

# From hidden data to actionable insight

How telecoms and utility companies are using advanced mathematical techniques to help transform their competitiveness



Commissioned by

**TrinityHorne.**

# Foreword

By **Brendan Cahill**, Chief Executive, Trinity Horne

As an established consulting firm in the telecoms and utilities sector, Trinity Horne has been at the forefront of the innovations outlined in this report. Operational managers in these businesses face huge challenges in improving productivity, ranging from



the inherent size and complexity of their organisations to the adherence to accepted ideas which accumulates in any organisation. In our experience, the application of advanced mathematical techniques can provide genuine insight and equip operational managers to better solve problems, make better decisions and minimise risk. In increasingly complex and fast-moving organisations, it can help them see the wood from the trees and potentially provide a significant competitive advantage.

W. Edwards Deming, a physicist and quality improvement pioneer, is often quoted as saying: "In God we trust, all others bring data." Companies are awash with data about customers, production – about each and every one of us. The evolution of computing power and the development of advanced analytical tools has made possible the use of statistical analysis techniques to identify trends, patterns and relationships in that data allowing the identification of actionable insight.

## Data has become a key strategic asset.

Of course, data in itself is of little value. In business, there is no substitute for management action. In their 1960's best seller, *The Rational Manager*, Ben Tregoe and Chuck Kepner suggested that, if sufficiently clarified, all management action falls into making decisions, solving problems, or protecting a future action or plan (risk management). What was missing in the 1960's was the computing power and analytic capability to identify the trends, patterns and relationships in data to enable better informed decision making, problem solving and risk management.

What this report highlights is the extent to which these opportunities are under-exploited. The research here demonstrates the extent to which managers feel confident about their ability to make the right decisions. Have they focused their operational expenditure in areas where it can add the most value? What are the priorities for capital expenditure? Do they really understand the relationship between their assets – primarily their network – and customer satisfaction?

This report reinforces our belief that the application of advanced mathematical techniques can help make sense of the complex and sometimes contradictory datasets that exist within organisations and on the way to create genuine, currently untapped competitive advantage.

# Contents

Foreword	2
Introduction	3
<b>Part 1:</b>	4
<b>An under-exploited opportunity</b>	4
<b>Part 2:</b>	7
<b>Pioneering a new approach</b>	7
Applied analytics	7
Four reasons to change	8
<b>Part 3:</b>	
<b>Overcoming the barriers</b>	9
From analysis to execution	12
<b>Acknowledgements</b>	13

# Introduction

## A hidden revolution

When, just after Christmas 2010, 40,000 people in Northern Ireland found themselves without reliable water supplies, it was a timely reminder, not only of how much we depend on utility companies, but also of the scale and complexity of these businesses.

At the height of the crisis, an extra 250 mega-litres of water were being pumped into the system every day, but most was lost in leakages from burst pipes. At the end of December, lorry-loads of 160,000 litres of bottled water had to be brought in from Scotland to families, many of whom had been without water since before Christmas. The delayed response by Northern Ireland Water caused public outrage. According to John Dallat, a member of the SDLP at the Stormont Assembly, “the company is now effectively being run by people who have no experience of water utilities. No one should be in any doubt that this crisis didn’t begin with the first snowflake... It should come as no surprise that there was no contingency plan and a complete breakdown in how to manage the situation.”

But for every disaster that hits the news, there are just as many examples of how utility and telecoms companies are finding innovative ways, not only to prevent problems like those encountered in Northern Ireland, but also to improve the service they provide to their customers.

Behind the scenes, utility and telecoms companies are changing the way they work, exploiting the huge volumes of data now being produced by the systems they have invested in over the last few years, and applying sophisticated analytical techniques, not just to cut costs in some of the most expensive areas of their business, but also to improve the quality of service they provide to their customers.

*Hard evidence removes the need for guess-work. It helps improve performance*

– Steve Wilson, Welsh Water

The aim of this report is to explore the extent to which applied analytics represents an opportunity for telecoms and utilities and to understand the factors which are critical to making use of the results of the analysis in practice.

We use the term **applied analytics** throughout this report to refer to the harnessing of raw data, complex statistical analysis and the knowledge of internal experts to provide factual insights which enable informed management action in areas as diverse as maintenance optimisation, investment risk and customer churn. At its heart is a sophisticated model in which all of the data points can be analysed in conjunction with any other. The crucial difference between this approach and other, more conventional analysis is that it is possible to compare the impact of different elements within it rather than looking at each element in isolation.

The first part of the report looks at the extent to which telecoms and utilities companies feel confident in their ability to understand how the key elements of their business interact. How easy is it for them to measure the impact their operational expenditure has on the performance of their network? Can they quantify the impact changes in network performance have on customer satisfaction levels?

Part 2 examines how leading organisations in these sectors are using applied analytics to change the way they run their businesses and explores the advantages of this approach. The final part of the report looks at how the barriers to making effective use of applied analytics can be best overcome in order to create competitive advantage.



