

*e-business technologies, tele-medicine,
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THE IMPACT OF E-BUSINESS TECHNOLOGIES ON HEALTHCARE - NEW HORIZONS OR FALSE DAWNS?

The expectation that computer networks combined with the Internet and associated technologies will be common in all businesses of the future has resulted in a flurry of investment in ICT around the globe, and in wide interest in the Internet, e-commerce and e-business. For example the Malaysian government has created a high-speed data highway, a federal capital that is a 'wired city', and a 'paperless hospital' [1]. The UK Government too has recently approved plans for major ICT projects [5, 10]. These projects are in healthcare, and involve large financial sums. It is important that the use of these public funds leads to successful outcomes. This paper analyses a large successful ICT project that uses e-business technologies. The aim of the paper is to identify the success factors in this completed project to see if these pointers indicate favourable prospects for the outcome of these new healthcare projects.

1. INTRODUCTION

The National Health Service (NHS) in the UK is to embark on a massive nationwide investment in information and communication technology (ICT) to improve healthcare provision. A £13bn budget over six years will support new projects, including e-prescribing and e-appointments [5, 10], based upon new technologies many of which have been successfully used in e-business. Will the transfers of technologies open healthcare to new horizons and opportunities? The investment provided by the government has been welcomed by many, but there have been a few that have expressed concern because of ICT high-profile failures that have occurred in the past [5, 14].

This paper reports on an on-going study of ICT developments that aims to provide understanding of the causes of failure and success. Success and failure are both conditioned by personal values; but in simple terms an ICT failure is a project that is abandoned. A success is a project that continues to operate because if it continues to be used then it can be assumed to satisfy some organisational purpose. It has been found that failed projects exhibit some of the 'critical factors' shown in Table 1. To understand the complex interactions that cause success and failure, it

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is necessary to examine the entire ICT development process from conceptualisation through design realisation to service operation [14].

In this paper, a large successful project, NHS Direct, that uses e-business technologies and was recently completed, is analysed. This might give pointers to success and indicate whether the major ICT investments described earlier, are likely to have successful outcomes.

<i>CF1. Poor reporting structures</i>	I Organisational Context <i>CF2. Abdicating responsibility</i>	<i>CF3. Bad news moderated</i>
<i>CF4. Over commitment to success</i>	II Management of project <i>CF5. Over committed to completion</i>	<i>CF6. Unable to be impartial</i>
<i>CF7. Political external pressures</i>	<i>CF8. Targets set from outside</i>	
	III Conceptual Stage <i>CF9. Complexity underestimated</i>	<i>CF10. Technology over-emphasised</i>
	IV Design Realisation <i>CF11. Lure of leading edge IT</i>	
<i>CF12. Poor consultation e.g. with stakeholders</i>	<i>CF13. IT fix for management problem</i>	<i>CF14. Design by committee</i>
	IV (Continued) During building stage <i>CF15. Competency</i>	<i>CF16. Staff turnover</i>
	V Implementation & Operation <i>CF17. Communication</i>	
<i>CF18. Poor testing of product</i>	<i>CF19. Poor training of users</i>	<i>CF20. Receding deadlines</i>

Tab.1. Critical Factors associated with failure

2. CAN ICT INVESTMENT AFFECT PRODUCTIVITY OR IMPROVE HEALTHCARE?

In any new vision of information societies or information highways currently imagined, healthcare is a major candidate for improvement. This is the case despite the fact that healthcare services in most countries absorb a high proportion of a country's economy. In the UK, the budget of the National Health Service (NHS) is currently some £68bn and is second only to the social security budget. In the USA, the healthcare service costs \$1.5trillion and is the single largest segment of the US economy [12]. In the opinion of Itagaki, Berlin and Schatz, the US healthcare system is recognised as being often wasteful without any major progress over the past 25 years; and they suggest that one promising solution for increases in productivity in healthcare is through the wider use of ICT [12].

