figure 1]
- Privacy and security consultant ['Protection' in Figure 1]
- Programmer using a wireless ASP ['Platform' in Figure 1]:

  a wireless network and devices

  b device and application transcoding

  c application service provider

  d back-end connection.

In conclusion, INET is looking forward to further advancements in the mobile e-health project delivery model to:

- achieve rapid advancements in healthcare delivery
- improve diabetes management
- enhance therapeutic compliance
- realise significant healthcare care cost savings.[5]

INET is planning to continue its role as a sources of use-case scenarios for the model with the delivery mobile e-health projects.

Please verify if this is correct, or if this should be "Work example" instead.

8 Worked example: intra-Europe medical image transfer

This example revolves around a collaborative partnership to develop a secure information network between two European regions. One of the regions is in the UK, the other (Country X) remains confidential at this stage because of ongoing funding applications and existing confidentiality agreements. Pseudonyms shall be used where appropriate to preserve anonymity.

The first stage of the project involves capturing the principles of the partnership by way of a pilot project, the aims of which are to analyse and understand the value of outsourcing (digital) medical images. Key issues in the delivery of services in Country X are: a widely dispersed population, healthcare provision in remote environments and an overall shortage of medical image professionals.

Within the UK, the routine analysis of digital medical images is becoming a growing issue with increased recruitment in other core medical disciplines not being matched in medical imaging.

The pilot project's objective is to establish the added value in outsourcing digital medical images over a secure and potentially portable Public Key Infrastructure (PKI)-based system for remote diagnosis across international borders. Added value relates to both improvement in quality of patient care and clinical outcomes, and financial/operational benefits to individual healthcare organisations.

Within the UK, analysis and delivery of a more cost-effective healthcare services by individual National Health Service (NHS) Trusts (hospitals) is encouraged by the introduction of a tariff-based system through 'Payment by Results' by the Department of Health. The UK Government medical imaging outsourcing targets encourage international collaboration, but there are barriers that must be overcome to enable successful partnership, namely:

- to establish clinical trust between countries and organisations
- to establish common data security policies
- to ensure full integration with existing healthcare ICT systems.

The following research areas will therefore be considered as part of the pilot project:

- clinical trust and security issues in the healthcare domain (in the UK and Country X)
- the importance of integration with existing systems
- the effect and added value of technology intervention
- the impact of outsourcing in healthcare (including barriers to delivery)
- the relevance of process simulation.

Delivery of the project will be managed through five distinct stages:

Stage 1 to develop project and research plans (including trial methodology), identify individual leads within partner organisations and potential sources of regional, national and EU funding

Stage 2 to establish organisational trust, define PKI functional requirements (framework of reference), and build a PKI network between Country X and the UK NHS Trust under a common security policy

Stage 3 to implement and integrate the PKI system into the existing medical imaging applications in Country X and the UK NHS Trust, to train end users in the application through the use of videoconferencing and e-learning techniques

Stage 4 to execute full trial, collate and report results

Stage 5 to extend technology to other clinical areas.

Looking at the UK proposed project serves as a good example where the AMR methodology may help. The AMR methodology started its longitudinal journey with a Diagnostic Imaging (DI) pilot project. The ARM took the DI project as a use-case scenario to formalise a standardised mobile internet (wireless) infrastructure and accelerate systems development achievements (Goldberg, 2002a; Goldberg, 2002b; Goldberg, 2002c; Goldberg, 2002d; Goldberg, 2002e; Wickramasinghe and Goldberg, 2004). To maximise project success and capture lessons learnt, the pre- and postpilot project events (*i.e.*, use-case scenario) are mapped to the INET delivery framework. Any changes or enhancements to the framework are mapped to the WI-INET business model; hence the accelerated mapping-to-realisation of the Wi-INET model today, to harness the potential benefits of the ARM begins with the INET framework and the engagement of a physician to lead the implementation of a wireless healthcare programme in small manageable chunks. This ensures that any enhancements in healthcare delivery are governed by the medical model, meet best medical practices, minimise risk, and avoid disruptions to daily operations. Each chunk represents a vertical representation of the players in healthcare delivery. For a DI project, the key players may include patients, radiologists, referring physician (primary care physician or specialists such as an oncologist), healthcare aid, technologists and transcriptionist. By working together the team's first step may involve shortening the time cycle and reducing the cost to read an image and deliver a final DI report. In addition, the INET framework realigns the systems development life cycle activities concurrently. In the UK example this may help them to quickly reach Stage 5 by completing Stage 1 through to Stage 5 in one project. Finally to expedite communisation the UK pilot project can be structured within the Wi-INET business model to recruit commercial funding sponsors, prepare a technology platform with component players, *i.e.*, compression software for the secure transmission of images, establish privacy policies, *i.e.*, separating the patient data from the image using IDs, and formalising linkages with international research initiatives to quickly scale local successes. It is hoped the ARM can be used for the UK pilot project and others as a method to expedite and expand local healthcare delivery success to national and international settings.

