

## Book of Pages

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Collection of articles named fractal to convey the breadth of material within

Early draft of articles developed to discuss Healthcare, Cynefin, Complexity, Change, Process Improvement and Information Technology and Value, amongst other things

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This work is dedicated to my wife Pauline and children Eve and Luke

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## About fractal

### Welcome to “fractal”.

My interests are wide and varied and after some thought, I felt it might be good for me to put fingertip to keyboard and share some related thoughts online.

My background is as an Emergency Physician which has been a great foundation for all my learning. It has helped me understand that amidst the complexity of the world we live in, there is real value in harnessing simple patterns to handle complexity.

Over time I have developed interests in leadership, organisational change, process improvement, the value of information, role of standards and the challenges of tackling complexity in my work. As I have been fortunate to have had a variety of perspectives on some common challenges, I thought I should start to share them.

As regards the title, one of the recurring themes of the world as I see it is that patterns are all around. A “[fractal](#)” can be a very beautiful thing, like the [spiral](#) fossil above, a [fern](#) or a [snowflake](#) is made from very simple and recurring patterns. Mix “fractal” with “freckle” and I came to the word “frectal”.

## Blog entries

### This is a pretty interesting and challenging time

In this year of 2010 I'd say this is a pretty interesting time to be alive.

Within very recent times we have seen enormous change on this planet and the likelihood is the pace of change will keep accelerating.

Within our world there are now populations that survive between the extremes of subsistence living and those living "lifestyles of the rich and famous".

[An Inconvenient Truth](#), a controversial film designed to provoke thought, offered some challenges to us all..

As the world grows in population and complexity, the earth we live on offers physical resources that are clearly finite, so there is no doubt we have to get smarter to look after the planet for future generations...

Within healthcare, we have seen [significant progress in the practice of medicine](#) in the last 100 years.

We are at a point that we can offer major technical solutions to a host of clinical conditions, yet are equally frustrated by other big killers (e.g. malaria, cancer). So there remains large inequalities across the world.... Even within the western world, many governments are struggling to balance the needs of the many with the needs of the few.

As we look forward, we hope that with our ingenuity in exploring ways of living smarter, we may be able to tackle these issues..

To do that....

We need both [leadership](#) and we need [the crowd](#) involved.

We need to do [more with less](#).

We need to share our efforts together which offers a win-win for all, via joined up global efforts.

To understand how just a bit of this challenge might be tackled, I hope this blog should explore a few useful themes..

We need to explore complexity of the world, what change is made up of; looking in particular at healthcare as an important field and how it needs to be improved ..

## What is fractal

Over the last few years I have been learning a lot and wanted to start put some of it in writing.

The world we live in is a fascinating place and this is a fascinating time to be alive, to see so much happening in the world around us. My interests are reasonably varied, from healthcare to information technology to management and across those fields I have noted that as complex as they are and as complex as the world is, that simple patterns are all around.

With that in mind I feel there are a number of interesting thoughts worth recording, sharing.

The picture on the top of the page is of a fossil, a spiral shape, known as an ammonite fossil. To me it symbolises quite a few things.

Firstly as its a very old thing, it reminds me that we are only on this planet for a very very tiny length of time in the grand scheme of things. The world has changed in unfathomable ways since it began. Change has been, is now and forever will be, all around is.

Secondly, the shell symbolises (for me at least) the spiral of change, at many speeds- from the Theory of Evolution that Darwin explained in his "Origin of the Species", to the more modern field of Rapid Application Development and the [spiral model](#) of software engineering.

Thirdly although the fossil is a complex structure in its own right, its made up from a very simple pattern.

As this spiral shell structure with its simple rules make up a complex structure, so it can be understood as a "[fractal](#)". A "fractal" can be a very beautiful thing and are seen all over the place, like the [spiral fossil](#) above, a [fern](#) or a [snowflake](#) and are all made from very simple and recurring patterns.

Of interest, the familiar recursive design of this kind of ammonite shell above is based on is linked to the [fibonacci](#) sequence of numbers (0,1,2,3,5...) that appear in many places around us.

Another dimension to fractals is that they exhibit similar characteristics, even if viewed at differing levels of scale.. a well quoted example of which is the coastline challenge, as in the 1967 "[How Long is the Coast of Britain](#)" paper ?

Fractals are closely linked with the science of Complex Systems which is a very useful multidisciplinary body of knowledge that I believe will grow in importance in many disciplines, from Healthcare, to Information Technology to Management fields and beyond.

Mix the name fractal with the word freckle and I came to *fractal*, hence "what is *fractal*".

I hope to share some further thoughts on many of these issues and themes in further posts...

## Starting at frectal

I've started this frectal at [WordPress.com](https://WordPress.com). I've been looking for a content management system/blogging tool to start writing with.

The aim is to find a platform for writing some articles in a book and chapter style, or with a series of posts, aiming to update the pages as I go, while I learn.

This looks like a good platform. I appreciate its open source background. Given the fact that it is a free hosted solution, lots of good features and options mean it has to be commended. Only constraint so far are the themes, not found a perfect one yet. Anyway.... the initial focus is on the material, the ideas..

## Book of thoughts

I'd like to introduce some articles that I have pulled aside from blog "posts" into "pages". In doing so I'm trying to set aside some articles that I hope hold up over time and provide a foundation for any other material that may appear here. I have worked towards 5 themes i.e. articles that cover the main themes of my work. As I like the number 5, it seemed the right number to break up the work into themes and chapters, without being too many.

The aim of this blog and these articles is to share what I consider common sense in areas of particular interest to me, something that I don't find is applied consistently enough.

Let me now step through very brief explanations of these articles, to ensure that there is a clear and consistent train of thought from start to end.

Firstly, I begin with an exploration of healthcare, I field I grew up within and into. That exploration will include a look at the pressure of the frontline of healthcare, the challenge of healthcare improvement, the challenge of aligning healthcare practice with healthcare research. In particular it looks at the need for change to deliver better value for money in healthcare.

Secondly, I then look at a broader framework that I find helpful in many ways to tackle those challenges, i.e. the Cynefin framework. It provides a framework to explore a broad range of life's issues, from Simple to Complicated to Complex to Chaotic, issues/problems/challenges. I find it useful across Healthcare, Management and Information Technology challenges, indeed across all domains and so it suggests a coherent means to address a wider range of challenges.

Thirdly, armed with this framework to tackle challenges, I explore the perpetual issue of change. Change is often discussed and promoted as a new idea rather than an inexorable part of life and part of the evolution of mankind. Here we accept that change is inevitable and discuss how this might be embraced by exploring common themes amidst the complex system of organisational change, again pulling common patterns together that I see in all directions I look. Those include ;

- people (including issues such as cultural change & the recurring importance of leadership in change),
- process (including process improvement, (a relatively modern term but in many ways simply this is what do we humans do)),
- information (as an integral part of our human existence, an enabling and empowering thing)
- technology (again a modern term but importantly humans have been developing tools to solve problems as long as we have been humans)
- value for money (where by I discuss what is this thing called value anyway?)

Fourthly, I focus in more detail on a key relationship amidst those important factors in change, i.e. the critical interface between process improvement and information technology. While many organisations have worked at connecting these in a "complicated" fashion, I make a case to suggest that as both process improvement and

information technology are "complex" fields, they need to learn from complex systems theory and learn about the importance of patterns. In examining the current relationship between process improvement (Lean Thinking) and Service Oriented Architecture worlds, I suggest an approach that I believe can help align teams with a generic approach that better unites process improvement and SOA efforts by examining common patterns, towards a simpler approach to this complex problem.

Fifth and last, I come back to healthcare as an area to explore how to apply these principles of improvement. This section examines the universal need for healthcare reform, the application of process improvement to healthcare and addressing the current problems with healthcare information systems. I make a particular case that clinical teams need to work to align process improvement efforts with electronic health records, based on common patterns in healthcare. In addition I explore a development named openEHR and its potential to handle the complexity and change within healthcare systems. In conclusion I examine the case for an open source ecosystem in healthcare, which I believe is now needed.

- Healthcare – an introduction
- Chaos-Complex-Complicated-Simple and Cynefin
- The challenge of Change; key patterns
- Change; Harnessing the key patterns
- Healthcare Change & the way forward



## Healthcare: an introduction

Healthcare, as an important body of both science and art has developed over many centuries with a body of knowledge that has been fostered by healthcare professionals who have long played a key leadership role in the delivery of healthcare.

While tremendous progress in healthcare science has been made over the past centuries, in more recent years it has become apparent that despite significant recent investment and progress in healthcare, that many systems (across the western world as much as the developing world) are struggling to cope with their systems under increasing pressure.

Taking on a career in Emergency Medicine after medical school was a straightforward personal choice. Emergency Medicine is at the frontline of the healthcare system, at the critical interface between primary and secondary care. EDs are open 24/7 and take all comers from those with major trauma to the minor injuries and lots more variety in between. Its a specialty that needs senior decision makers and when I took on the choice, there was not then, nor is there now, enough specialists in this important field.

There are few better places to see the insatiable demand on healthcare systems than Emergency Departments. Over my time in Emergency Medicine it has become clear that we need to revise our current approach to the delivery of healthcare. So we need to change. By change I do not mean we need to add more pressure to those at the frontline. Rather I mean we need to work smarter rather than harder

Let me now introduce 5 related articles about healthcare.

Firstly we need to examine the current state of healthcare in some more detail, to clearly state the current challenges that exist across healthcare systems and the need to change.

Secondly, to understand healthcare challenges at the level of an individual patient, we need to explore how complicated and complex it can be and how we can improve this the key critical element of healthcare, i.e., the encounter between clinician and patient..

Thirdly to explore mechanisms to healthcare improvement at a practice/departmental level, we will focus on healthcare audit and look at common challenges in information and knowledge management therein as well as potential remedies.

Fourth, at a higher level again, we need to explore the current disconnect between healthcare delivery at the frontline and healthcare research, plus how this may be addressed.

Fifth and last, we need to explore the efforts that are being made by governments across the world to introduce better “Value” from healthcare systems.

- [Healthcare under pressure ..and needs to change](#)
- [Healthcare; challenges at the frontline](#)

- Healthcare-and-the-challenge-of-departmental-improvement
- Healthcare; the "right thing to do" challenge
- Healthcare; the Value challenge

Beyond these introductory articles on Healthcare, let me explain some other related material here..

One of the common themes that will emerge from this exploration of healthcare, is that improvements are hard due to the complexity of the healthcare system. For that reason, you might be interested in material on a related and useful framework, which helps illustrate principles for tackling complexity, change in complex systems etc.

In addition, to tackle any change we explore the complexity of organisational change and look for common patterns that emerge.

As it is such a real challenge, we will then focus in particular at the interplay between process improvement and information technology sciences.

In the final chapter, we then return to healthcare to focus on informatics, its role in improving healthcare, how to handle its complexity and some related developments of interest...

- Chaos-Complex-Complicated-Simple and Cynefin
- The challenge of Change; key patterns
- Change; Harnessing the key patterns
- Healthcare Change & the way forward

## **Healthcare under pressure. ...and needs to change**

In my introduction to healthcare I mentioned that in recent years it has become clear that healthcare systems around the world are under major pressure.

Wherever we look we see that healthcare systems of all types are undergoing major change. The pressure to change seems a constant regardless of the underpinning approach to healthcare delivery.

In recent years my work has been based in the NHS, the National Health Service in the UK. The NHS is one of the largest employers of the world, was set up after the second world war, and is a key institution within the UK. In the late 1990s, the New Labour government launched the “NHS plan”, aiming to address “the lack of standards”, “lack of incentives and levers to improve performance” across the system via “investment and reform”.

One of the key ambitions that was declared was a 98% 4hour standard, from arrival to discharge in Emergency Departments. Those of us at the frontline thought it could not be done, but it has happened and it has transformed the care of patients in Emergency Departments in the UK, largely for the better.

While several of those measures were very successful, others were less so. Overall the NHS changed for the better, but the challenge to change remains. With the global downturn, the focus 10 years later once again is to “do less with more”. So the pressure continues to mount with the need for innovation and improvement being given a higher profile every successive year.

Elsewhere in the world, the pressure of healthcare systems to change has also been mounting.

In the US, on the other side of the Atlantic, the healthcare system is both a subject of envy in some respects and in others it is seen as broken and deeply inefficient. In a country that spends 16% of its GDP on health, the outcomes they get are very mixed, by some accounts they are poorer than other systems that spend less (such as the NHS in the UK).

Time after time the cry for healthcare reform has been raised in the US, to address the many millions of those uninsured people which has been one of the key drivers behind the Obama led Healthcare reform effort. On the other hand, many of the international centres of excellence in healthcare are based in the US. Largely privately funded there are pioneers in their field with global reputations.

The dichotomy between the successes and failures of the US healthcare system has been difficult to explain in recent decades, so there remains a significant amount of work to be done to foster a healthcare system that delivers Value for Money in the US.

Many other countries have been examining ways to transform their healthcare systems in recent years.

In Ireland, in recent years the Department of Health has overseen the establishment of the Health Service Executive as the delivery arm and the Health Information and Quality Authority as the regulatory arm of a health system attempting major change.

In Australia, there has been a tussle between the federal government and the regional states over the funding of healthcare and varying suggestions as to the means to tackle the increasingly pressing need for healthcare reform..

Many other examples of healthcare systems under pressure to change can be seen in New Zealand, Canada, South Africa, not to mention the many developing countries also working to improve their healthcare systems.

So wherever you look across healthcare system (be they public or privately funded, tax or insurance based), it is evident that healthcare is under pressure to change across the world, and many countries are actively pursuing programmes of significant change and reform across their healthcare systems to address these pressures.

Most recently given the global economic downturn, it is also safe to say that the option to spend ones way to healthcare reform is now not an option for most healthcare systems. So the pressure will mount.. to work harder.. or work smarter.. and deliver better value for money.