This view of the value of ICT in healthcare is endorsed in the recent report for the British Government concerning the future of the NHS [10]. The review proposed that the expenditure on ICT should be doubled from £1.1bn currently to £2.2bn in 2003-2004 and increasing to £2.7bn in 2007-2008. This is within a context of the total NHS budget increasing from £65.4bn in 2002-2003 to £105.6bn in 2007-2008 [10]. The review states that success or failure of the large increased investments in the NHS will depend on how effectively the NHS uses its resources; and it supports spending on ICT as a way of increasing productivity. Following-on from the review, to turn the vision into a reality, four massive ICT projects have been selected. They are to be completed by 2005. These are (i) a new broadband network for the NHS, (ii) an e-patient-record (EPR) system, (iii) e-prescribing, and (iv) e-appointments, to 'e-enable' some 1 million staff at a cost of £13bn over six years [5].

3. E-BUSINESS AND NEW ICT TECHNOLOGIES

In 1994 the Internet and e-business were essentially unknown. Now the Internet and the Web are known to huge numbers of people throughout the world, and the Internet within ICT is a powerful enabler. The Internet has impacted on all branches of life including healthcare; and the Internet craze has spawned a host of new names and ideas, some of which are shown in Table 2. The Internet has also meant that ideas that could not be realised in previous ICT eras can now be revisited e.g. the paperless hospital [1] and telemedicine [18, 24].

Unfortunately, ICT including the Internet – like telemedicine – is not helped by inexact terminology and jargon [24]. Therefore in this paper the definitions from Rowley [21] will be adopted. E-commerce relates to the processing by ICT of any transaction of business, administration or information exchange. E-business, a wider concept than e-commerce, embraces all aspects of ICT in business. Terms with an electronic or ‘e’ pre-fix have only arisen through the popularity of the Internet and imply an Internet dimension.

<i>Within E-business</i>	<i>Within Healthcare</i>
Customer Relationship Management (CRM) Related Call Centres, and Help-Lines	Help-Lines to manage the demand on health services and on clinicians
E-publishing, Online publishing, Online information	Cyber-health, Cyber-hospital, E-hospital, Telemedicine
Document Management, Paperless Office	Paperless Hospital, Paperless General Practice
Supply Chain Management, Globalisation, Outsourcing	E-patient, E-therapy

Tab.2. Examples of terminology and new opportunities in healthcare

Kalakota and Whinston claim that (i) these new technologies are important because they can contribute to more favourable inter-actions between patients and healthcare organisations (i.e. customers to business, or ‘C2B’); and (ii) ICT is a catalyst for dramatic change in the way organisations (a) are structured and (b) respond to customers, i.e. patients [13]. Section 6 of this paper, explores a healthcare development that demonstrates these claims.

4. TELEMEDICINE

Definitions of telemedicine often include a telecommunications component; but telemedicine does not require telecommunications. The prefix ‘tele’ means distance. Therefore, telemedicine quite simply means medicine, i.e. any medical activity, provided to a patient who is remote from the healthcare provider. Consequently, with this simple definition, telemedicine encompasses a whole range of medical provision, including a doctor writing a letter to a patient prescribing treatment, and the use of (a) simple telephone services, (b) a virtual reality device or (c) a high-speed wide-bandwidth network.

Early telemedicine was done in Scandinavia where governments were committed to providing healthcare access for a population where geographical distance and barriers made this difficult to achieve. Consequently, telemedicine was a technique to explore [24]. By 1967, a radiologist in the USA based at the Massachusetts general Hospital was providing, at his local airport, diagnostic

advice to doctors travelling through the airport; and by the 1990s, tele-radiology was quite widely available, and the use of video-conferencing and video-film were commonly used in experimental mode in dermatology and cardiology [20]. Now, ICT can satisfy virtually all telemedicine requirements.

