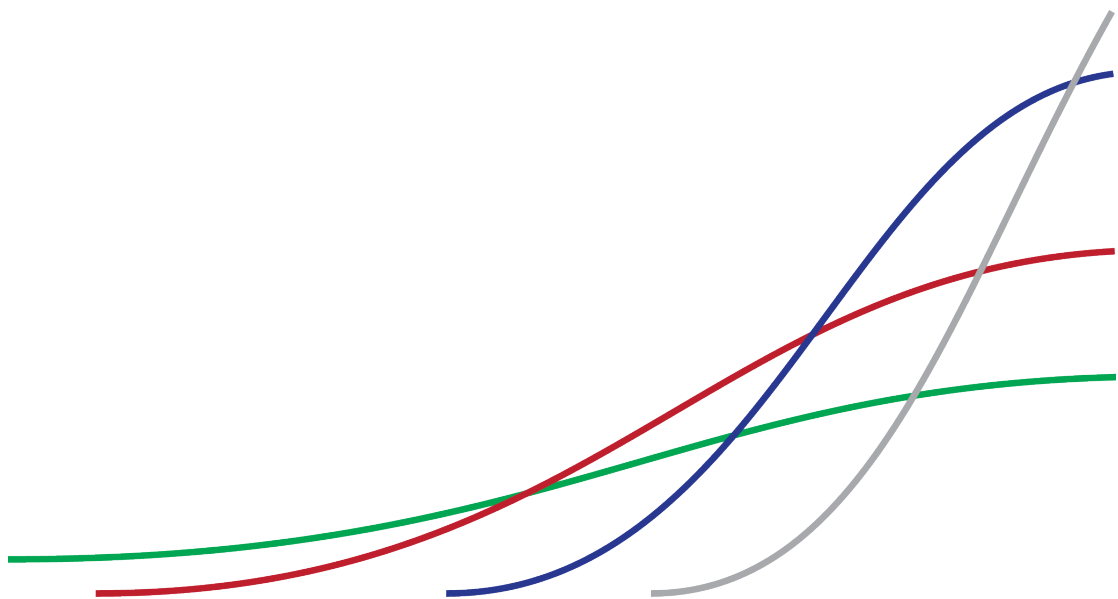


Information Technology Futures

for suppliers and technology professionals



Written by Martin Butler

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Introduction

The first forty years of the business use of IT has been dominated by process automation and labor displacement. Compared with what lies around the corner this is the equivalent of riding on horse-back, and while pleasant it is hardly appropriate for a journey down a motorway. It is my opinion that we are on the cusp of something quite different - a second wave of technology that will be primarily concerned with intelligence. All the pieces are in place and are being assembled by businesses that have already got the message. How will your organization cope?