In trying to tackle the challenges ahead for healthcare in the 21<sup>st</sup> century, where should one start?

In attempting to answer that we will now look at healthcare from a number of perspectives

- At the patient-physician encounter
- At the healthcare department trying to improve
- Exploring links between healthcare delivery and research that are needed
- Exploring the pursuit of Value for Money across healthcare systems.

In each of those we will identify common themes and particularly expect to identify that amidst the complexity there are some simple key principles that must be now tackled by all those attempting healthcare reform.

- Healthcare; challenges at the frontline
- Healthcare-and-the-challenge-of-departmental-improvement
- Healthcare; the "right thing to do" challenge
- Healthcare; the Value challenge

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Healthcare Reform in the US

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Healthcare Reform in Australia

<http://www.healthreform.org.au/>

Irish Health Service Executive Transformation Programme

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## **Healthcare: challenges at the frontline..**

Having identified that healthcare is under pressure across the world to change, let us now look at healthcare at the frontline to identify some common challenges that may help explain the complex nature of healthcare and the scale of the change challenge.. ..

In order to do so, let's take a look at a patient-physician encounter at the frontline. Let's use the Emergency Department setting for a number of reasons. It's the clinical environment I am personally most familiar with, it is at the critical interface between primary and secondary care, it acts as a pressure valve for the rest of the system as it is always open and some explain it as a good microcosm of the wider healthcare system.

Let us begin with a look at a single patient journey, a common case of a patient who has an acute episode of abdominal pain for instance.....

If the patient's problem begins at home, they can (at least in some healthcare systems such as the NHS) telephone a healthcare advice line and undergo a form of telephone assessment and get related advice.... e.g. please self-care/ go to your doctor/ go to the Emergency Dept/ an ambulance may be called.

If an ambulance is asked to attend, the paramedic will likely also perform another assessment, begin some preliminary investigations, commence some treatment before usually escorting the patient to the Emergency Department (ED).

At the Emergency Department the paramedic may hand over care of this patient to reception or nursing staff who will take over the care of the patient. Here they are usually seen by an ED nurse to reassess the patient's condition, take a brief story from the patient and some vital signs (e.g. heart rate, blood pressure), perhaps some more questions about the nature of their abdominal pain and then make a judgement their "acuity" (to triage), and assign them to a care "stream".

Now the doctor will review the patient and usually begin with what we call "history taking" ....this is a process that involves getting details on the patient's most recent story (often a narrative of the patient's problem) and more structured detail on past medical history, their medications, allergies, smoking, alcohol status etc. Now while it is quite common for much of that information to be recorded somewhere else, i.e. scattered around the rest of the healthcare system.

Without access to a shared patient-centred electronic health record, the Emergency Physician is often unable to get access and so reverts to safety first principles and reassesses the patient from scratch. (While there is absolutely merit in reassessing the patient's condition at regular intervals along the patient journey, some of you will already spot the inefficiencies in the current system and the room for improvement.)

After history taking, medical school teaches doctors to examine the patient and document related findings. There is a common structure to the approach required for this and this should be reflected in the patient's notes..

Investigations are often performed and the results of previous investigations may also be needed at this point. Ordering tests and getting the reports of results is another extremely common healthcare process, one that is also information intensive and again an area ripe with room for improvement.

A “differential” diagnosis or problem list may now be in mind at this time after reviewing the “history” and examination. (e.g. is this appendicitis? a urinary tract infection? constipation? inflammatory bowel disease?)

This may be drawn from the doctors memory and innate knowledge base, or they may need to go to the books/online to check up on their knowledge.

There is an acknowledged gap in the “bench to bedside” cycle of medical discovery and its implementation in clinical practice, which can mean a gap of years changing “what we know to what we practice”

This is another point where information and knowledge management is critical in helping with the decision making process and thereby patient care. There is no doubt much room for improvement in the current approach to this, with many doctors currently relying on their tacit knowledge base at the frontline which, while mostly effective, is subject to human error.

Once the differential diagnosis or problem list is drawn up, then a related treatment plan should be formulated, and treatments in the form of procedures and/or prescriptions for medications may be required.

The medical notes that are made to document the patients journey are collated during the patient clinician encounter. These are critical in several aspects- aiding the decision making process, helping to share information with the next person involved in the care of this patient (e.g. inpatient team), as a medico legal record (increasingly important) and as a record of care that can form part of a wider audit of clinical practice (as per the clinical audit/and or research process).

The patient may then be admitted to an inpatient team or discharged to a clinic or to the care of that patients General Practitioner and so the cycle of care continues....

Of note, in looking at this single patient encounter, it should be evident that the majority of the patient provider care processes are very information intensive

Naturally any inefficiencies in the physician patient encounter of history-taking , examination, investigations, results, treatments are often replicated during successive encounters the patient will have with the healthcare system.

You can see that the current approach builds in much repetition as a safety measure though there remains considerable room for reducing both wastage and risk.

If healthcare systems need to adopt a more patient-centred, cross- organisational approach to care delivery/care pathways etc you can see that changes needed in healthcare information systems will be vital to the future.

Having just examined a single patient clinician encounter, consider the added layers of complexity when as a doctor you are looking after 2 or more patients at the same time in

the Emergency Department, dipping in and out of these processes on an “interrupt-driven” basis..

Let us move up a level now, to explore healthcare from the departmental level..

- Healthcare-and-the-challenge-of-departmental-improvement
- Healthcare; the “right thing to do” challenge
- Healthcare; the Value challenge

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## Healthcare: the challenge of departmental improvement

Aside from tackling patient care on an individual patient by patient basis, you might wonder how healthcare teams and departments make efforts to improve the organisation of the healthcare they provide.

We have already acknowledged the gap between evidence based medicine and current practice with a real gap between “what we know and what we practice”. One of the key approaches to tackling this gap can be termed “clinical audit”.

Clinical audit has grown in importance over the last few decades in the medical field. I can remember being introduced to the PDSA cycle as a junior doctor and wondering how it might fit into the medical world, as the business improvement culture it hailed from was different to the rest of medical science I was taught at that time (anatomy, physiology etc). Yet it has caught on and become common parlance within the medical community.

### Brief Introduction to Clinical Audit

The common approach to clinical audit may be explained with the help of a cycle, the audit cycle. Within some healthcare systems the PDSA or PDCA cycle is the cornerstone of audit. PDSA meanings Plan, Do, Study, Act or PDCA meaning Plan, Do, Check, Act.

Lets examine these important elements in a little more detail.

What does the PDSA or PDCA stand for?

P is for Plan.. i.e. the clinician decides what they want or need to explore. For instance in the field of Emergency Medicine it may be the management of asthma care in the Emergency Department (ED).

It may begin with an interest to explore this aspect of care in the department and compare this with the gold standard that may be recommended nationally or internationally.

With an eye on the “gold standard” knowledge base a number of parameters from a number of patient records need to be explored, i.e. in asthma care, perhaps the % of patients who had their Peak Flow Rate (PFR) measured on arrival to the department and/or the time within which they received their first treatment.

An analysis of a selection of patient records is needed, gathering the relevant patient related information in order to be able to compare current practice against the gold standard that the best evidence knowledge bases recommend.

That analysis usually highlights some common problems (e.g. the PFRs are not being routinely done). Then related solutions need to be formulated, such as standardise the process of initial assessment of asthma, perhaps with a proforma which mandates the recording of PFRs. This trial solution forms the basis of the “Plan”

D is to Do..

The second step in this particular cycle is called Do. That simply means implement the changes recommended in the plan, at a small scale at first..

S -Study (or C for Check) is to then measure the effect of the changes that were developed in the Plan. It is hoped that improvements will have been seen as the cycle unfolds, but disimprovements are equally important to measure and inform further improvements and actions.

Act.. is in theory, the final phase acting on the further actions recommended in the Study phase.

It should be evident that as explained this is not a single cycle of change but at least two. One can also note that the formality of the PDCA cycle is simply as a variant on the human problem solving cycle....albeit focussed on exploring the clinical issue in question. One interesting thing to note is this clinical audit/process improvement cycle is one of many improvement activities that are to be cyclical in nature (i.e. you complete a loop and then reloop some time later). Most of the various methodologies behind quality and risk management are also cyclical in nature. As are other approaches to quality management.

If I haven't said it before, life is full of cycles..

Needless to say that much of the current activity of clinical audit involves trawling through patient records to see if things have been done well or not. Interestingly many of the key findings of clinical audit commonly highlight the poor information available and poor clinical documentation is very often an issues that is uncovered. Without available, complete or legible clinical notes, much of the conclusion drawn in a typical audit are thereby limited by these constraints. Furthermore one of the most common conclusions from a clinical audit that I regularly see is to improve clinical documentation. ( e.g. suggest a template/proforma for specific documentation purposes)...

Ultimately the important and growing need for clinical audit as an integral part of medical practice clearly highlights that we need to get much slicker at information management in healthcare.

Indeed the clinical audit process ultimately needs to be made available as a by-product of routine care to enable real-time feedback of clinical care and continuous improvement. As this is challenging but important, currently audit has become a common driver to develop information systems around "secondary use" drivers such as audit, without serving the frontline particularly well, which has limited success.

Indeed as the health industry currently suffers from such a poor connection between information and knowledge management systems, one can imagine the complexity of coordinating multiple audits across organisations from a patient oriented perspective.

There is a related need for greater effort towards interoperability of health information systems, to ensure that benefits to primary users of clinical systems can also facilitate secondary use processes such as clinical audit.

- Healthcare; the "right thing to do" challenge
- Healthcare; the Value challenge

References:

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## Healthcare: the “right thing to do” challenge.

If clinical audit is aimed at ensuring clinicians are “doing things right” then healthcare research aims at searching for the “right thing to do”.

Academic Medicine has always been highly regarded within the medical profession and been instrumental in changing the lives of many many people. You may recall the story behind the research into the cholera outbreaks across districts of London by Dr John Snow in 1854. The secret of that breakthrough was by uncovering the right information that provided the “evidence” that there was a very strong link with a local water pump. This evidence helped break the cycle of cholera at the time and began the science of epidemiology.

Internationally, healthcare has of course developed at significant speed over the last decades. The rate of medical discovery is already outstripping our ability to keep up and provide Evidence Based Medicine at the point of care. In modern times, after much progress in medical research there now exists an important disconnect between medical research and information management at the frontline. This gap from “Bench to Bedside” is the target of Translational Medicine and Knowledge Translation attempts to “Bridge the Chasm”.

There also remains many unanswered healthcare questions that need to be tackled, particularly as we get into discussions about value for money in public services such as healthcare... we need to be increasingly certain that we are guiding clinicians based on the best available evidence, which will always raise related research questions

At the frontline, clinical care is paramount of course, it requires the support of Evidence Based Medicine in real time and given the right information and knowledge management systems, there could/should be increasing support for important clinical research as a by-product of routine clinical care.

Yes healthcare research is hard to do at the frontline, esp. in the midst of the complexity of busy departments and complicated patient care. We have talked about clinical audit, which often begins with a retrospective look at clinical practice aiming to improve. The challenge of tackling prospective clinical research questions at the clinical coalface is an order of magnitude more complex again..

From my experience, one of the key current challenges of supporting and participating in a clinical trial in an acute clinical setting comes down to the current paper based approach to both clinical documentation and research. .

When you are in the midst of a busy clinical shift in an ED, under pressure for time, you may not be surprised to learn that recruitment to clinical research trials can be challenging.

While difficult to do, the important role of research in healthcare today is recognised. My own view is that in order to greater align the pressurised clinical frontline delivery agenda with the academic research agenda, we must forge a much better union between clinical frontline and the academic research information and knowledge systems. Indeed if healthcare information systems could better support clinicians at the frontline and harvest the information needed for a clinical trial as a by-product of that process, that would revolutionise the research burden.

In that way, I should be able to manage my patients care as needed and interwoven within the clinical encounter and with the patients consent, I may ask some additional research related questions, order an additional research related investigation without interrupting the clinical cycle of care the patient requires. In that way, in avoiding the current duplicative effort that is currently required (i.e. documenting clinical care of the patient in their record, then re-recording many of the same details in a parallel research proforma) we could align these efforts in a win-win for all

So again the key conclusion from my brief look at healthcare and research agenda is that these are increasingly interdependent, so therefore require the greater integration and interoperability between healthcare frontline and research information and knowledge management systems.

- Healthcare; the Value challenge

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..

## Healthcare; the Value challenge

Healthcare as we have mentioned elsewhere.. is under pressure to change. If you look at the % of GDP spent of healthcare, one of the interesting conclusions is that the % countries spend on healthcare does not directly relate to the outcomes from that spend.

So in these difficult economic times, rather than spending more money or necessarily working harder, it appears we all need to be smarter about the way we manage healthcare. That may involve more patient self-caring, more patient centred care pathways that reduce duplication and waste and/or changes in the way that we use technology in healthcare. In short we simply need to deliver better value for money in healthcare.

Currently across much of healthcare many would admit it is difficult to measure “value”. We may currently exercise our judgement or know it when we see it but there is a related challenge in how to deliver “Value for Money” within healthcare systems. Value is a loosely defined concept, though I find value definitions commonly relate to things that most of us believe are important in life (i.e. quality, safety, timeliness and costliness).

Ultimately if we aim towards value in terms of quality, safe, timely and not costly care, this needs to be delivered at the frontline, which requires changes. Towards those changes we need to make iterative improvements with routine and regular audit. In addition research is needed to provide the Knowledge Base of which quality/safety/time and cost measures are most useful.

Within the UK the speciality of Emergency Medicine has used a time measure (4-hour standard from Admission to Discharge) as a proxy of quality of care and value for the patient. This thinking is now developing towards most balanced measures to get a more holistic approach to measure value from the patients perspective..