9 Conclusion

In the current high-paced knowledge economy, commercialisation of a good idea is important. Especially in healthcare, too many innovative ideas never make it to successful commercialisation because of the inherent risks and lengthy development stages. This is largely due to the fact that many of the methodologies in use, such as SDLC, fail to capture the full complexity of the healthcare context and/or require too much time to traverse their very structured stages. The AMR methodology provides an opportunity to have a robust methodology that also supports rapid commercialisation. Moreover, the dynamic nature of the model facilitates the continuous incorporation of prior lessons and knowledge into the project process, thereby making it a truly knowledge-based methodology.

We have described the use of this methodology in the context of m-health initiatives. To be successful, wireless initiatives in healthcare require the coordination of many players and the AMR methodology coupled with the Wi-INET business model and practice delivery framework provide the perfect triumvirate to ensure not only that all key elements are included but also that due consideration is given to technology, people and process aspects of such initiatives. We believe, based on successful results in conducting our longitudinal studies, that the AMR should be adopted as a standard methodology for technology implementations in a healthcare context. However, we note in closing that our AMR methodology can be as useful for all mobile initiatives and we urge for further application of the methodology in non-healthcare mobile initiatives.

References

Blair, J. (2004) 'Assessing the value of the internet in health improvement', *Nurs. Times*, Vol. 100, pp.28–30.

Boyatzis, R. (1998) *Transforming Qualitative Information Thematic Analysis and Code Development*, Thousand Oaks: Sage Publications.

Canadian Healthcare Technology Magazine (2005) 'Wireless reporting for diabetes patients offers up dramatic results', September ed., p.4, http://www.inet-international.com/INET/Update/PressCoverage2005.htm.

Committee on Quality of Healthcare in America (2001) 'Crossing the quality chasm', *A New Health System for the 21st Century*, Institute of Medicine, Washington, DC: National Academy Press.

Eisenhardt, K. (1989) 'Building theories from case study research', *Academy of Management Review*, Vol. 14, pp.532–550.

European Institute of Medicine (2003) *Health is Wealth: Strategic Vision for European Healthcare at the Beginning of the 21st Century*, European Academy of Arts and Sciences, Salzburg, Austria.

Frost&Sullivan (2004) 'Country industry forecast – European union healthcare industry', 11 May, http://www.news-medical.net/print_article.asp?id=1405.

Goldberg, S. (2002a) *Building the Evidence for a Standardized Mobile Internet (Wireless) Environment in Ontario, Canada*, January Update, internal INET documentation.

Goldberg, S. (2002b) *HTA Presentation Rendering Component Summary*, internal INET documentation.

Goldberg, S. (2002c) *HTA Presentational Selection and Aggregation Component Summary*, internal documentation.

Please cite in the text or delete from the reference list.

Goldberg, S. (2002d) *HTA Quality Assurance Component Summary*, internal INET documentation.

Goldberg, S. (2002e) *Wireless POC Device Component Summary*, internal INET documentation.

Kavale, S. (1996) *Interviews An Introduction to Qualitative Research Interviewing*, Thousand Oaks: Sage.

Kulkarni, R. and Nathanson, L.A. (2005) 'Medical informatics in medicine', *E-Medicine*, http://www.emedicine.com/emerg/topic879.htm.

Kyprianou, M. (2005) 'Healthcare: is Europe getting better?', *The New European Healthcare Agenda – The European Voice Conference*, E.U. Health and Consumer Protection, http://www.noticias.info/asp/aspcommunicados.asp?nid=45584.

Lacroix, A. (1999) 'International concerted action on collaboration in telemedicine: G8sub-project 4', *Sted. Health Technol. Inform.*, Vol. 64, pp.12–9.