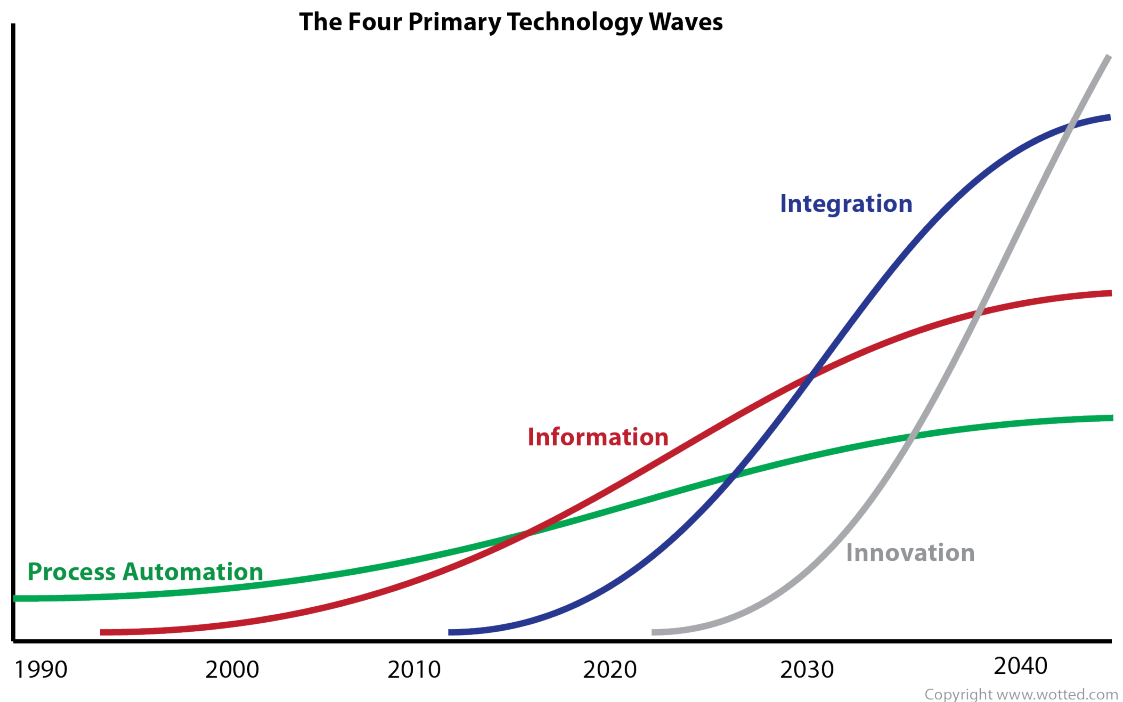
The first section of this paper looks at four primary waves that, ever since I formulated them in the late 80's, have been a guiding light in my analysis. These are long-term trends, but they are of particular interest right now because we are at an inflection point between the first and the second. So if you are a supplier there are changes afoot that will determine where you create value, and if you are a user of technology this change may make you want to steer your career in a certain direction.

The second section focuses fully on the implications of the trend crossover we are witnessing for users and suppliers. This is where I explore in some detail the fairly frightening global business environment that is taking shape and who will be the heroes in this brave new world. I'm on fairly safe ground here simply because it is already happening. When I spoke on these things ten years ago I could see conference delegates trying to figure out whether I'd been served with the wrong type of mushroom for breakfast. Just as a taster - would you like to make US\$3,000,000? It's up for grabs (at the time of writing) - but you need a pointy head. More on this later.

Finally I'll go out beyond the current wave crossover to the next primary wave, which may be on us sooner than we want. As far as I am aware no one has written about this, and it may be at this point that you emulate the conference delegates of ten years ago. But I can assure you that I have not had mushrooms for breakfast, and that there is an internal logic in these arguments.

The Four Primary Waves

The waves I'm about to describe are very long term - measured in decades, and they are not mutually exclusive. In fact one builds upon the other, and the later waves would not be possible without the preceding ones. So there is overlap, and individual organizations will have their own journey from one wave to another. So without further ado let's get down to business. To this end I've displayed the waves in the diagram below.



Each wave follows the usual 'S' shaped curve of adoption and eventual stabilization, and they overlap. What you will also notice is that each wave is larger than the one preceding it. In reality we are only just off the starting blocks with information technology. It seems that we have been automating business processes for ever, and that it is the only use for IT. But nothing could be further from the truth.

Process Automation

This is the comforting, familiar world most of us have grown up with. Sales order entry, human resources, supply chain, production scheduling and so on. Administrative functions have been particularly well served over the last several decades and the whole thing reached a sort of crescendo with Enterprise Resource Planning (ERP) - although this is a total misnomer. ERP is not primarily concerned with planning, but with day-to-day admin. Expense sheets, general ledger, sales reports etc. In any case ERP will be seen as something of a swan song for the era of process automation. Of course we need predictable, repetitive processes for them to be automated (it would be very difficult to automate unpredictable, individually unique processes). Business Process Management (BPM) is another manifestation of this particular use of technology, and expect to

see other initiatives. But importantly, this is a domain of diminishing returns and is no longer where the big payoffs can be found.

In many ways process automation can be seen as the bedrock for much of what follows, since without the capture of data nothing else is possible. At various conferences I have typically conducted a number of straw polls. One of them was to ask how many organizations used IT for anything other than process automation. The response is always the same - about one in ten (an unfortunate coincidence for those who remember the song). This model of IT is so dominant that many organizations will have difficulty moving beyond it, making way for those who do of course.