While I am not suggesting that measuring value is easy, what is clear is that if we are aiming at measuring any of those elements that contribute towards value (i.e. quality, safety, time and money) that we are providing at the point of care, we need better information systems to support attempts to increase the value offered. So whatever health system one explores internationally, be it tax based or insurance based or a mix of something in between, all systems are converging on the realisation that better information is required to drive changes required to get better value for money within healthcare systems.

If measuring value in healthcare strikes you as complex, you will have noted that the term complexity keeps coming up in our exploration. As complexity is such a recurrent theme across my work, I would like to now introduce you to a range of concepts from simple, to complicated, from complex to chaotic and a related framework named Cynefin that I find very useful.

We will return to healthcare to look again at related solutions in due course.

- **Chaos-Complex-Complicated-Simple and Cynefin**

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## **Chaos-Complex-Complicated-Simple and Cynefin**

We have looked at the healthcare field and will be exploring further management and information technology areas in later articles. We are doing so for the simple reason that my current work spans these domains and I am keen to share some related thoughts.

After a formal education in medical school, I was armed with the related medical vocabulary. Yet that language is very different to that used by the management and software engineering folk I now work with.

Understanding the differences and commonality in languages and mental frameworks between disciplines is in many ways key to tackling multidisciplinary challenges (e.g. Healthcare reform) today. In the modern world differing folk with differing backgrounds increasingly need to come together to tackle challenges together.

Over time I have found myself looking across these disciplines for some common patterns that span across disciplines and found some common ground that I think may be useful to share.

One of the key aspects of that common ground is that all 3 disciplines can learn from complex systems science which is a multidisciplinary field that crosses most/all other scientific fields and is very helpful. We will shortly look in a little more detail at this critically important field.

While “complex systems” is very useful, if you have explored it in the past you may have found it challenging to reconcile with your educational background and structured training.

Thankfully there is a framework that I find a simple yet effective way to reconcile many of the challenges in the modern world named Cynefin. While it has emerged from the leading work of Dave Snowden from the knowledge management industry I believe it has very widespread applicability. Within this field there are a number of related and valuable schools of thought including work by Ralph Stacey (Agreement & Certainty Matrix) and adaptations by Brenda Zimmerman et al (Edgeware).

Very briefly the Cynefin framework explains the world across 4 key states, from simple to complicated to complex to chaos. (There is a 5<sup>th</sup> state, namely disorder, which must also be mentioned).

### **Simple**

You began your education with the basics of reading, writing and arithmetic. While challenging at the time, you likely take these challenges for granted now and might class them as “simple” to do.

### **Complicated**

Further along your education you most likely will have chosen a path that you enjoyed/preferred for a variety of reasons. While your chosen field may have appeared a “complicated” at the outset, requiring years of study and effort, over time you will have



got a very good grasp of the subject. Indeed you may be a master in that field. Those from a scientific background will be familiar with this domain.

### Complex

Regardless, there is for all of us, stuff that appears more than complicated, complex even, that stretches our ability and it can be hard to explain how, but somehow we get through these challenges. Within the complexity, patterns emerge and can be distinguished and harnessed, which may be understood as the art within many disciplines.

### Chaos

At the edge of complex challenges, occasionally lies chaos... a bad day, an organisational mess, a challenge so unwieldy that chaos is the only word that fits..

In brief, the Cynefin principles of how to deal with each of these domains can be summarised as follows..

Simple:	Sense, Respond, Categorise	(Best practice)
Complicated:	Sense, Analyse, Respond	(Good practice)
Complex:	Probe, Sense, Respond	(Emergent Practice)
Chaos:	Act, Sense, Respond	(Novel Practice)

We will now try to look for some common ground between three disciplines, Emergency Medicine, Management and Information Technology, using the Cynefin framework which should help to explain and illustrate its value

We will then conclude this section with a look for a single pattern that emerges from exploring these three fields.

- [It's become a complex world; an-introduction-to-Complexity](#)
- [Cynefin and Healthcare](#)
- [Cynefin and Management](#)
- [Cynefin-and-Information-Technology](#)
- [Amidst the complexity simple patterns emerge](#)

We then explore common patterns amidst the complexity of change.

- [The challenge of Change; key patterns](#)

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## **It's become a complex world...an introduction to Complexity**

Before we get into the broader framework of Cynefin ( which looks at the world in a range of 4 key domains -from simple to complicated to complex to chaos) lets me delve initially into one that deserves particular mention, i.e. complexity and the world of Complex Systems

As history has unfolded human civilisation has inexorably moved from a relatively simple hunter gatherer/agrarian life towards the development of more complicated skills and expertise and we now find ourselves in the complex world of the 21<sup>st</sup> century.

The word complex is one that is bandied around all the time.. yet what does it mean to you? Have you heard of complex systems science? Well if not, you may be interested as while its relatively new, it's already pretty useful.

The principles of complex systems..

A complex system is one that;

- is made up of many parts with
- has many interactions between its parts
- cannot be completely understood
- cannot be completely controlled.

so rather than trying to understand and control the whole system you look for the simple patterns and simple rules that emerge from the system and you harness those then the rest of the system will self-organise...

Certainly from my perspective, that is a perfect description of one of the places I work, i.e. an Emergency Department and I'm eternally grateful for being introduced to the subject by Dr Mark Smith of Washington Hospital Center ED.

Over time I realised that it was also a very good way to explain hospitals.. and local health economies .. and healthcare systems in general too!

Moving beyond the confines of Healthcare, I ventured into studying and taking on more Leadership and Management roles. Whereupon it was quickly apparent that many/most projects I was involved with fitted the same "Complex System" description. As has any of the management programmes I have been/am involved in. So it became clear to me that Complex Systems have a very good fit with Management science too.

Furthermore, as more of my work became involved with the Information Technology field, over time I began to understand most software quickly moves away from being complicated (its rarely simple) to being complex too, especially if issues of scalability and maintainability are examined. So yet again, I believe there is a good fit between complex systems science and the world of information technology/software engineering. If you would like an example of a complex system in the context of Information Technology... think Internet..

So though I've just mentioned 3 differing fields, I should explain that complex systems science applies to just about anything you can think of, from biology to mathematics, ecology to evolution, social science to economics, from military strategy to medicine.

If you have an interest in that tiny taster in the subject, I should recommend Making Things Work by Yaneer Bar Yam of the New England Complex Systems Institute as a very good introductory book on the subject.

If perhaps you may be someone who has come across complex systems before and wondered "that's all very useful, but I'm not quite sure how to bring that into my world at work"/"how does this fit with the rest of my education?" etc....

For a time I was finding the principles of complex systems useful to my work while wondering how to reconcile these principles with the rest of my education and knowledge base. While I was wondering how to fit complexity into the rest of my thinking, I got some very useful help from Kate Silvester, a fellow medical doctor who introduced me to looking at complexity within the broader Cynefin framework. As I've already mentioned it's a framework that helps explain some/all of the world in 4 key domains- simple, complicated, complex and chaos.

Lets now explore this broad framework across 3 differing fields.. Healthcare, Management and Information Technology, exploring the complexity as we go. Again, I hope that in doing so, that just might help...

- [Cynefin and Healthcare](#)
- [Cynefin and Management](#)
- [Cynefin-and-Information-Technology](#)
- [Amidst the complexity simple patterns emerge](#)

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## Cynefin and Healthcare

In an effort to introduce you to the Cynefin framework, let me introduce you to the field I work in, Healthcare and one of the places I work.. an Emergency Department.

### Emergency Departments

Emergency Departments (ED or Emergency Rooms (ER) as they are known in the US) are not known to be calmest, most peaceful of places. They are not the easiest places to work, but I sense they are amongst the most challenging and rewarding.

They are the front doors of the health service, always open, never closed, offering a 24/7 service to anyone and everyone who attends with anything they feel is an Emergency. While the ED is at the interface between the primary, community and the hospital elements of the health service, as an organised unit they are a relatively new phenomenon, though some suggest they are a microcosm of the wider healthcare system. The speciality of Emergency Medicine developed after army medical doctors returned to the US from the wars of Korea and Vietnam in the 1960s, 1970s and has spread steadily since then.

The Emergency Departments at Leeds Teaching Hospitals NHS Trust, based on 2 sites see over 200,000 patients per year.

Over the last years the NHS has significantly changed the way we coordinate the flow in the department, as we now need to ensure 95% of patients are cared for between arrival and discharge- in under 4 hours. So what was a challenging environment and the bottleneck in the system is now a much more efficient environment, particularly from a patients perspective.

Let me now explore how I see Emergency Departments from my own perspective using the Cynefin framework.... looking at their simple, complicated, complex and chaotic features.

At any one time each/all of these may be at play.

### Simple stuff

One could explain that Emergency Departments have a pretty simple function.. to assess and treat the sick and injured in a timely effective manner.

So patients arrive, are assessed and treated and they leave. Simple.

As one of our sites we see approximately, on average 300 patients at day.

$300 \times 365$  days = approximately 109,500 per year. Simple.

Of the 300 patients we see per day, 95% (it was 98% for several years) need to be in and out within 4 hours. 5% are allowed “clinical exceptions” to the standard.

$300 \times 95\%$  = 285 out of 300 need to be sorted in under 4 hours. Simple... at least from a mathematical point of view.

Aside from the simple maths....there are a variety of patient presentations that those of

us trained in Emergency Medicine might consider relatively minor or “simple”.  
E.g. If someone presents with a finger injury I’m pretty happy with the assessment of the problem and related treatment. As the anatomy and related pathology is pretty well known and well defined, so most cases are fairly simple to diagnose and treat (e.g. Mallet Finger Injury).

#### Complicated cases

Beyond the management of a single patient with a single isolated clinical problem, ED life of course quickly gets more challenging.

Imagine if you have to look after a patient with more than 1 clinical problem...

Lets take an illustrative case of a elderly diabetic patient who has collapsed and suffered head and hand injuries.

We need to assess the patient from several perspectives (the diabetic, the collapse, the head injury, etc..). taking into account several potential problems and formulating a related plan that is in the best interests of that patient (who may have physical, mental and social needs). That can get complicated.... though medical school training trains us to be systematic and structured in our approach, so we sort it out, complicated though it may be.

It gets even more complicated if you need to get advice on an aspect of patient care from a specialist colleague. While you could expect that in that a single specialists opinion may provide clear-cut advice, it can often happen that if you ask 2 specialists for advice on the same clinical problem, that you may get 2 differing answers....

That is not in any way a poor reflection on those individuals, often simply a reflection of their prior experience, training and preferences, as well as differing mental models and frameworks for dealing with clinical problems.

So to get a clearer opinion on how to manage complicated patients you sometimes have to build a consensus opinion, which involves a dialogue between several minds.

Its often easier to agree with three minds in one place, triangulating problems to come to an agreed approach.

This approach to dealing with complicated problems is used successfully all the time at the front-line and is the basis of how clinical guidelines and protocols are developed.

#### Complex challenges... and simple rules

Beyond tackling complicated patients, things get more complex when we routinely have to juggle the care of multiple patients simultaneously. So as I mentioned as we see about 300 patients per day on the LGI ED site, as the senior doctor in the department, it is not uncommon to have 50/60 patients at any one time in the department, all of which you are nominally responsible for .

Overseeing the care of those patients is a pretty complex challenge at times, trying to ensure the quality and safety of the care involved, while under pressure to meet the Emergency Care standards we adhere to (i.e. the 95% standard I mentioned; 95% of

patients should spend no more than 4 hours in the Emergency Department from arrival to discharge (home or hospital bed)).

In this regard the Emergency Department is a very good example of a complex system.

I should clarify that..

The Emergency Department;

-is made up of many parts,

-Has multiple interactions between those parts

-is impossible to understand completely

-is impossible to control completely

-can be controlled by harnessing some common patterns and letting the rest self organise.

-if not controlled properly can quickly turn to chaos..

so is the perfect example of a complex system.

What are those simple rules amidst the complexity you might ask?

Well what I can say is that I find myself asking the same key questions all the time, on every shift...e.g..

Is there any patients unstable in the resuscitation room?

Do they have an immediate A (Airway), B (Breathing) or C (Circulatory) problem that is life threatening?

If not..

Who is the next person who needs a decision made... usually in time order from when they arrived

If they are being admitted, is that really necessary?

What are this particular patients top 3 issues/problems?

If they are being discharged, are they safe to discharge? E.g. do they have someone at home?

If a patient is going home, I'll always explain that one of 3 things should happen.

a) if they get worse, come back anytime ;

b) if their problem persists please see your GP ;

c) hopefully they will improve

Before leaving I make sure they are happy with our agreed plan and have no further questions.

On the edge of chaos;

Occasionally, the pressure and the complexity make it feel just a little bit chaotic at times.

It doesn't take too much to tip such a complex system "on the edge of chaos" into chaos.

A power outage at one of our Emergency Department has done it. A number of potential "chemical incidents" in the city had the potential to do the same (though thankfully none were at all as bad as they could have been).

We are always aware of the potential for a "Major Incident" in the Emergency Department to be declared at any time. The principles in preparing, keep it very very simple, keep calm and issue clear simple instructions such as..

"We are expecting a major incident, would anyone who is sitting in the waiting room and able to walk please consider leaving and returning if your case is non-urgent". That can work..

#### Principles from Cynefin

As this article isn't aimed exclusively at Emergency Physicians or Healthcare folk alone.. let me again clarify how the principles of the Cynefin framework help with tackling the variety of challenges that Emergency Departments can present....

Simple: Sense, Respond, Categorise (Best practice)

Complicated: Sense, Analyse, Respond (Good practice)

Complex: Probe, Sense, Respond (Emergent Practice)

Chaos: Act, Sense, Respond (Novel Practice)

I hope it has been useful to explore this Cynefin framework using the Emergency Department as a case in point. I should finish by saying I find the framework useful at the frontline..

Let me now explore the same framework and related principles in the very different world of business & management..

- [Cynefin and Management](#)
- [Cynefin-and-Information-Technology](#)
- [Amidst the complexity simple patterns emerge](#)

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## Cynefin and Management

Having now explored the world of Medicine (esp. Emergency Medicine), let us now explore the world of management through the lens of the Cynefin framework.