During these many stages of evolution, telemedicine was generally considered in terms of two doctors, where the referring doctor who is geographically close to the patient calls upon the remote doctor. This might be a GP seeking advice from a consultant. The second doctor uses video-conferencing, specialist cameras or other technology to obtain the same visual inspection as the referring doctor. This has been a typical scenario in the context of dermatology, radiology, pathology, gynaecology or cardiology [8]. There have been few telemedicine formats that have considered the potential of 'simple' telephone consultation as effective telemedicine. Similarly telemedicine by healthcare professionals other than doctors is less often mentioned in the literature. The potential of nurse triage has been recognised but not explored comprehensively. Some GPs have, however, indicated that telephone consultations are important and represent 43% of their interactions with patients [4]. In Section 6 a telemedicine service using nurse triage and telephone consultation is described.

5. NURSE TRIAGE

The word triage comes from the French verb 'trier', meaning to sieve or sort. Surgeon Marshal Larrey, chief medical officer of Napoleon, practised triage. He inspected the wounded during battle and sorted the wounded soldiers into two groups. The first were those who had minor wounds that could receive immediate treatment before the soldier returned to the battlefield; and the second group were those with serious injuries who would have to wait for treatment.

There are various features that can be varied in the triage, for example (i) the decision-maker, (ii) the method used by the decision-maker in the triage process, and (iii) the medium through which the decision-maker and the patient communicate. The healthcare professional responsible for the process of sorting might be a doctor or a nurse; but irrespective of the professional discipline of the decision-maker this person must be highly experienced and perhaps trained in the skills of medical triage. Within the triage process, the decision-making can be directed by (a) the professional's own experience and judgement or (b) protocols that specify both the questions to be asked and the decisions to be made. One might also use a process with a combination of professional judgement and protocols [7]. With respect to the communication medium, the decision-maker can meet the patient face-to-face or in some other way, e.g. by telephone. Several studies have demonstrated that:-

➤ nurse triage using telephone consultation, supported by sound protocols combined with computerised decision support aids, is safe and effective [17, 23].

NHS Direct is precisely this type of service.

Aims:	1. To provide easy to use and fast health advice and information
	2. To provide improvements to out-of-hours services
	3. To improve appropriate directions to healthcare services
1998:	Launched as a 24 hours per day, 7 days per week service
November 2000:	National telephone coverage of the UK achieved
October 2001:	National computerised decision-support software fully implemented
Size:	The largest provider of telephone healthcare advice worldwide

Tab.3. Basic facts concerning NHS Direct

6. NHS DIRECT

NHS Direct is a telemedicine service. It is a 24 hours per day nurse-led telephone call centre or help line that operates every day of the year. In less than three years, the service was piloted and implemented in 22 national centres across the UK. It provides advice to callers that telephone through a single national telephone number. Nurses assess callers' needs with the help of decision-support software. They then give medical advice to a caller who is directed (i) to seek fast help at accident and emergency units in hospitals, or (ii) to make an appointment with their GP, or (iii) to 'self-help'.

The online Web site, NHS Direct Online, was launched in early 2000 and is an excellent example of e-publishing. On its first day of operation, it was inundated with visitors and collapsed under the load. In normal operating circumstances, after a search, especially if one has a diagnosis, a sensible quantity of material rapidly appears. The information errs on the side of caution.

7. EVALUATION OF NHS DIRECT – A SUCCESS AND A NEW HORIZON

7.1. FINANCIAL ASPECTS AND FINANCIAL JUSTIFICATION

Although NHS Direct was not created with the aim of reducing costs, it does – in the process of directing a large number of callers to more appropriate forms of care - have cost implications. A report to the UK Parliament, prepared by the National Audit Office (NAO) says that NHS Direct:-

- has not had any noticeable impact on the ever increasing demand for health services, i.e. not significantly increasing or decreasing demand
- has resulted in a small reduction in out-of-working-hours calls on GPs, and
- was likely to refer a caller, on balance, to a less costly level of care than the caller would have chosen without guidance from NHS Direct.

Based on the above, the NAO report says that (i) an accurate financial evaluation of the impact of NHS Direct is complex, but (ii) NHS Direct is balancing around half of its running costs through encouraging more appropriate use of health services [18].