# Part 1:

## An under-exploited opportunity

The core operational and financial challenges facing every utility or telecoms business are scale and complexity. Their “network” assets, whether that takes the form of cables carrying electricity from generators to substations to offices, optic fibres delivering broadband telephony and data to homes, or pipes for clean and waste water, will be hundreds of miles in length and may well combine the legacy technologies of different companies now merged into a single infrastructure. The performance of this network drives customer satisfaction, so while the costs of maintenance and repair are huge, the costs of problems are far higher.

Complexity and scale make it enormously difficult for network managers to be sure that they’re investing in the right areas. Our survey of more than 50 senior managers in the utilities and telecoms sectors suggests that there is a lack of confidence in their ability to make the right decisions. It also showed that confidence levels vary by type of decision and by sector.

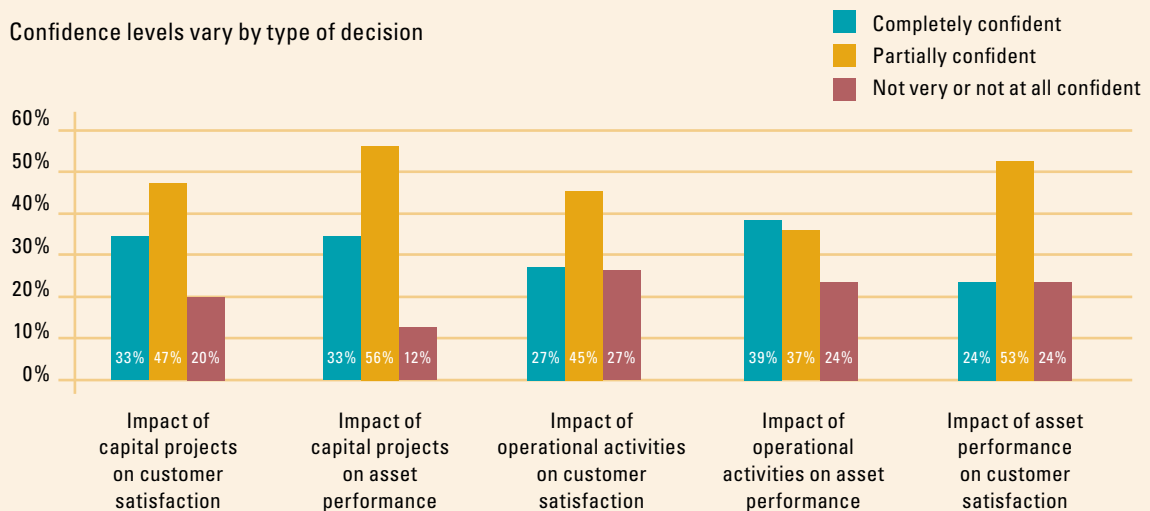
As Figure 1 indicates, overall levels of confidence are highest when it come to understanding the impact operational expenditure has on asset performance, but even here the proportion of people who say they are completely confident is less than 40%. Confidence tends to be lower where the impact on customer satisfaction is concerned: only a quarter of those respondents felt completely confident that they understand the impact asset performance has on satisfaction levels and only a third the impact of their operational expenditure. At the same time, around a quarter rated their confidence in these areas as slight or non-existent.

**24%**  
The proportion of organisations that don't understand the impact asset performance has on customer satisfaction

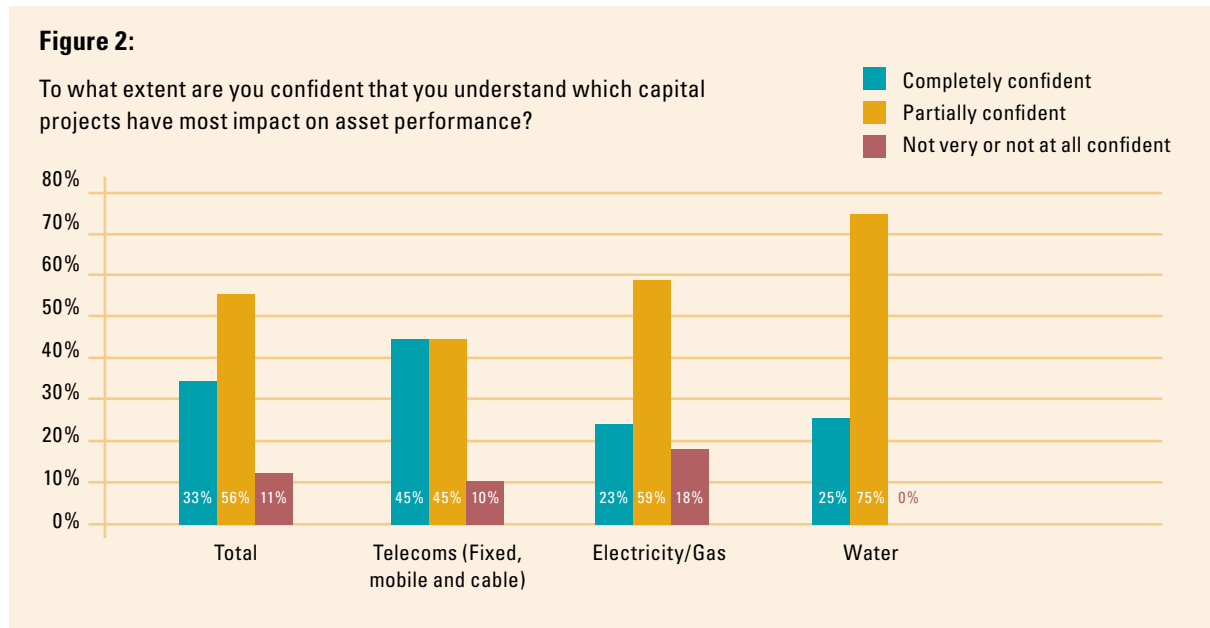
**27%**  
The proportion that don't understand the impact operational expenditure has on customer satisfaction