When I began studying management I started exploring for definitive texts on the subjects of Leadership, Organisational Change, Project Management, Financial Management etc. I soon discovered that there were few “definitive texts” (I thinking of Grays Anatomy in Medicine) that have stood the test of time across this field, which appears to have undergone several revisions over recent decades.

What also surprised me was that much of the management literature has yet to harness the value from complex systems science. Instead most texts still seem to explain management as a complicated business and fewer still attempt to explain any differences between complex and complicated challenges....

Here again is where I believe the Cynefin framework can help. The Cynefin framework sees the world as made up of 4 key domains, simple, complicated, complex and chaotic. There is an important 5th disorder, though my focus is on the key 4.

While all involved with management will be very familiar with these terms, few will have considered how to usefully interrelate them.

Let me introduce the 4 domains in the context of management moving from simple to chaos.

Simple-

Here lets introduce the basic algebra and elementary maths of this world. Numbers can be the foundation of many key management or economic challenges, be that managing beans, pennies or pounds. The skills to handle algebra required to handle these “simple” challenges can be taught at school to the multitude and can be considered to be within a very well established body of knowledge or best practice.

Complicated;

While the basic algebra of a balance sheet or profit and loss account may be simple, the challenge of accountancy is a more complicated affair. The rules of taxation systems take time to learn and apply consistently hence the accounting profession has developed. Complicated challenges are not limited to accountancy of course, but can be seen within very many other fields ( e.g. within management fields the term might fit with skills required for standard operating procedures development, workflow analysis, business process modelling notation etc). The skills required here are those of the highly skilled and often niche expert and the related knowledge in Cynefin terms is named good practice.

Complex:

In my view, the challenges inherent in much of organisational management are much more closely related to the challenges of complex systems than most folk realise. Perhaps many intuitively realise this but this important issue hasn't been articulated adequately to date.

As complex systems cannot be completely controlled, solutions will emerge from amidst the diversity of a complex system, with or without central control.

Those adaptive solutions may often have emerged from the actions of a small group within the system and then they grow organically within the ecosystem- like environs of the complex system.

Complex systems are;

-made up of many parts

-have multiple relationships between those parts

-cannot be completely understood

-cannot be completely controlled

-can be best controlled by harnessing the common patterns that emerge from the system, as the rest will self organise..

Chaos;

Beyond complexity lies chaos. Of course one doesn't need to look too far in the management world to see examples of chaos within management systems.

The global financial system, which many may have previously considered to be a complicated system was clearly a complex system on the edge of chaos, before the actions of a single bank helped to triggered the global economic chaos in September 2008.

Chaos is by its nature very hard to control. According to the Cynefin framework what is needed to move a system out of chaos is some action, which will either exacerbate the chaos or move some of the chaos into more manageable complex or complicated environments that can then be dealt with.

It is within the chaos domain that the importance of leadership is apparent, where some one, just one person is needed to take a lead and attempt to encourage the crowd to follow their lead..

We now move on to explore Cynefin within the context of Information Technology

- **Cynefin-and-Information-Technology**
- **Amidst the complexity simple patterns emerge**

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## **Cynefin and Information Technology**

Having looked at challenges in Emergency Medicine and Management let us now look at those in the world of Information Technology.

The Cynefin framework can also help to explore the world of information systems/technology/software engineering from 4 key differing perspectives.. Simple, Complicated, Complex and Chaos.

### **Simple**

Let us start with the basic stuff of information science ( the binary 0 or 1 , machine code stuff). This is the stuff that computing machines excel at, where  $2+2=4$ . The rapid progress in this field (supported by Moore's Law) has laid the foundation for much of the fast moving information revolution that we are now living through.

### **Complicated**

When you begin to abstract out binary logic, to higher level programming skills, in whatever programming language or application framework you like, the software world can begin to appear complicated.

Each programming language/development framework may have much the same elements in their makeup, but there is a huge range and variety to choose from, each tailored to their own specific niche area.

Again this is a complicated field, though with enough hours in the classroom, the principles can be learnt and put into action.

### **Complex**

Software development rapidly gets more complex as more folk get involved as one tries to scale and then maintain software. Again it is useful here to explain the key elements of a complex system.

A complex system ;

- is made up of many parts
- has many interactions between those parts
- is impossible to fully understand
- is impossible to control
- exhibits patterns which can be harnessed to control key elements of the system
- elements of the system will self organise

Yet again I would suggest this description fits very well with many large scale Information Technology and Software Engineering projects. There is slow but steady move to understanding this new paradigm, as many large scale IT projects have failed as

they were not able to handle the complexity of the cultural change and/or process improvements required.

The traditional approach to large scale engineering, (i.e. the waterfall approach) with its long lengthy periods of requirements analysis, design, build and test before deployment (think about the airplane industry) doesn't fit or scale with within the complexity of socio-technical change projects, hence the move towards more agile, iterative approaches to software development.

On the other hand, examples abound of small agile groups that spotted an opportunity within the diversity of the IT field and iterated through regular and rapid development cycles to then achieve great success at scale (e.g. Bill Gates and MSDOS, Linus Torvalds and Linux)

### **Chaos**

At the edge of complexity lies chaos. When IT systems that are deployed into an organisation to achieve change without the right leadership chaos can and does commonly result. Again we note the importance of effective leadership in both avoiding and tackling chaos...

After this brief run through elements of the Information Technology field, we can conclude that the Cynefin framework can help to frame related discussions.

Having explored Emergency Medicine, Management and Information Technology fields we now explore across those fields, looking for some common patterns.

- **Amidst the complexity simple patterns emerge**

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## **Amidst the complexity simple patterns emerge**

Having had a look across the fields of Emergency Medicine, Management and Information Technology, what simple patterns emerge from that exploration? Well for a start I hope it is reasonable to conclude that each of the three fields complies with the Cynefin Framework.

In drawing that conclusion, I would suggest that Cynefin offers a wide variety of disciplines a common/generalisable framework to explore their related challenges.

My own further interpretation of the Cynefin framework is that the chaos/complex/complicated/simple elements can be further explained as the key phases of change/evolution/development.

- Chaos may occasionally be the prevailing conditions for change, but order can emerge from the chaos over time, under the right leadership conditions.
- Complex patterns can be observed and identified and even harnessed to an extent particularly if a group with multiple perspectives cooperate
- Complicated elements that emerge from amidst the complexity can then be analysed and over time that analysis becomes part of a related body of knowledge that a greater number of people can reuse.
- Simple elements can also emerge, and given enough time those simple elements can be taught further down the educational tree.

This may appear an abstract construct but remember that once upon a time men has very limited understanding of the world amidst the chaos of the world.

In early years some of our ancestors thought of the world being made up of 4 elements (earth, air, fire and water). Over time others then explained that in fact we have 118 core elements that now make up the periodic table.

When once human anatomy was not fully understood, over time we have looked deeper to see cells amidst our human makeup, they in turn highlighted cell nuclei within cells, which contain the spiral helix of DNA, which in turn is made up of 4 key bases (“A, C, G, T”). So over time our perspective of the world changes and again I find the chaos, complex, complicated, simple elements a useful means to understand our changing knowledge..

We can also explore the Cynefin domains from a simple start towards chaos..

In tackling common problems humans (who are born to innovate) usually find the simplest solution that tackles a common local problem.

As that innovation spreads its wings a more complicated framework may be built up around it.

A deep understanding of complex domains can uncover frameworks that are complex systems ready and scale beautifully to foster both reusability and diversity. e.g. the beauty of DNA highlights that while it has “simple” origins, i.e. ACGT bases, these then contribute to the double helix of DNA, which helps to build proteins, which form biological structures then life forms etc.

In contrast if the very foundations of an innovation are not able to address the tension between diversity and reusability, the challenges of scaling up and then maintaining solutions becomes a complex challenge that can end up in chaos.

In exploring patterns in evolution, we note a pattern of iterative movement from chaos to complex diversity to complicated specialisations with simple reusable components. We also note that periods of history see shifts from chaos through complex politics to complicated organisational arrangements with simple elements that bind a culture together.. until a disruptive force as the limits of progress from the first iteration are found and the state shifts back to chaos and so on ... on an iterative basis as civilisations and mankind slowly move towards ongoing refinement.

These fits with the spiral/evolutionary pattern of development that is seen in so many fields of life, as is fitting with our widest understanding of development on earth. Indeed there is a principle related to spiral development worth mentioning here, i.e. the Pareto principle (or the 80:20 rule), which may be explained as 80% of the benefit comes from 20% of the initial effort, while the remaining 20% of the benefit requires 80% of the effort...

Indeed spiral/cyclical patterns are all around us, in the historical world (history repeating itself), the mathematical world (e.g. Fibonacci numbers), the medical world (e.g. the cardiac cycle, DNA helix), management world (e.g. PDCA cycle) and the software world (Boehm's spiral model). These should be understood to point to the commonality across all human disciplines of endeavour.

Indeed I would suggest this single observation, that spiral cyclical patterns fit with the natural order of change is the key bottom line I would like to move on with...

Having explored the fields of Medicine, Management and Information Technology, from a range of perspectives from simple to complicated to complex to chaotic, let us now move onto look at the common challenge of change.

After exploring the complex challenge of change, we will focus on some key elements within (esp. process improvement and information technology) before returning to the healthcare field to look at related keys to the future of healthcare reform.

- **The challenge of Change; key patterns**

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The challenge of Change; key patterns

After starting with healthcare we have also looked at the Management and IT fields to identify that these fields all share common challenges.. not least in terms of their complexity.

We have looked at the Cynefin framework for tackling the chaos/complex/complicated/simple challenges across healthcare, management and information technology fields and we have also seen that change is a common theme across these complex fields.

Change is a word that we hear quite a lot of these days. It has become such a feature of modern life that its hard to think of living in a society where change was not a part of daily life. Imagine when the pace of change was so slow to be imperceptible. Perhaps that's the way it felt in centuries gone by but its certainly not like that anymore. As the 21st Century moves on "the times they are a changin"..

Of course change is built into the human DNA, as I remind myself when my children try to push "the boundaries". Children are designed to change and push their parents boundaries. How else can one generation progress to the next?

As a look into complex systems can highlight common patterns, we now try to identify those key patterns that emerge from the complexity of change.

- Change starts with People
- Change and a focus on Process
- Change is driven by information
- Change- advancing with Technology and Standards
- Change and the pursuit of Value

At a later stage we will take a look at the key interplay between some of those particular elements that are pivotal to those aspiring towards a smart economy.

- Change; Harnessing the key patterns

We will then return to the intersection of healthcare, management and IT as an important challenge for the 21<sup>st</sup> century.

- Healthcare Change & the way forward



## Change starts with People

So amidst the complexity of change, what are some of the key common patterns that we see emerge..

If we begin an exploration of any human change, one clear pattern that inevitably emerges from amidst the complexity is that in brief, people make change happen.

The key themes that emerge from an exploration of people involve issues of leadership, politics and cultural change.

Let us again use the Cynefin framework to explore the role of people in tackling chaos, complex, complicated and simple challenges.

### Chaos & Leadership

Amidst the challenge of any change a degree of chaos may be the starting point. While no one individual can solve all chaotic problems alone, there is no question that leadership is essential to escape chaos.

As many leadership books make clear, single individuals make leaders who are willing to take a lead and do something, to provide that beacon of light for others amidst chaos and to point the way forward.

Many stories of leadership abound from all walks of life. Whether looking at the course of World War II and the role of leaders like Winston Churchill or the recent push for Healthcare reform in the US led by Barack Obama, for real change an individual needs to lead that change.

### Complexity

Beyond taking initial control of a chaotic situation, an effective leader will have a deep understanding of the domain they are leading in and have identified common patterns that need to be harnessed/addressed.

To gain a good understanding of the common patterns and solutions likely to succeed, a leader will often give a small yet diverse team scope to generate ideas that may succeed. The size of the team is important here also and there is evidence that ideal teams are small in number.

Change in a complex field ideally requires a blend of top down leadership and bottom up innovation. This is why a good leader will encourage diversity in their team. With enough diversity, some solutions will thrive while others may fade/fail.

The field of politics involves groups of people making collective decisions, which is in itself a complex endeavour. This is naturally more art than science which helps illustrate that dealing with complexity can feel/appear more akin to an art form than scientific endeavour.

An understanding that solutions in complex systems cannot be made failsafe but safe to fail is key. Some leaders may be either uncomfortable with this principle or unable to communicate it.

My sense is that some leaders hold a naive yet commonly held and harmful view of change that in the 21<sup>st</sup> Century complicated solutions are available (again thinking of systems in machine rather than organic terms) and that failure is not an option. My

experience is that this misunderstanding of the nature of change in complex systems is still a real barrier to progress.

Of course if leaders don't harness and foster diversity and innovation to tackle complexity, the nature of complex systems is that others will network and innovate despite the leadership (rather than because of it).

Complicated;

Amidst the complexity, if a large group of experts tackle a complicated problem then, given enough analysis, related complicated solutions can be developed.

Engaging these wider body of influential stakeholders is key to achieving the cultural change needed in change.

If the complex nature of the domain is adequately understood by those involved, then patterns inherent in the complex system can be harnessed to develop reusable solutions that can be scaled and maintained for complicated purposes.

However if the complex nature of the domain is misunderstood, those key patterns will be missed and complicated solutions are developed that struggle at scale and are hard to reuse and/or maintain.

Again, as many professionals have not been trained in complex versus complicated systems, it is my experience that professional groups commonly devise (in parallel) complicated solutions that struggle when then attempting to align or integrate their respective solutions, often due to a clash of cultures that have developed independently.

Simple

Over time as the system moves away from chaos to complex, in order to deliver any complex or complicated solutions there exists a requirement for underpinning simple tasks that are then delegated to large numbers of staff..