In many ways process automation and the thinking that goes along with it is just an extension of the era in which it grew up. People made stuff and wanted to make it for the lowest cost, so efficiency was important. Automation is just a mechanism for greater efficiency, although this is no guarantee of success. If your products are unattractive and the markets in which you participate are not growing then efficiency means almost nothing. It is rumored that one of the US auto giants invested more than two billion dollars in its global ERP rollout - and then went bust (almost).

Information

For an industry that uses the word 'information' an awful lot, it is surprising that there is precious little understanding of what the word means. So to give the rest of this document some context a definition is in order. Information reduces uncertainty. Don't take my word for it; ask a communications engineer, an economist or social scientist. In fact it seems that almost everyone knows what information is apart from the information technology industry. This definition is important because, although the world of process automation makes us feel as if everything is proceeding along a well-determined path, the reality is quite different. Uncertainty is everywhere and we need information to deal with it - at the micro as well as the macro level. Anyone who has built or run a business is primarily rewarded for dealing successfully with uncertainty (watch the movie 'Margin Call' to see what I mean). And I should add that while Butler Group was not a large company (employing about 120 people), my daily diet of uncertainty was something that was always present.

Senior managers consume the most potent information. Their uncertainties are profound. Is this a good company to acquire (will it enhance my bonus)? Will the new product sell well? What are competitors doing - and so on. This is addressed to some extent by Enterprise Performance Management systems - but only partially. Senior management often call on outside resources to provide information in an attempt to reduce their uncertainties.

Next we have middle managers who have very specific information needs - usually about performance, but increasingly concerning how to optimize their operational activity (more on this shortly).

Finally we have day-to-day operational activity which is served by a raft of essentially dumb applications that support the capture, storage and retrieval of

information. This was adequate just a few years ago - today it isn't. Dumb was once good - it was stable. Today dumb is bad, because markets are no longer stable (and becoming less so) and we need smart applications.

Until recently the only information most managers thought they needed was historical analysis. Last month's sales figures, today's production numbers. This could be got using any number of Business Intelligence (BI) applications. While this is useful information, the game has changed. We now have to predict how customers are going to respond, or who is a bad credit risk, or when equipment is going to fail, or even when someone is likely to resign.

At this point it is worth digressing a little to give some background to what follows. The people with pointy heads (mathematicians in the main) are not a total waste of space (as many commercial folk tend to think). They have been busy over the last fifty years or so creating a wide array of techniques that allow data to be analyzed for trends, patterns, correlations, cycles - in fact almost everything that is of interest to businesses. Many techniques predate this, and one goes back to an eighteenth century vicar - a certain Thomas Bayes (so vicars are not a total waste of space either). These techniques have been eagerly adopted by technology suppliers because they do indeed allow us predict outcomes from the analysis of historical data. Many of these methods are very mathematical involving reams of linear algebra, and it wouldn't be good to discuss such things in polite company. However impolite folk (the ones with pointy heads) are now in great demand. I refer back to the US\$3,000,000 figure I mentioned earlier. Heritage Provider Network in the US is offering a US\$3,000,000 prize to the information scientist who predicts patient hospital admissions most accurately. Go to www.kaggle.com if you fancy your chances.

Enough said on information for now. I'll be majoring on it in the next section and exploring how it affects IT professionals and suppliers.

Integration

This wave is germinal, but it will become mainstream when business managers realize that volatile markets need an agile response. There has been much talk of agility. It's a perennial that flowers over and over again because in reality we've never really had the means to address it. A fundamental prerequisite for agility is integration, and most businesses are anything but. I'm not just talking about process and data integration, although these are of course necessary. Integration needs to happen at the organizational level, and so the functional stovepipes that characterize most businesses will have to be integrated in some way. I have suggestions but I'll keep them to myself.