A different evaluation [22], which does not disagree with the above, compared the cost of a call to NHS direct with the cost of visiting a GP. The costs for 2001-2002 were £18 and £14, respectively. Naturally, as the number of calls to NHS Direct increases, the cost per call will reduce.

Some critics, while accepting that many people may like to pick-up the telephone for advice, raise the bigger question as to whether the diversion of financial resources from other NHS activities is justifiable in terms of (i) financial benefits or (ii) health outcomes?

It may be that evaluation too often concentrates on economic gains, and too infrequently on quality of life. Nevertheless, on balance these financial figures look promising.

7.2. EVIDENCE TO SHOW THAT NHS DIRECT IS A SUCCESS

To be a success, a new service must be (i) built to time and cost targets, and (ii) satisfactory to users when operational. NHS Direct satisfies both criteria.

Staffing:	1,150 equivalent full-time highly qualified nurses
Operating Costs:	£66 million per annum (2000/2001, and 2001/2002); £70 million (2002/2003)
Number of calls:	3.5 million (2000/2001) through 22 call centres
Set-up Costs	
NHS Direct:	£22 million plus £70 million for the advanced computerised support software
NHS Direct Online (Website):	£45 million (just less than 0.1% of NHS annual budget)

Tab.4. Calling volumes, staffing and costs

Building the service: Bearing in mind the size of the project, the targets set for the national telephone service and the online service were demanding; and it was a considerable achievement for the service to be operational by the target dates [18]. The operational service is an excellent example not only of e-business technologies (e.g. e-publishing and call centres) but also of embedding decision support software in a broad and comprehensive service [15].

The operational service: From Table 5 it can be seen that over 90% of users of the service are extremely pleased with the telephone advice that they receive. Table 4 shows that the service is widely used, and that the operational service appears to satisfy an enormous demand for help from callers, enabling callers to avoid (i) visiting their doctor or (ii) waiting unnecessarily in accident and emergency units in hospitals. However, perhaps more significantly, during three years of operation the service has been safe with less than one adverse event for every 220,000 calls [18].

The above factors clearly show that NHS Direct is a success in both creation and in operation. Bearing in mind the innovative nature of NHS Direct, these figures and views suggest a project that is a success. Perhaps this implies good prospects for future ICT projects in the NHS.

Marketing the new service:	60% of population were aware of service by March 2002
Satisfaction levels:	Greater than 90% of callers were completely satisfied.
Time to speak to a nurse-adviser:	In 5 minutes or less: 64% (September 2001)
Clinical safety:	Few adverse incidents i.e. 29 in 3 years, 1:220,000 calls
Groups less aware of service:	Young men; younger people generally; the over 65s; ethnic minorities; less advantaged social groups; people with disabilities

Tab.5. Performance data – public awareness, satisfaction, response times

7.3. WHY WAS THE PROJECT A SUCCESS?

There are numerous examples of ICT projects being failures. Is there anything inherent in NHS Direct that contributed to its success? From Table 1, it is apparent that these critical factors are not evident in NHS Direct. Other factors contributing to a successful outcome include:-

Absence of change problems: Most importantly, NHS Direct does not replace anything. It adds to and supplements existing services. Therefore change management aspects were minimal.

Using proven technologies: The service uses technologies that have been proved in e-business or as research tools. Call centres are commonly used; triage has been successfully tried in smaller medical settings [17]; and decision support software has been widely researched and been proposed for embedding in comprehensive systems [15]

Allowing local implementation plans: This was a nationwide project controlled from the centre – a situation commonly associated with failure – but this was balanced by allowing local site providers to develop their own plans for local implementation.

Other factors: The project had high-level support from the government, including the Prime Minister. It had generous funding, but funding is no guarantee of success.

From the above we can conclude that (i) the development of NHS Direct did follow the counsels of perfection that correspond to Table 1, but (ii) the project did have some unique factors from which it benefited, namely generous funding combined with Government sponsorship, and a virtual absence of management of change problems.