Within the structure of armed forces, change at this level is delivered by the frontline troops who are given simple orders to follow. In non militaristic organisations the principle is similar so that frontline staff should have simple tasks to fulfil.

Again the nature of complex systems are that if the tasks given are not well defined and easy to do then staff will often find a workaround..

We now move on to look at the common change pattern involving process

- Change and a focus on Process
- Change is driven by information
- Change- advancing with Technology and Standards
- Change and the pursuit of Value

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## Change and a focus on Process

Amidst the complexity of change, the next important common pattern I wanted to explore involves process.

Now process is a word that means many things to many people, but to keep it simple, let me explain it as “what people do”. So most human activity and all change involves people and process.

The changes of the Industrial Revolution and the assembly line approach of Henry Fords Model T highlight the dramatic changes that changes in process have had in modern society. While the manufacturing industry has seen huge changes in process in recent decades (e.g. Lean thinking) which are now impacting on the service industry, deeply complex systems such as healthcare can struggle with process change. Nonetheless the march of process improvement in advancing change continues.

Let us again use the Cynefin framework in order to discuss change and process.

### Chaos

Let us start with the challenge of chaos in systems and chaotic processes.

In a chaotic situation, again the key principle is to “do something”, indeed the simpler the better. In a major healthcare incident, in Emergency Medicine we are taught to walk into the ED waiting room to tell the walking wounded to move away from the scene. That is a simple action, but it helps achieve a lot.. move those that can to a place of safety, help differentiate the minor from the major injuries and help focus attention on those most seriously injured.

Its a simple yet effective process in a chaotic situation.

### Complex

Let us now look at some patterns in process terms.

Firstly the term process usually has a fractal dimension.. i.e.,

Daily operational processes at the frontline

Weekly/Monthly tactical processes at the term or departmental level

Yearly strategic processes at the enterprise level.

Even within operational processes one can spot fractal patterns in processes depending on how deeply one is looking.

Secondly many processes in the 21<sup>st</sup> century are very information intensive (e.g. healthcare, management, information technology etc).

Here again we can see the fractal nature of processes with both physical and logical layers, a theme to which we will return later.

### Complicated

It is my perspective that the vast majority of people think of process in complicated terms, without looking for common recurring patterns.

This is seen within healthcare, these are the multitude of pathways/protocols currently in use.. often based on specific patient problems (e.g. NICE guidance) that do not integrate well.

Within management this is seen the detailed BPMN analysis of process flows/and/or the value stream mapping of Lean.

Within software engineering this seen when local and specific code is developed rather than reusing a common OO library.

While complicated process are ubiquitous in the modern world, they are often not complex systems aware and so struggle at scale..

### Simple

At this layer we see simple reproducible processes all around. They are those that can be easily done with minimal training.

Within healthcare that would be taking a patient vital signs e.g. HR average 60-100, oxygen saturations >95%

Within management this is the book keeping..  $200+200=400$

Within software this is the binary stuff that computer processors can handle effortlessly.

As we noted with the last article, the challenge here for leaders is to have an overarching perspective of chaotic/ complex/ complicated and simple processes if tackling complexity to look for those complex process patterns that should be harnessed.

We now move on to look at a common change pattern involving information

- Change is driven by information
- Change- advancing with Technology and Standards
- Change and the pursuit of Value

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## Change is driven by Information

Amidst the complexity of change, we have looked at the role of leadership and an exploration of process as key elements. Another key element that must be considered at every turn is the role of information. Information is central to and a by-product of many processes.

Information is needed at the frontline, by the middle managers and the high level strategists and researchers. Information is at the heart of many/most public services such as healthcare and education, many industries and most scientific tasks. In many ways information is an essential ingredient of the world around us.

The invention of the printing press by Gutenberg in the 15<sup>th</sup> Century and the World Wide Web by Berners Lee in 1990 have been two pivotal moments in the history of our world. These help illustrate the dictum that information is power and by making information available to others it is clear how transformative that power can be in driving change.

Here again we use the Cynefin framework to discuss the role of information in change.

Let us begin as usual with Chaos.

Chaos.

The predominant feature of a chaotic situation is noise. The solution needed here are simple messages (e.g. Smoke Alarm noise, “Everybody please leave”). These clear information instructions can make all the difference in a chaotic system and the ability to communicate such information is one of the hallmarks of effective leadership.

Complex

In a more complex environment, patterns begin to emerge from the noise. Those patterns can range from data that can be structured (e.g. in the financial world that is numbers) to the more narrative end of communication exchange.

Within the modern world the cry of information overload can be a significant problem in the modern world. Facing a mass of complex information can be a recipe for poor decision making or worse no decision making at all.

Here again the effective leader will be able (perhaps with a small multidisciplinary group) to spot patterns from within the mass of information (e.g. very common cross organisational problems) and then probe with solutions accordingly. Those patterns may emerge from a structured analysis of the information available, or may come from the more narrative end of the information spectrum (in the form of corridor conversations etc).

From a scientific background I was taught the value of structured data above all else (e.g. statistics). Yet over time I had come to appreciate the value of narrative information also. While somewhat unorthodox at first, this now fits very much with my experience in healthcare, where patients stories can reveal the most important detail and other important stories emerge from critical incidents, to interactive teaching sessions to coffee room conversations....

## Complicated

In recent times, many complicated fields have developed their own bodies of structured information and knowledge. As this body of information and knowledge becomes the basis of their working language hence it may be difficult to develop joint working efforts between these groups who have very differing vocabularies..

One could argue that the current state of international economic order was a result of the misunderstanding that the key to success was in deeply complicated information structures such as Collateral Debt Obligations structures that few could understand or challenge with devastating results.

It is my experience that isolated professional groups can develop niche and siloed structures for information and knowledge management which can be a confounding factor in organisational change and thwart efforts to deliver cross organisational change at scale. I have noted that between those involved in the fields of healthcare, management and information technology and indeed within those respective fields. (This may help explain my efforts at writing aimed at a multidisciplinary audience looking for a common framework (and therefore language) to tackle our challenges)

## Simple

Simple information has been explained in several examples within these articles as best exemplified by “the numbers”. That is those ubiquitous algebraic pieces of data that can be added, counted, sliced and diced...

We now move on to look at the common change pattern involving technology and standards.

- Change- advancing with Technology and Standards
- Change and the pursuit of Value

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## Change- advancing with Technology and Standards

Another recurring pattern within change is the role of tools to drive and support change.

Effective tools are often a critical element in successful change. One of those things that make us human is that we develop tools to help us solve problems. That began with making stone tools in the stone age, iron tools in the iron age and so on to the present day. So tools are an integral part of human life and key to our progress as a human species. In modern times tools are now referred to as “technology”, but this is simply a change in terminology.

Standards are also introduced here as standards are the embodiment of tools/technology that can be reused so we examine them in this context. Again there are many examples of standards in action that have transformed our world e.g. the Greenwich Mean Time and related times standards, the Metric measurement systems, the HTTP standard that powers the Internet etc etc.

Let us now examine the evolution of tools/technology/standards from another end of the Cynefin spectrum.

### Simple

As tools are developed initially to meet a local need they often have simple origins (e.g. the reuse or revision of an existing tool to solve a new problem). For instance man once considered the use of the wheel an amazing breakthrough. Not that it was devised by a committee, its humble origins likely sprang from a diverse set of needs before playing a new role in transportation.

### Complicated

Given the right foundations then simple building blocks can produce pretty complicated machines. Over time simple single individual tools became assembled together to produce even more complicated tools, e.g. the chariot, the train, the car etc. If such building blocks are adequately reusable (e.g. cogs in a gearing system) then they can scale up to very complicated environment (e.g. Boeing 747) In this context an airplane is considered a complicated not a complex system as all the component parts are known and predictable in their actions.

### Complex

Complex systems however are an order of magnitude more challenging than complicated systems. We have already seen good examples of complex systems being successfully engineered. Here the principles are that one cannot control and understand the whole system but by if one engineers a few key components the rest will self organise. Here the best examples may come from the development of the World Wide Web and/or open source projects (e.g. Linux), where with the minimum of intervention they have flourished at scale and amidst diversity to drive enormous change and the information revolution we are living through.

### Chaos

Starting from a position of chaos towards a complex system, then if enough diversity is

encouraged then some successful tools will emerge from the complexity and thrive. However if diversity is not encouraged then any single solution that is forced from the top down into a complex environment may not scale well..

The same principles apply to the field of standards development. If led properly and developed with complex systems in mind then they can be cascaded from the top down. On the other hand if standards development is over complicated and cannot be implemented at the frontline, then as a by-product of the diversity defacto standards can emerge from the bottom up (e.g. QWERTY keyboard, VHS tapes, Linux operating system).. a point to which I will return later.

We conclude this look at patterns in change, looking at Value..

- **Change and the pursuit of Value**

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## Change and the pursuit of Value

If humans are striving for any change it is surely aimed at making things better. We must now look at the last key pattern amidst the complexity of change, the pursuit of value.

Now let me bring the term Value into this discussion. For value is another term that is bandied about a lot without clear definitions.

Value in many ways is a judgement call, and may be best considered as a balancing act between quality, risk, cost and time.

So high value goods or services should be high quality, low risk, low cost and low in time (e.g. short waiting time). (Though to achieve high quality may take more money and more time)...

On the other hand low value goods or services are low quality, high risk, high in cost and high in time (e.g. long waiting time).

In exploring value as a complex entity, the term “value for money” may be helpful here. Money has long been used as a bartering mechanism/yardstick for measuring the value of goods and services exchanged between people which was needed as civilisations emerged over time. While money is seen as purely a financial or numeric instrument it is the “value of money” that matters particularly. Hence the Oscar Wilder quote that “the cynic knows the price of everything and the value of nothing.”

### Simple

In simple terms the mechanism of money has long been relatively easy to deal with, add, subtract etc, i.e. it can be treated like any of algebraic number. Hence its pre-eminence in the world and why it is so often tied into discussions of value.

There can be little doubt that money is perhaps one of the purest forms of incentive to facilitate change. After all the end recipient of money is then able to choose how to spend their money to furnish their own needs and wants.

Another simple element that can be explored here in the context of value is time. In bygone years time was not seen as a particularly valuable thing, as men in the fields had lots of it. In recent years, time itself has become a precious commodity, hence the expression the “value of time”.

### Complicated

If single measures of money or time are deemed too crude to measure value then mechanisms such as balanced scorecard are means to develop more complicated measures of value. By mixing a number of simple variables towards a more balanced approach should represent a more holistic measure of value from within an organisation. As complicated measures these usually require a group for development, to represent a variety of perspectives.

Values such as Quality and Safety are still challenging to measure objectively and consistently, even within a complicated approach such as the balanced scorecard. While some measures of safety and risk can be translated into numerical values which can be scientifically analysed, measurements of quality may be the most challenging of all.

## Complex

Quality as an attribute of value that often emerges after experience that measures of money, time and safety alone are not enough to give a balanced measure of value within a system. Quality is a perceptual and somewhat subjective attribute which may be understood differently by different people.

While again elements of what may be perceived as quality can be broken down into numeric values and analysed within a balanced scorecard framework, some are now advocating the more unorthodox approach of measuring value (inc quality) within complex systems using more narrative methods.

## Chaos

Chaotic systems offers little means to measure value so therefore little or no measurable value to those involved within the chaotic systems.

They require a leader to emerge from within the chaos and demand better value from the system, therefore requiring efforts to tackle the complexity within..

Having explored some common patterns in change, we can now move on to harnessing those patterns together to achieve change..

- **Change; Harnessing the key patterns**

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## Change; Harnessing the key patterns

We have now explored a number of themes

In exploring the healthcare sector, we identified healthcare as a system under pressure to change and explored the potential of information and technology to support that change.

Across those diverse fields of healthcare, information and technology we have explored the chaotic/complex/complicated/simple elements through the lens of a useful framework named Cynefin.

Lastly we have examined the complex challenge of “change” and the key patterns that can be observed amidst this complexity, namely People, Process, Information, Technology, Standards and the pursuit of Value.

In this section, we particularly focus on key elements of those important patterns (one that smart economies should be working towards), i.e. the interplay between process improvement and information technologies and some of the key gaps that currently lie within.

- Change – blends of People, Process and Technology
- Process Improvement- and the role of Information-Technology
- Information Technology-should support Process-Improvement
- Uniting Process Improvement and IT- a-move-towards-smart-economies?
- Standards and Value .....and a note about “the last mile”

In the next section we will be applying some of these earlier principles back to the healthcare domain to explore further the international challenge of healthcare reform.

- Healthcare Change & the way forward

## **Change - blends of People, Process and Technology**

We have looked in the previous section at the complexity of change and identified some key patterns that emerge from any related exploration.

We have identified key patterns relate to people, process, information, technology, standards and value.

As we have considered those key elements in isolation, let us now consider the important interplay between these key elements with a single example.

Lets take a brief look at the history of the shipping industry. We do so in the knowledge that a single narrative story can help illustrate some complex theory..

Over the long centuries of moving and distributing goods by sea, you wont be surprised that over time the shipping industry had become a very complex business. Indeed it had become chaotic in places with desperately inefficient efforts to move goods common place. Indeed back in 1937 one shipping executive suggested “that it cost his company more to move cargo 1,000 feet from the street in front of a pier into the hold of a moored ship than it did to transport the cargo thousands of miles across a hostile ocean.”

Amidst that chaos and complexity, entered Malcolm McLean. He had observed closely the complex and complicated process of loading and unloading ships and made transformational improvements in these processes with a standardised container, which (rather than waiting for any top down solution) he developed and pioneered the use of from 1957.

The modern shipping container is constructed to standard dimensions and has a standard approach to information display (inc Owner, Container ID, Size, Type) to aide ease of tracking. While the design was initially patented, Mc Lean made his designs available royalty free to the ISO standards organisation and hence the revolution in the shipping business of the 20th century.