From a systems and information point of view we need feedback and control mechanisms. Just as the folk with pointy heads delivered devilishly clever ways of deriving predictive capability from data analysis, so another group of pointy heads will deliver control structures based on cybernetic principles. A concrete illustration will help. Your smart systems have been implemented and are doing well. However you notice that a certain segment of customers is falling away. At what point do you decide that action is needed? Is it a blip, or something more serious? Predictive technologies would have nothing to say about this - you need

something different. Just like a thermostat knows to trigger the heating when the temperature drops by more than four degrees say, so we will need systems that trigger a response when matters deviate beyond a certain threshold. But here is the rub. We are operating in real-time markets using 'big data' technology and real-time analytics. Our response has to be in real-time and even the most pointy headed person cannot meet this need, and so we need real-time feedback and control.

Some techniques that are very rarely used in business will probably become commonplace, and I'm specifically thinking of game theory. Real-time strategy implemented in mathematical algorithms.

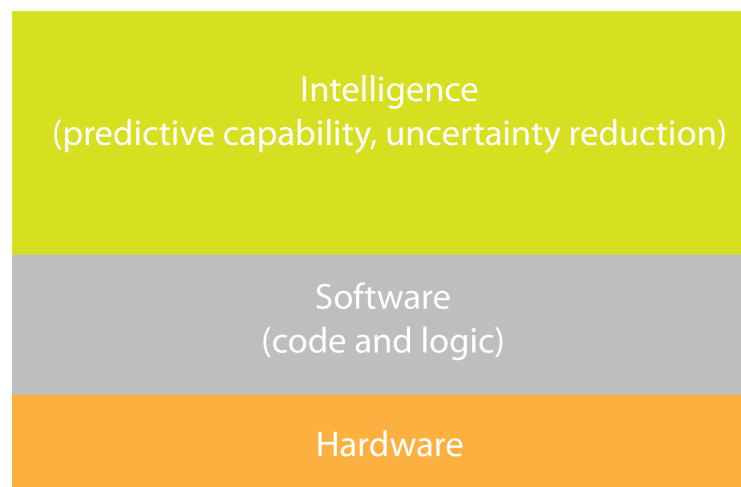
This is at least five years away, and the rest of us will get to know about it when a few others have already built multi-billion dollar empires from it (as Google, Amazon and Facebook have from real-time analytics). I could say much more about this, but maybe in another document.

Innovation

No organization can innovate unless its systems and information house is in order. They can of course try to innovate, but the best of efforts will fail when the back-end does not hang together. It should be screamingly obvious (particularly with the Facebook float just completed) that innovating with information has a big payback. This is light years from where most senior execs are thinking and so there isn't much point dwelling on it. Just remember that tomorrows Facebook and Google will be information innovators.

The Cusp of Information

Back to the present. So who is earning the big bucks in IT today - and more importantly who will earn them tomorrow? Well if you understand such things as support vector machines, neural networks, Bayesian statistics ... and you can apply them to predictive data mining, then the chances are you can make big bucks. More than this. If you are a supplier of technologies with predictive capability and you target them at receptive industries then you can do very well indeed. There is a third layer of skill and supplier forming over the two layers we are already familiar with - hardware and software. We could call this third layer 'intelligence'. It's a much overused term since Business Intelligence wasn't really about intelligence at all - it was about facts. This relationship is shown in the diagram below.



While hardware is primarily concerned with circuits, cables, disks and processors, and software with logic and code, the Intelligence Layer is concerned with information. It needs the two supporting layers, but is quite different from them. A new set of skills is required here too. People in this domain use words such as entropy, nominal values, p values and so on - it's a different world.

Just as software became a compelling reason to buy hardware, so Intelligence will be embedded into software. Suppliers are already appearing who provide the means for suppliers of dumb software to add intelligence (thinkAnalytics for example). This will become a whole new layer added to the technology industry.