8. IS THE PROGNOSIS FOR ICT PROJECTS IN HEALTHCARE FAVOURABLE?

8.1. DO THE CONCERNS RELATING TO NHS DIRECT GIVE POINTERS FOR THE FUTURE?

Advice offered by nurses in NHS Direct has been shown to be useful in meeting callers concerns, even if some of these concerns did seem relatively trivial in the opinion of some doctors. Not surprisingly, with a new service, some concerns and criticisms have been made, such as:-

- The relative absence of serious illness among callers. But medicine is more than serious illness
- The need for large numbers of telephone staff to field incoming calls. Interactive voice response (IVR) equipment can help in the interface with large numbers of callers.
- The problem of ensuring consistency of advice. Consistency of advice can be improved through good protocols combined with computerised decision support systems.
- The difficulties inherent in the absence of face-to-face interaction. Some research has shown that decision-makers compensate for the absence of face-to-face contact by creating a mental picture of the caller and the caller's situation [6], but the difficulties of telephone and remote diagnosis are well documented [3, 19]. The things that a physician can see, smell, touch and sense, help with diagnosis and discussions with a patient. However, strictly speaking NHS Direct does not diagnose. It directs callers to other professionals who will diagnose. Its aim is to provide a confidential, reliable and consistent source of professional advice.
- The need to recognise that only certain things can be done over the telephone. For example, there are callers, especially those with a poor quality of life, who might benefit - even with an apparently simple enquiry - from a face-to-face meeting with a clinician rather than a telephone interaction [20]

- There is evidence that not all social groups are using the service equally. See Table 5 [18].
- It is known that there is variation in consultation outcomes, and that this might reflect a tendency to err on the side of caution. This can be compared with other studies showing that telephone nursing services are more inclined to give self-help advice rather than other healthcare settings [23]. However, this criticism needs to be viewed in the context of NHS Direct's operations over three years, during which there have been only 29 adverse events, i.e. one adverse incident in every 220,000 calls.

The implications of the above factors should not affect future ICT projects adversely.

8.2. HAVE OLD PROBLEMS IN ICT PROJECTS BEEN RESOLVED?

There are larger issues concerning ICT projects than those indicated in Section 8.1 and these will be considered under (i) change management, (ii) management and (iii) maturity.

Management of change: Unfortunately, there has been a history of ICT failures in healthcare [5, 14], causing some to query the wisdom of so large an investment in healthcare ICT. Only recently, a project to introduce EPR in 35% of acute hospitals resulted in only 5 hospitals (i.e. 2%) achieving target dates [5]. The projects listed in Section 2 do not have the stand-alone nature of NHS Direct. Consequently these projects, like the EPR in acute hospitals project, require special care to overcome change management issues, using technical and organisational skills [14, 16]

Managers: To manage change requires good managers. The Health Informatics Committee of the British Computer Society (BCS) warns that the success of the new programme of work – listed in Section 2 – might be prejudiced because of the lack of experienced ICT managers at hospital level [2].

Maturity: As organisations use ICT over long periods, organisations learn. This is described by Nolan as the evolutionary stages of initiation, expansion, control, integration, data administration and finally maturity [9]. An organisation needs to move from one stage to the next, and if stages of evolution are omitted then complications can be expected. Healthcare over the last two decades has not had the sustained or level of expenditure that other business sectors has experienced. It is probable that hospitals are not as experienced as organisations in other business sectors and are not 'mature' ICT users. This may be the cause behind the BCS comments referred to above [2]

While there is much new technology to exploit in healthcare for the benefit of patients, the old problems of change management still remain.

9. CONCLUSIONS

The paper shows that (i) large ICT projects, like NHS Direct, can be implemented to cost and timetable, and (ii) e-business technologies offer new opportunities for healthcare. Despite the success of NHS Direct, experience with projects over the last three decades indicates that implementing ICT in healthcare organisations can be difficult, because people's behaviour is not predictable, not constant and sometimes not rational. Organisations are complex and the management of change is problematic [14, 16]. It is the responsibility of practitioners of medical informatics to ensure that new technologies are nurtured, harnessed and delicately managed in the drive for better patient care.

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