The value added was enormous, in reducing the loading/unloading process from days and weeks to hours, in facilitating huge increases in port and ship productivity, helped to lower the cost of imported goods around the world. In numerical terms.. in 1956, loose cargo cost \$5.86 per ton to load...using an ISO shipping container, the cost was reduced to only .16 cents per ton.

This single story is typical of how people.. can change processes.. with supportive information, technology and standards.. and add value to all concerned.

There are many similar stories of transformational change available, from the medical domain (e.g. Trauma care & ATLS) , the management field (e.g. Manufacturing and Lean thinking) and the information technology field (e.g. Networking and the World Wide Web),

These key patterns identified in our exploration of change highlight that people, process, information, technology, standards need to be harnessed together to deliver real change that adds value.

At the heart of the interplay between these factors is an area that is ripe for improvements as we develop smarter knowledge economies... that is the interplay between process improvement methodologies and information technologies. ..so we will now focus on this issue further.

- Process Improvement- and the role of Information-Technology
- Information Technology-should support Process-Improvement
- Uniting Process Improvement and IT- a-move-towards-smart-economies?
- Standards and Value .....and a note about "the last mile"

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## Process Improvement- and the role of Information Technology

We have already noted that many healthcare systems are under pressure to change, indeed the recent global economic changes is forcing change across industries.

With less money available all around and the complexity of the challenges mounting, how are systems to cope?  
As we have suggested the solutions will be an effective blend of people, process and technology.

Of the elements needed for change, it is worth singling out process improvement for further exploration. While the business process reengineering movement of the 1980s was evidently not a large success story, there is no doubt that we remain under pressure to work smarter, not harder.

Of the process improvement methodologies that have successfully grown in recent years, Lean Thinking, Six Sigma, Total Quality Management, PDCA, let us look at Lean Thinking as an key player in this important field.

Originating from manufacturing origins, its fit within the Cynefin framework and complex systems thinking is worth considering..  
Certainly in my reading on Lean thinking, few is any texts begin with an exploration of the complexity of the world, the nature of complex systems and how process improvement methodologies fit within those systems.  
Rather Lean (in common with most other current process improvement methodologies) appears to take a more complicated view of systems, which certainly fit with the traditional engineering origins of Lean.

It is important to point out the huge success and impact of Lean thinking around the world, across industries, which points out its major value. There are many examples of Lean success stories to be found, my own personal experience is from the major changes in Emergency Medicine in the NHS which leveraged Lean thinking is the story I am most familiar with and try to share..

So while it is evident that Lean thinking has clearly “added value” within complex systems, I believe there is room for an even greater fit with complex information intensive industries such as healthcare.

Within complex systems, process improvement methodologies should take an iterative approach (rather than waterfall approach) to system redesign.  
The first iteration should begin with an analysis of the core (and generic) processes within the system.  
Within the Lean methodologies, this involves an exploration of value streams that relate to key processes within the organisation. Most of this value stream mapping is done at a physical layer which makes obvious sense if dealing with physical objects, in a manufacturing environment or other.  
However if improving information intensive processes (which are predominant in a field like healthcare) to add real value we need to explore the underpinning logical processes in systems.. i.e. to look for the generic within.

So while the traditional approach to process redesign moves between;  
Physical As Is  
Physical To Be

This then transforms the process analysis from into a 2 layered (physical-logical) approach..

Physical As Is  
Logical As Is  
Logical To Be  
Physical To Be

From an information systems point of view this 2 layered approach should be key to influencing the design of core elements (in software engineering terms those object-oriented classes needed at a logical layer) required to support the diversity that exist at the physical level.

This additional step may appear an added burden, but in my view unless and until you do this level of analysis you cannot tackle many of the key challenges of aligning process improvement efforts with an effective information systems architecture in complex information intensive fields.

My sense is that Lean thinking as a valuable and successful process improvement methodology appears agnostic about process analysis at this level for several reasons. Historically Lean has emerged from a manufacturing background. While it is now thriving in the service industry field, Lean appears to remain agnostic about information systems analysis.

There may be some logic in doing so, as the number of Lean thinking success stories without IT demonstrate the value that can be added by changes with people and process alone. Equally there are a significant number of large IT projects that have neither improved processes or added value, which may warn Lean practitioners off delving into information science too deeply.

For now, the term “Lean IT” appears to refer to how to improve your IT service within your organisation... rather than...how to transform and add value from the core of your organisation by aligning both process improvement efforts and effective information systems.

Clearly there is room for change for the greater alignment of process improvement efforts and related information systems to add value for all.

For now we move on, to look at this potential from an information systems perspective..

- Information Technology-should support Process-Improvement
- Uniting Process Improvement and IT- a-move-towards-smart-economies?
- Standards and Value .....and a note about “the last mile”

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## **Information Technology-should support Process Improvement**

Having just explored process improvement methodologies and the potential for greater alignment with information technology, I would now like to explore this issue from the other side of the fence. The end point is the same, but the point to push here is that the information technology field could benefit from a much better alignment with the process improvement field.

The reason for reiterating this point, is that most of those folk whom I have met within process improvement (e.g. Lean Thinking) projects are more often from business than a technical background.

Equally, those who drive information technology efforts are more often from a technical than a business background.

So my sense is that there is a degree of disconnect between these fields which is closely related to the differing background of those involved in these fields..

Having visited the healthcare world under pressure and the nature of complex and complicated systems, we have explored change amidst complexity and concluded that information and technology are both key elements required.

Clearly our world has been transformed by the information revolution of recent years. As I grew up alongside some of the early changes, I expected that that revolution I was experiencing at home might be also seen at work.

Yet no, unfortunately not, a gap has emerged between what I see happening all over the world of work and what has happened to healthcare. Simply put the complexity of the system has meant that health IT has not kept up with our rising expectations.

Of course the challenges of complex large IT projects are well known in many fields, suggesting there are common factors at work. As we have already discovered there are a blend of chaotic/complex/complicated and simple issues at play in any organisation. We have also noted that complex change requires people, process, information and , technology.

Herein lies one of the issues at the kernel of this challenge...

Many/most large complex IT projects struggle at scale... largely down to a poor fit between the people, the process and the technology. In fact you can revisit most complex IT failure stories you like and the same theme of clash between process and IT will recur.. its a common pattern amidst the complexity.

Therefore I suggest to those from an IT background , that an awareness of the Cynefin framework and its categorisation of the chaotic/complex/complicated/simple elements will help.

In my experience significant numbers of those involved in Information Technology and related Software Engineering fields, fail to appreciate the nature of complex systems. This is not particular to those from IT or software engineering I should add.

Indeed many folk seem to see the world through complicated (as per Cynefin) eyes.

Standard software engineering methodologies include an early requirements analysis phase of any project which should include a look at the customer's business processes, to inform the related information technology requirements of the project.

In common with our look at Lean Thinking this is most commonly done by looking at the current physical processes As Is and thinking through to future physical processes in a To Be state. While this approach can work well at a small scale, when attempting to scale up, then maintain or change such systems, they can quickly flounder amidst the complexity.

To tackle complex IT projects, both business analysts and software engineers alike, need to look at the logical processes that underpin the organisation.

Therefore the approach should involve both parties having a shared understanding of;

Physical As Is

Logical As Is

Logical To Be

Physical To Be

processes and information technology requirements.

In this way it should be possible to engage Lean thinkers and Agile developers alike in a more common approach to process improvement and information technology development.

However the current process analysis methodologies may not be routinely used in this fashion, and the differences in approach taken by notations such as Business Process Modelling Notation (BPMN) and Unified Modelling Language (UML) highlight the less than mature nature of the link between these fields.

So having explored the challenges in linking process improvement methodologies with information systems science, let us focus on the means to develop solutions to bridge this gap .. therefore the role of a generic-business-process related service-oriented-architecture.

- [Uniting Process Improvement and IT- a-move-towards-smart-economies?](#)
- [Standards and Value .....and a note about "the last mile"](#)

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## Uniting Process Improvement and IT- a move towards smart economies?

Having looked at the complexity of change across the domains of healthcare, management and information technology, we have concluded that the key patterns seen involve people, process, information, technology, standards and the pursuit of value.

We have looked at the link between process improvement and information technology from both angles and noted that the join between these disciplines is suboptimal at present, with significant room for a better join.

To reinforce and conclude this key point one more time, I would like to highlight the theoretical potential value of generic business process oriented - service oriented architectures. We need to go back to the Cynefin framework to put this abstract recommendation into context.

If we begin with the knowledge that chaos can be the starting conditions for change within an organisation. Chaotic organisations might demonstrate a very poor fit between their processes and related technologies. While not unheard of such organisations needs change and leadership to begin that change

As the change challenge is usually a complex one, so it needs a small number of people to look for common patterns amidst the chaos or complexity of an organisation to suggest ways to change.

(Note this exploration must be done at a “logical” aka “generic” level. Too often this is done at a physical level which is not enough to abstract out the common patterns )

While an uncommon view, it is my experience (in healthcare at least, though I strongly sense it is a more generic finding) that if one looks deeply into any organisational complexity one quickly finds common patterns;

One such pattern is the layering of processes within organisations at the operational, tactical and strategic levels.

Another pattern relates to the generic cycle of process, such as the common problem solving process, which certainly lies at the heart of healthcare.

Furthermore these process patterns also exhibit both fractal and recursive properties at all levels.

These process patterns should help inform process improvement methods as well as related service oriented architecture design.

The splitting of physical and logical/generic layers is critical to pursue moves between;

Physical As Is

Logical As Is

Logical To Be

Physical to Be..

process improvements.

Beyond this complex systems oriented approach to analysis, there is a related need to avoid the traditional waterfall approach using an army to building enterprise information

systems, rather to foster smaller teams using more spiral, agile development cycles.

Of course the more traditional approach to software engineering has taken a more “complicated” (see Cynefin) view of systems.. with resulting efforts ranging from the use of BPMN to model physical processes at a software project level to the wider development of information systems architectures such as the Zachman framework at an enterprise level.

While these traditional/complicated approaches have their successes they appear to struggle to fit with the spiral, agile methods of software development best suited to complex systems.

As the promise and expectations of Service Oriented Architectures has grown in recent time, my sense is that this technology advancement is probably being held back within the aforementioned constraints around software engineering for complex system. However given the right complex system ready foundation then services provided on a service oriented architecture should be welcomed, as they will move the industry to better supporting process improvement with scalable, maintainable and interoperable information systems..

While there are, as yet, few if any, concrete examples of this theory in action, this appears as a potentially fruitful area for those considering the development of their smart economies. Meanwhile, developments in healthcare may be leading the way.

We will now look briefly at the challenge that related standards face to deliver value and the particular challenge of “the last mile”.

- **Standards and Value .....and a note about “the last mile”**

As I will be exploring in the next section, the openEHR specification has evolved as a generic business process oriented service oriented architecture for healthcare.

As we move on from this high level look at process improvement and information technology fields and delve into more detail within the context of healthcare, you may spot some familiar patterns..

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## Standards and Value .....and a note about “the last mile”

Having begun an exploration in healthcare and moved onto look at the healthcare, management and information technology through the lens of the Cynefin framework.

While it may be an unusual blend of topics for an Emergency Physician to explore, I am only able to do so due to the varied and valuable experience I have had in these fields, primarily within the NHS in England.

As my work has developed standards have become a regular theme and I have been exposed to quite a range to date. They include;

NHS Emergency Care Standard (98% ED arrival to discharge in less than 4 hours) and more besides...  
PRINCE 2- another UK government standardised method for Projects in Controlled Environment  
Managing Successful Programme- UK government standard for the management of change programmes across the UK  
BPMN- a Business Process Modelling Notation  
UML- Unified Modelling Language  
Zachman- an enterprise wide information architecture  
Royal College of Physicians Clinical Record Keeping Standards  
SNOMED CT- Systemised NOMenclature of MED Clinical Terms  
openEHR architecture/ISO en13606 Archetype standard

I have already explained that standards can be a key elements in successful change in complex systems. Indeed my experience is that several of these standards have been pivotal in focussing effort and achieving significant change...

However it has also been my experience that the majority of the national/international standards I come across have been/are being designed without any understanding of the nature of complex systems science or the wider interplay between Chaos/Complexity/Complicated/Simple domains that Cynefin explains..

It has therefore been my experience that there is commonly a real gap, between the standards that are being set from on high and the reality on the ground. Of late I have begun to call this gap “the last mile”. That is akin to the challenging “last mile” that the water, gas, postal, electrical and other utility companies struggle with..

The starting point for the introduction of a standard may be within the context of chaotic system where doing anything (e.g. imposing a standard) could/should help to positively disrupt the system.

It is my experience that standards that are imposed from the top down, while usually dabbling into pilot projects to start with, struggle with implementation on an ongoing basis and particularly as they try to scale up.

Quite simply if the standards don't add value at the frontline they wont be properly used and the nature of complex systems is that folk will find local workarounds..

However if a complex systems view is taken, then a more agile iterative approach to standards development and rollout should take place. This should be a joint affair, facilitated by those in authority with links those innovators at the frontline who are adding value with the introduction of standards.

Furthermore the standard should allow some room for local flexibility within. One related example would be the 4 hour Emergency Care standard of the NHS, where a national 4 hour standard was set from arrival in the ED to discharge in 98% of cases, with plenty of room for local flexibility in terms of how that value was achieved..

So to add value, complex change programmes should set standards to be achieved that allow for local flexibility and related innovation should be fostered from the ground up. This principle should apply to those key people, process, information and technology elements that drive change.

Having explored the principle of harnessing key elements in tackling change amidst complexity, we now return to healthcare, to explore how these principles may be applied..

- **Healthcare Change & the way forward**

## Healthcare Change & the way forward

Having begun by identifying that healthcare systems are under pressure to change, at a number of differing levels, we highlighted the complexity of the related changes that are now required.