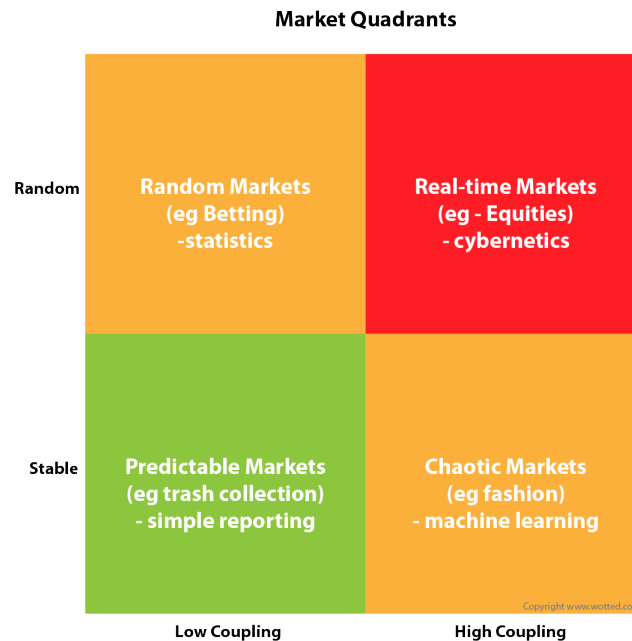
Obviously there will be degrees of capability that organizations will buy in to. Very large corporations can afford to build their own bespoke intelligent applications. The cost of this will be substantial and beyond the means of smaller organizations. They will opt for 'black-box' solutions with little or no idea of how they work. There are dangers here, but that's another story.

We will not simply be processing the same old data either (sales order, payroll etc). Social data, sensors of various kinds (RFID), web data and so on are all up for grabs. Much of this is 'live' and volatile. Respond now or miss the opportunity. To meet the needs this data presents the term 'big data' has been introduced. The trusty relational model just cannot cope with petabytes of streaming data that needs to be analyzed in real-time - big data technologies can

(look at Apache Hadoop if you are interested). And I should add that the computational burden imposed by predictive algorithms is not small, so parallel computing is essential - and for this we will need new languages. Out with object oriented - in with functional programming. Not today or tomorrow, but over the next ten years. If you are a programmer you should at least be looking at F# or Haskell.

Markets

All of this translates directly on to a map of market characteristics. This is shown in the diagram below:



Every market can be characterized by the degree of coupling between market participants (ie how well they communicate) and the degree of random activity. Strong coupling can lead to chaotic markets – something similar to a shoal of fish moving in a coordinated but seemingly random manner. Highly random behavior means that events that affect a market can in no way be predicted, and as such a statistical treatment is appropriate.

When coupling and randomness are small we get very stable markets – the type of market most organizations like to pretend they operate within, even when they don't. Analysis of such markets can be accomplished through spreadsheets and simple reporting mechanisms. A good example is trash collection. There may be seasonal variations and holidays, but in the main the number of trash cans that need emptying varies slowly with time.

High levels of coupling on the other hand result in chaotic markets. The word 'chaotic' is a little misleading since it implies that nothing can be predicted. This is not true however, and machine learning techniques (predictive analytics) can usefully be employed in this domain.

Real-time markets occur when both coupling and randomness are high. These markets cannot be predicted – they can only be responded to in an appropriate manner, and for this we need systems based on cybernetic principles.

In reality most markets are steadily drifting toward the real-time scenario, and when trash cans with sensors become commonplace even this market will change.

There is much more I could say about this, but as one delegate at a conference complained - 'you move too quickly, every slide is a slap in the face'. Well maybe you've been slapped in the face enough, and so I'll summarize.

Summary

We are currently experiencing a change of emphasis in the way information technology is used. The long, and fairly exclusive period of process automation is being complemented by a rising use of technology to exploit information for uncertainty reduction - predictive analytics particularly. As data sources proliferate we need different technologies to handle the volume, volatility and complexity of this data. We will also need new skills. The future belongs to the information professional. The technology may well be in-house or hosted in 'the cloud' - a simple spreadsheet will tell you which, and as such I consider 'the cloud' to be somewhat passé.

The volatility of markets will require a third wave of technologies that implement feedback and control methods, and this may come upon us sooner than we think as predictive technologies contribute to the unpredictability of the very things they try to predict.

Finally the innovators will have implemented all three layers - automation, information and integration and will be able to manipulate markets for their own advantage.

About

Martin Butler is best known as Founder of Butler group, Europe's largest indigenous IT analyst firm before its acquisition by Datamonitor in 2005. He now focuses on second wave information technologies and publishes through Butler Analytics. He can be contacted at: martin@butleranalytics.com