Lee, M.Y., Albright, S.A., Alkasab, T., Damassa, D.A., Wang, P.J. and Eaton, E.K. (2003) 'Tufts health sciences database: lessons, issues, and opportunities', *Acad. Med.*, Vol. 78, pp.254–264.

Nadkarni, P. (2004) 'Evolving standards for clinical content in biomedicine: overview and lessons', *Intl. J. Services and Standards*, Vol. 1, No. 1, pp.112–124.

National Center for Health Statistics (2002) 'Health expenditures', CDC/NCHS, Hyatsville, MD, http://www.cdc.gov/nchs/fastats/hexpense.htm.

National Coalition on Healthcare (2004) *Building a Better Health: Specifications for Reform*, National Coalition on Healthcare, Washington, DC.

Organisation for Economic Cooperation and Development (OECD) (2004) 'OECD health data 2004', CD-ROM, www.oecd.org/health/healthdata.

Pallarito, K. (1996) 'Virtual healthcare', *Modern Healthcare*, pp.42–44 Mar.

Plunkett (2005) *Health Care Industry Almanac*, 2005 ed., Plunkett Research, Ltd., Houston 2004, ISBN 1593920180.

Russo, H.E. (2000) 'The internet: building knowledge & offering integrated solutions to health care', *Caring*, Vol. 19, pp.18–20, 22–4, 28–31.

Standish Group International Inc. (1994) 'The CHAOS report', http://www.standishgroup.com/sample_research/chaos_1994_1.php.

Wickramasinghe, N. and Goldberg, S. (2003) 'The wireless panacea for healthcare', *Proceedings of the 36th Hawaii International Conference on System Sciences (HICSS-35)*, Hawaii (CD-ROM), Copyright 2002 by the Institute of Electrical & Electronic Engineers, Inc. (IEEE), 6–10 January.

Wickramasinghe, N. and Goldberg, S. (2004) 'How M=EC2 in healthcare', *International Journal Mobile Communications*, Vol. 2, No. 2, pp.140–156.

Wickramasinghe, N. and Mills, G. (2001) 'MARS: the electronic medical record system the core of the Kaiser Galaxy', *International Journal Healthcare Technology Management*, Vol. 3, Nos. 5–6, pp.406–423.

Wickramasinghe, N. and Misra, S. (2004) 'A wireless trust model for healthcare', *International Journal Electronic Healthcare*, Vol. 1, No. 1, pp.60–77.

Wickramasinghe, N. and Silvers, J.B. (2003) 'IS/IT the prescription to enable medical group practices to manage managed care', *Health Care Management Science*, Vol. 6, pp.75–86.

Wickramasinghe, N., *et al.* (2006) 'Assessing e-health', in T. Spil and R. Schuring (Eds.) *E-Health Systems Diffusion and Use: The Innovation, The User and the User IT Model*, Heresy: Idea Group Publishing, forthcoming.

World Health Organization Report (2000) *Health Systems: Improving Performance*, Geneva, pp.1–215.

World Health Organization Report (2004) *Changing History*, Geneva, pp.1–167.

Lacroix or LAcroix?

Please verify.

Please provide author's first name initial.

Please verify.

Standish Group International Inc. or The Standish Group International Inc.?

Please cite in the text or delete from the reference list.

Should this be "M=EC^{2}" instead?

2006 or 2005?

Please verify if this has been published already.

Please cite in the text or delete from the reference list.

Notes

1 © Copyright 1999, 2006 Steve Goldberg.

2 INET International Inc. is a management consulting firm, with a focus on delivering rigorous high-impact process improvement projects in large corporate, government and healthcare organisations. These projects refocus an organisation's one- to five-year systems development life cycle into concurrent, 30-day solution-delivery cycles. These are custom mobile, internet, intranet, extranet (INET) and wireless solutions. Steve Goldberg founded the company in 1998. More Information is available at http://www.inet-international.com.

3 Fourteen percent to 21% of patients never fill their original prescription and 30% to 50% of patients ignore or otherwise compromise their medication instructions. Source: http://www.managedhealthcareexecutive.com/mhe/article/articleDetail.jsp?id=105388.

4 Wireless Diabetes Management Protocol © Dr. Sheldon Silver, MD 2005.

5 In Ontario, this may save $1 billion over three years: INET Talk 'Enhance therapeutic compliance using wireless technology', *WNY Technology & Biomedical Informatics Forum*, 14 October 2004, Niagara Falls Conference, New York.