As complexity is such a recurrent feature of diverse fields such as healthcare, management and information technology, we have briefly explored the important complex systems science.

In addition we have identified the useful role of the Cynefin framework as a means to better understand the varied chaotic/complex/complicated and simple challenges that span these varied fields.

We have then looked in more detail at this thing called change, seeking important patterns that emerge when attempting change. Those patterns relate to people, process, information, technology, standards and value.

While the interplay between all these elements is critical in successful change, we have further focussed on the join between process improvement methodologies and information technology as a particularly challenging area.

That tour away from healthcare, now allows us to return, to look in particular at those elements needed for the successful progress of healthcare reform.

We will explore these in some depth, coming to the related conclusion that several key challenges required related support from healthcare informatics.

- Healthcare change: the ingredients needed.
- Healthcare: needs better Information-Technology
- Healthcare: chasing the right fit between Process and IT..
- Healthcare: openEHR's potential to handle Complexity & Diversity
- Healthcare change: why "Open Source" is part of the recipe..

## **Healthcare change: the ingredients needed.**

Our earlier exploration of healthcare has highlighted that many healthcare systems are under pressure and need to change.

We have also identified that healthcare is an example of a complex system, where change is difficult to achieve. In our exploration of complex systems we have identified that the Cynefin framework can be useful in framing discussions about complex systems such as healthcare.

Having identified people, process, information, technology, standards and value as key elements amidst the complexity of successful change, we now explore if these patterns apply to healthcare?

Let us begin our exploration of these patterns in healthcare by taking a clinical issue for starters.. e.g. the improvements of trauma care that emerged from the introduction of ATLS internationally.

ATLS: People, Process, Information, Technology, Standards, Value

Prior to the introduction of the Advanced Trauma Life Support (ATLS) programme there was no international standard approach to the management of trauma care and so outcomes varied considerably and were often suboptimal. The success of ATLS can be explained by examining the key elements in successful change...

People;

When Nebraska Orthopaedic Surgeon James Styner and his family suffered in an air crash, the poor care they received immediately after led Styner to conclude there was a significant problem with trauma care and to then lead the changes needed.

The ATLS programme is now professionally led by the American College of Surgeons. This ATLS training programme that began in Nebraska, has since cascaded the cultural change and training required across the medical profession internationally.

ATLS requires a team approach to trauma care where team members take individual responsibility for key processes (see ABC below)

Process:

ATLS enforces key common process (and good practice) patterns that are key to success in trauma. Those processes are labelled ABC, i.e. Airway, Breathing, Circulation and should be undertaken in that order, i.e. you should address problems in order of A then B then C, regardless of how complex the case. Once complete you should reassess in a cyclical fashion.

This simple set of rules amidst the complexity helps unite the whole trauma team effort.

Information:

The language of ABC offers the trauma team a shared and well defined language which helps greatly. The trauma team leader can simply tell a member to look after "A" and



that is widely understood. Trauma care documentation is standardised with a trauma chart.

#### Technology:

Each of the key processes has a related set of technologies that are key to success. e.g.

A: Airway adjuncts and Oxygen supply.

B: Breath sounds- requires stethoscope for listening.

C; Circulation; IV Access for taking blood samples and administering IV fluid replacement.

Again all of these are universally understood.

#### Standards:

The ATLS approach is in essence a set of professionally led standards that help address a challenge that previously suffered from unnecessary variation.

#### Value:

The value sought in ATLS is a mix of time/ safety/quality.

The “Golden Hour” of trauma care simply means that time is a proxy for good care.

Standardised processes ensure a safe approach and greater consistency in the quality of care, regardless of the setting.

Our structured exploration of the common people, process, information, technology, standards, value issues in trauma care should help explain the importance of these key elements in change.

We will now move onto another exploration.. this time from the UK.

This second example of healthcare change revolves around the 4-hour Emergency Care in the NHS in the UK.

Ahead of the recent reforms in Emergency Medicine in the UK, the care of patients in the emergency departments in the UK was less than ideal, with many patients waiting long times to be seen by medical staff/ on trolleys to be admitted to the inpatient ward. While these conditions still prevail in many healthcare systems around the world, the NHS has been pioneering changes in the Emergency Care over several years and with dramatic results.

#### People

The changes in Emergency Department care were led from the top of the Department of Health in England, with the appointment of a Czar for Emergency Care to oversee the changes. They were also supported by the College of Emergency Medicine in England which helped to tackle the cultural change which was required.

While the changes were led by Emergency Care staff in the hospitals, the Chief Executive of hospitals were also held to account to deliver the standard which helped work the standard through the rest of the hospital organisation.

#### Process:

While ED processes had been very variable prior to the introduction of the standard, the introduction of the 4 hour standard drove major changes in ED processes. Note that detailed processes were not imposed from the Department of Health down, rather Emergency Departments were encouraged to locally innovate to meet the standard. While local innovation was encouraged emergent and good practice between departments was encouraged through a process of sharing of practice of Inflow, ED flow and Outflow by the NHS Modernisation Agency/Institute for Innovation based on the Lean Thinking methodology. As the standard was implemented incrementally over several years, departments were actively encouraged to iteratively innovate their processes to achieve the standard.

#### Information:

Within this complex change the power of a single information measure has been very clear.

The 4 hour maximum time between patient arrival at the department to discharge from the department in 98% of cases made for a huge focus on that single measure to drive the change.

Some critics expressed issues of gaming of the measure, although there is now widespread acceptance that it has been very good for patients and Emergency Departments alike.

#### Technology:

Closely related to the information requirement, many departments moved away from white boards to track patient progress towards electronic systems to monitor and then analyse their 4 hour standard, which also facilitated the incremental change.

#### Standards:

This 4 hour Emergency Care standard is very good example of a single national standard that successfully allowed for local innovation in tackling a complex change.

#### Value:

From a patients point of view, by reducing the time that patients spent waiting for care in the emergency department, it is widely agreed that this change has added value. Indeed as time to care is generally a useful proxy of quality in Emergency Medicine this suggests that quality and safety improvements have also accompanied the change. Critics have pointed to safety concerns (i.e. patient care being rushed) and some overall increase in costs as there is some evidence that the number of admissions to hospital has increased as a by-product of the change.

As the standard is currently being revised, a more balanced scorecard of ED value is currently being prepared to inform that revision.

These two illustrative examples of healthcare change should help confirm that the key elements of change (people, process, information, technology, standards, value), explored earlier, apply as well within a healthcare setting as anywhere else.

To reiterate these key points.. healthcare reform requires;

People; Clinical Leadership and Cultural Change

Process: Adoption of process improvement methodologies, while cognisant of the complex systems nature of healthcare.

Information; Healthcare is information intensive. Information and Knowledge are key to change..

Technology: Staff need technology that supports their key processes. In noting that healthcare processes are information intensive, therefore healthcare has important information technology requirements.

Standards: Standards are very helpful in focussing change efforts. Again standards should be developed with awareness of the complexity of the healthcare system.

Value: Healthcare delivery may be difficult to quantifiable value. Yet benefits in terms of quality & safety improvements, time and/or cost reductions should be pursued with every change..

As our initial exploration of healthcare under pressure highlighted the particularly information intensive nature of modern healthcare, we now focus our exploration on the particular needs in healthcare for process improvement supported by better information technology as essential to achieve significant healthcare reform.

- Healthcare: needs better Information-Technology
- Healthcare: chasing the right fit between Process and IT..
- Healthcare: openEHR's potential to handle Complexity & Diversity
- Healthcare change: why "Open Source" is part of the recipe..

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## Healthcare: needs better Information Technology

In our initial analysis of healthcare under pressure, we have identified the particularly information intensive nature of modern medicine.

We have seen that information is a critical element of clinical care at the frontline, improving the quality of care via clinical audit, improving the research and evidence base of healthcare and delivering better value for money.

You may then naturally conclude that healthcare reform needs important support from information technology. However you may also be aware that the evidence of successes in healthcare IT is decidedly mixed.

What is clear is that there is some evidence of the significant value of healthcare IT (e.g. within primary care medicine and across a number of hospital institutions) in ;

-improving the quality of care e.g. with adherence to guidelines

-reducing the risks of care e.g. by reducing medication errors

..though there is much less evidence of related savings of time or money.

Certainly the evidence of widespread benefit across healthcare systems is limited and points to the challenges of scaling and maintaining information technologies amidst the complexity of healthcare.

Yet while there has been a myriad of stories of suboptimal health IT deployments, the appetite and drive towards greater and wider use of healthcare information technologies continue apace. What can explain this puzzle and gap between aspiration and reality?

Firstly, healthcare is complex.

As we have explained already, healthcare is a good example of a complex system. As a system of many parts and many interactions between those parts healthcare is more of an ecosystem than a machine and should be treated as such.

So while there may be umpteen stories of IT success at a local level, it is when one tries to scale up and then maintain larger and larger systems across healthcare systems that it can quickly become unmanageable.

Secondly as with change in an complex systems, success or failure usually relates to some of the key patterns that we have identified within.

The failures usually come down to one or more of 3 key factors-

People- lack of clinical leadership, clash of cultures

Process- poor fit with clinical process and

Technology - inflexible technology that struggles at scale .

Equally the successes are usually linked to ;

People - strong clinical leadership,

Process- a concerted and combined effort to improve processes and

Technology – that is flexible technology that can handle change..

Let us look further at these key points with a brief exploration of some work I have done in the past..

As part of my MSc and the start of my work within NHS Connecting for Health (which ran between 2004 and 2010 to deliver the NHS National Programme for IT), I was involved in the setup of a “Model Community”.

In healthcare terms this was a novel idea, attempting to support good practice in clinical engagement, process improvement and information testing by setting up an alpha test site as a Model Community..

Located within an NHS clinical setting, we invited NHS clinical and administrative staff to attend and explore and trial process changes with health IT software, in advance of it going live in any live clinical setting.

The clinical staff who attended enjoyed the experience for the most part, while highlighting common process and software issues that were then fed back to ensure further process improvements and software fixes.

It was fascinating at times and as expected familiar common patterns began to emerge from amidst the complexity..

People;

NHS Staff from differing parts of the service often/usually came with their own culture and view of the health service. While the NHS is one very large organisation, cultural variances within the NHS were/are common place.

Process:

As diverse groups exist within the NHS, each had their own view of their own processes. So alongside significant variation in existing processes, we also noted that the language used to describe similar processes differed significantly between groups. For example, the clinical terms “assessment”, “care plan”, “care pathway” while widely known, meant differing things to different groups.

Without a consistent healthcare process vocabulary and widespread process variation, one of the common findings we made was a clash between good process/practice and the related information technology solution that was expected to add value.

This finding of a mismatch between business process and information technology is not a new finding by any means, rather a common pattern that is exposed when exploring business change with technology amidst complex environments.

Technology

Without a common process language and framework, the natural result was/is that clinical teams, by articulating their processes in varied ways have defined varying information technology requirements that produce information systems with significant variation in their design and build.

Therefore the current health IT landscape has a multitude of technical solutions (with significantly overlapping functionality) yet they do not interconnect and interoperate, which is an acknowledged barrier to future healthcare reform.

The most common approach to interoperability to date has been to agree on and standardise the messages between disparate systems. There are numerous international standards available for “interoperability”, primarily for messaging... within healthcare the standards body Health Level 7 has long been the pioneer in this field.

To date the approach to interoperability between systems via messaging alone, while yielding significant benefits, continues to assume that clinical facing frontline systems can be treated as “black boxes”, without any pressure to standardise component parts within

the clinical systems.

While that fits with the current health IT markets' approach to each vendor maintaining their own proprietary information systems architecture, this does nothing to attempt to standardise the important fit between best practice or process and supporting information systems across healthcare that is needed for healthcare reform.

Naturally these issues are not confined to the NHS in the UK, but are rather universal issues found across the world of healthcare.

Simply put, Healthcare needs better IT.

Further to my work within the NHS CfH Model Community exploring common challenges in people, process and technology, we then began to explore common patterns in healthcare processes as a means to identifying common information technology requirements and related standards towards interoperable solutions. For more on that I will move on....

- [Healthcare: chasing the right fit between Process and IT..](#)
- [Healthcare: openEHR's potential to handle Complexity & Diversity](#)
- [Healthcare change: why "Open Source" is part of the recipe..](#)

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## **Healthcare: chasing the right fit between Process and IT..**

We have already noted that international healthcare systems are under pressure and that healthcare is a complex, information-intensive system.

We have also noted the mixed success of the Health IT industry to date, which also highlights the often poor fit between healthcare processes and related information systems.

In order to address this key challenge for healthcare, learning from the findings from the NHS CfH Model Community, we sought related solutions.

Aiming to tackle these issues of complexity and the alignment of process improvement and information technologies evident within NHS CfH NPfIT, I was part of a team that set out to explore the complexity of healthcare, looking for common generic process patterns, seeking common requirements and related standards.

The key findings from that work can be summarised along the usual key themes..

### **People**

In order to move beyond the challenges of specific clinical groups articulating specific clinical processes and specific IT requirements, clinicians need a greater understanding of the importance of generic reusable solutions.

### **Process**

As the healthcare domain lacks a common vocabulary around healthcare process, we sought to avoid the usual complicated look at process.

As per the Cynefin framework we took the view that healthcare is a complex rather than complicated system, therefore set out to seek common process patterns across healthcare. It was my observation that that some important process analysis methodologies omit to explore generic patterns amidst complex systems, but typically take a “complicated” approach to process analysis (e.g. BPMN).

It should be noted that the business process analysis field is not yet a mature science, so there exists significant room for further development in this area.

The process improvement methodology I like to borrow from to explain this challenge is named PISO (Process Improvement for Strategic Objectives) explains business processes at 4 layers.

As Is- Physical

As Is- Logical

To Be- Logical

To Be- Physical

This important separation of process thinking from physical to logical is key to identifying generic process patterns in healthcare (as in any other complex field).

Naturally it should be noted that thinking in physical/logical layers of process does not come naturally to all clinicians, hence this analysis should not /need not be redone all the time...



Our approach to seek generic process patterns in healthcare was/is very useful. The key point here is that while healthcare is a deeply complex system at the core of the healthcare process, the encounter between patient and clinician, there are a very small number of recurrent and generic processes, which exhibit a cyclical nature. This conclusion is not new, but it has profound implications particularly with regard to the design of health information systems architecture.

#### Information Technology

A conjoint approach to change focussed on generic processes can offer a plausible route for the greater alignment between process improvement methodologies such as Lean Thinking with the related requirements for a Service Oriented Architecture in Healthcare.

(While this complex systems oriented thinking is not confined to healthcare, I shall confine my discussion within healthcare to further develop the point).

At one level this requirement can begin to be met via portal development, integration of existing systems and a service oriented architecture approach to tackling core process requirements such as the NHS Clinical 5. Elements of this approach are gaining increasing traction in many places internationally and form the basis of our own current Leeds-TH Informatics Strategy.

At a deeper level there is a more profound requirement, i.e. a -generic healthcare process-related – information system architecture- is needed in healthcare, therefore I then went in search of related standards from the healthcare standards field.

While the main players in the healthcare standards field (HL7, IHTSDO, IHE) have not developed a clinical process oriented health record architecture standard, in 2006 the openEHR Foundation published version 1.0 of an openEHR architecture specification for this very purpose. The openEHR specification is in itself the result of an evolving body of European and Australian Research and Development that laid the groundwork for openEHR. While I must admit it took some effort to digest the key elements of the specification, openEHR does I believe contain several of the key elements that are required in the healthcare information systems standards space, which I will explore shortly.

So though it has taken me some time as a frontline clinician to draw this conclusion.....  
..if our ambitions are to improve care across healthcare systems, with better processes at the frontline, greater sharing of patient information between providers, more seamless audit and research and deliver greater value for money in healthcare.....  
.....then I believe an open health record architecture standard is now needed..

Since drawing that conclusion I have become closely involved with the openEHR Foundation and in the next article I will delve further into the fit between complexity, healthcare and openEHR.

- Healthcare: openEHR's potential to handle Complexity & Diversity
- Healthcare change: why "Open Source" is part of the recipe..

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## Healthcare: openEHR's potential to handle complexity & diversity

We have noted that healthcare is a complex system that is particularly information-intensive. We have noted that healthcare reform requires clinical leadership, process improvement and effective health IT.

In noting that healthcare IT has had mixed success to date, we have identified the important need to support the greater alignment of process improvements with information systems.

While aware that the current health IT industry has some way to go, the conclusion reached in exploring this challenge to date is the international requirement for an open, generic-process-oriented health- information service-oriented-architecture standard.

As I have already introduced the openEHR specification (the result of many years of European and Australian R&D) as the leading candidate solution to this need, let me now briefly explain its key parts in a little more detail.. which can be conceptualised in 4 key layers...

At the core of the openEHR specification is the reference information model that is immediately recognisably as linked to the generic processes of healthcare. Within the openEHR specification those processes are named as Observation, Evaluation, Instruction and Action. (This generic process nomenclature fits with any generic process analysis I have seen to date and I might further suggest that the approach taken may have utility in other domains.). This clinical process oriented foundation is key to the value of openEHR, setting it aside from all other international health IT standards and provides the useful basis of components that are then built on top..

At a layer above the reference model in the openEHR “stack”, openEHR offers the archetype, now an EU and ISO standard en13606, currently being explored by eHealth programmes in the UK, Sweden, Singapore amongst others.. The archetype can be explained to clinicians as a maximal dataset/common structure for common clinical concepts eg Pulse, Blood Pressure etc that relate to the key core generic process patterns that are seen amidst the complexity of healthcare. While there is one reference model, the number of draft archetypes internationally available today number in the hundreds. The openEHR Foundation has made an openEHR Clinical Knowledge Manager available online as a means to harnessing a growing online community who are overseeing and furthering the development of key archetypes, as per “wkinomics” and the rest of the Web 2.0 revolution. To clinical staff archetypes can be explained as clinical “Lego bricks” as they should therefore be developed with reuse in mind. In process terms, archetypes relate to the logical layer in our earlier look at process analysis.. In software engineering terms they can be understood as reusable objects within an object oriented software library that the clinical end users help to co-author.

While the archetypes should be understood as maximal datasets that can be reused by many/all clinical specialties, it is at the template level that the balance between international standardisation and local flexibility is struck.

The template mechanism allows a national/region/hospital/department/individual clinician to reuse standardised archetypes, while composing the template and constraining the archetypes in order to meet the requirements of their specific template requirement..

Candidate templates might include Emergency Discharge Summary, Asthma Pathway, etc.

While archetypes may number in the hundreds, one can easily imagine thousands/tens of thousands of template requirements in the diverse ecosystem of healthcare.

To clinical staff, templates can be explained as those “Lego toys” that can be rebuilt in an infinite number of ways from the underpinning bricks.

In process terms, templates relate to the physical process layer in our aforementioned look at process analysis.

In software engineering terms templates can be understood as close to the applications that can be derived from reusable object oriented libraries.

This “2 level modelling” between archetypes and templates are key to openEHR and I believe are the key to both handling the deep complexity, wide diversity and ongoing evolution of healthcare systems.

At the top of the openEHR stack, templates can be transformed into a User Interface (UI) layer.

There may be room for debate on how much variation there should be at the UI layer in an ideal healthcare information system platform.

If you accept the patient safety arguments made by the NHS CfH Common User Interface team, then you could argue there should be a consistency transformation between an openEHR template and the related UI layer, thereby ensuring a consistent approach to navigation, data review, data entry etc..

However from a health IT vendor perspective you may want to offer a choice of e UI on top of the openEHR archetypes and templates...

In my opinion these 4 key layers of openEHR specification (i.e. reference model/archetype/template/UI) offer key elements that healthcare now requires of a open service oriented architecture standard.

In offering this open specification, openEHR offers a foundation which should offer;

- fit with clinical process
- reuse of clinically related component parts
- balance between international standardisation and local flexibility
- basis to support cross organisational workflow required of patient centred care pathways.
- basis for integration of healthcare information and knowledge management via effective linkage between the electronic health record and decision support... thereby the potential (and holy grail) of semantic interoperability in healthcare.

Having explained the important elements of the openEHR specification, let me now make a case for greater collaboration between openEHR and the other key players in the health IT standards field.

Aside from the key requirements around a clinical process oriented health record architecture standards, there is a case to be made for other important related standards.

If archetypes provide a common specification for building healthcare information systems, then the key elements of the language used within that information system may also benefit from standardisation.

The International Health Terminology Standards Development Organisation (IHTSDO) offers an international standard terminology (i.e. SNOMED CT), while the and the World Health Organisation offers the International Classifications of Diseases (e.g. ICD 10) as important medical vocabulary standards that are also important to note.

While neither offer the 4 layer stack and the 2 level modelling on offer with archetypes-templates... it is clear that archetypes and templates need to leverage the important added value of terminologies and classifications and indeed should be developed with that alignment in mind..

Beyond the need for standard and reusable components (e.g. archetypes/templates with terminology subsets etc) within systems , there is of course a requirement for a standard mechanism to exchange related information between healthcare systems. Health Level 7 (HL7) is the key player in this space internationally, having developed the widely used HL7 v2 messaging standard and then the more recent and more complicated v3 standard. The HL7 Clinical Document Architecture as an important messaging standard that appears well suited to the interchange of structures messages between healthcare systems (while flexible about the clinical content within) and is one of several important and valuable standards that HL7 offers health IT developers as health reform moves forward.

By standardising the messages between systems rather than the underpinning health information platform, the approach of HL7 to date has understandably been to accommodate the diversity of proprietary health information architectures within the current market.

This approach has provided (and continues to provide) significant value by facilitating the sharing of information between healthcare systems, yet without either a process oriented SOA or the complex-systems-ready two-level-modelling that openEHR archetypes and templates offer, my view is that the current HL7 standards alone are not enough to address the complex and diverse needs of healthcare reform.

The Integrating the Health Enterprise also offer standards for information sharing, with an emphasis on the logistics of sharing specific elements of the health record such as patient identification and document sharing, while also remaining agnostic about the foundational architecture of clinical information systems.

While I have attempted to expound the inherent value and potential of the openEHR specification in healthcare, it is my view that none of the health IT standards outlined can thrive and add value in isolation.

Healthcare reform now requires both collaboration between those key international health IT standards bodies and ongoing innovation from those tackling healthcare improvement efforts at the frontline.

As we conclude our exploration of openEHR and its potential to handle the complexity and diversity of healthcare, we now move onto explore one means to unite both international standards and local innovation efforts.. and the growth of open source efforts which may support international healthcare reform.

- Healthcare change: why "Open Source" is part of the recipe..

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## Healthcare change: why “Open Source” is part of the recipe..

We have explored the key elements required for healthcare reform, the critical role of health IT therein.

We have also noted the challenge in aligning clinical process improvement efforts with the right service oriented architecture for healthcare.

We have noted that important international interoperability standards are emerging, while aware that real change and innovation must be fostered from the bottom up. After some recent efforts attempting to bridge this important gap, my conclusion is that there is now an important role for open source IT to support health IT. Let me explain...

Having begun my work within the NHS CfH National Programme for IT usability testing within a Model Community, then exploring generic clinical processes to identify common generic health IT requirements... my work then evolved into clinically leading an effort focussed on “clinical content” within the health record and related standards.

Though the scale of the challenge was large, in Cynefin terms considering the almost chaotic state of clinical documentation in an health system as large as the NHS, the solution was simply to take a lead and look amidst the complexity for some important patterns that should be harnessed.

Those key patterns were quickly evident thanks to the important work that had begun by the Royal College of Physicians (in conjunction with the Academy of Medical Royal Colleges) around Clinical Record Keeping standards. In achieving professional consensus around the headings that should be used for 3 key clinical documents, i.e. admission, handover and discharge documentation across the NHS, the focus of our efforts towards supporting key clinical processes with clinical information standards was clear. We took those clinical headings and over a series of iterative workshops with frontline clinicians developed a maximal dataset that detailed related common clinical statement patterns.

Following earlier work on best fit between clinical process and health information architecture standards, we then passed these clinical standards to our technical standards team who dutifully took our requirements and design and built related openEHR archetypes and templates to match these requirements.

These nationally agreed clinical and technical standards were then passed to the vendors so they could consume them within their own systems, so they could be used at the frontline....

..Which is where the cycle of development stalled..

The fact that this single professionally led, process improvement effort with IT stalled tells us several very important things about the current state of health IT;

That efforts to follow a waterfall approach to requirements, design and build of health IT standards get you so far. but a paper based standard is of limited value.. the challenge is in the implementation.. i.e. “the last mile”.

..As while your vendor may promise “interoperability” and adherence to important standards, their currently proprietary architectures make it challenging for them to reuse those emerging components from international standards efforts (e.g. archetypes, terminology etc). They may not be able to, they may not want to ..either was it reflects the current state of the market...

..Therefore those clinicians looking to innovate at the frontline, showcasing healthcare IT with related standards and pioneering semantic interoperability in action are also constrained..

Therefore.. it is my considered view that to address these key challenges, a radical shift in the health IT industry may be required.. which may be facilitated by emerging developments from the open source world.. While I understand that this is, at the present time, an uncommon view, let me return to where I started...

Healthcare needs to change, with clinical leaders tackling process improvements, supported by information technology and standards that add value. .  
Equally Healthcare IT also needs to change, away from competing with proprietary technologies , towards an open architecture and platform for healthcare innovation...so that the industry moves to competition based on the services that are provide and the value that they add.

While this change will affect the international standards bodies, commercial partners and frontline innovators, it may emerge from several directions. We have already noted a gap between the aspirations of the international standards bodies and the realities of interoperability at the frontline. Therefore it would appear that greater collaboration between the international health IT standards community and those attempting process improvements at the frontline via a shared open source effort could be fruitful next step for all concerned..

With that in mind, I have in most recent times taken a clinical lead on two open source health IT projects which I should mention...

The first named Opereffa (openEHR REference Framework and Application) which, via my research links with the openEHR Foundation and UCL in London, is an open source effort aiming to showcasing openEHR archetypes, templates, SNOMED terminology and HL7 messages in action within a web-based UI environment.

The second, codenamed Prottean, is an open source clinical portal effort based in Leeds Teaching Hospitals NHS Trust which is being developed as part of a broader service improvement with informatics strategy. Aimed as the key user interface for clinical users it will provide the frontline with an iterative approach to systems integration and addressing the “clinical 5”.

Both are leveraging the open source Eclipse platform.. a close relation of the important openHealthTools.org initiative which I believe offers a very important opportunity to support the healthcare reform challenges ahead...



## References

NHS eHealth open source ecosystem

<http://www.ehealthopensource.com/>

Open Health Tools

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Opereffa

<http://opereffa.chime.ucl.ac.uk/introduction.jsf>

RCP/AoMRC Clinicians guides to medical record standards

<http://www.rcplondon.ac.uk/clinical-standards/hiu/medical-records/Pages/clinicians-guides.aspx>

# Bookmarks

## Book of thoughts

- Healthcare – an introduction
  - Healthcare under pressure ..and needs to change
  - Healthcare; challenges at the frontline
  - Healthcare-and-the-challenge-of-departmental-improvement
  - Healthcare; the “right thing to do” challenge
  - Healthcare; the Value challenge
- Chaos-Complex-Complicated-Simple and Cynefin
  - It’s become a complex world; an-introduction-to-Complexity
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  - Standards and Value .....and a note about “the last mile”
- Healthcare Change & the way forward
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  - Healthcare: chasing the right fit between Process and IT..
  - Healthcare: openEHR’s potential to handle Complexity & Diversity
  - Healthcare change: why “Open Source” is part of the recipe..