**Figure 1:**

Confidence levels vary by type of decision



Looking at this from a sector-specific perspective, confidence was highest in the telecoms sector and lowest among electricity and gas companies; there, almost a fifth of senior managers said they were not very or not at all confident (Figure 2).



*There are hundreds of thousands of different components to a telecoms business, some of which impact customer satisfaction directly while others have an indirect bearing or none at all. We can't take one in isolation because they're inter-related. Data analysis is crucial to helping us see the business as a single integrated whole*

– Carl Grose, Arqiva

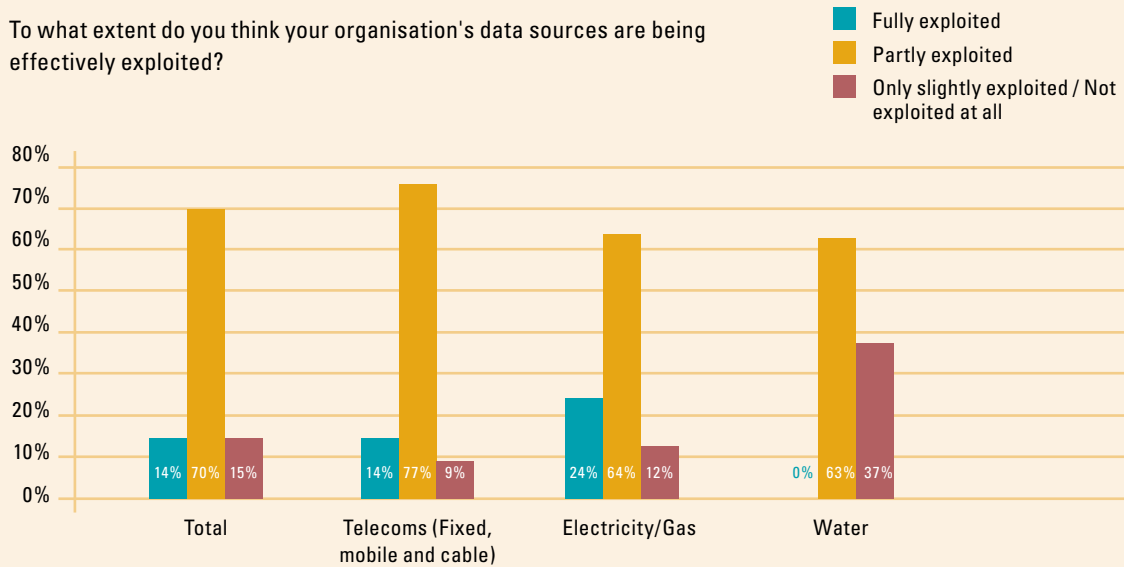
This picture is echoed in the different areas of decision-making. Telecoms managers were roughly twice as likely as their equivalents in the electricity and water industries to be completely confident in their ability to measure the impact of capital projects on customer satisfaction. Even where measuring the impact on asset performance (an area where confidence levels were generally slightly higher), four fifths of telecoms managers were either completely or partly confident that they could measure the impact of their operational activities on asset performance, compared to two thirds of people in electricity companies.

It is interesting to note that confidence also appears to vary with role: those in more hands-on roles such as engineering tend to be more confident than finance people or even asset managers.

Just 14% believed that their existing source of management and other information are being effectively exploited (Figure 3). Again there are marked differences from one sector to the next: not a single firm in the water sector felt their data was being fully exploited, while 24% of electricity and gas companies did. However, even the latter means that fewer than one in four directors think they are getting everything they could from their IT systems.

**Figure 3:**

To what extent do you think your organisation's data sources are being effectively exploited?

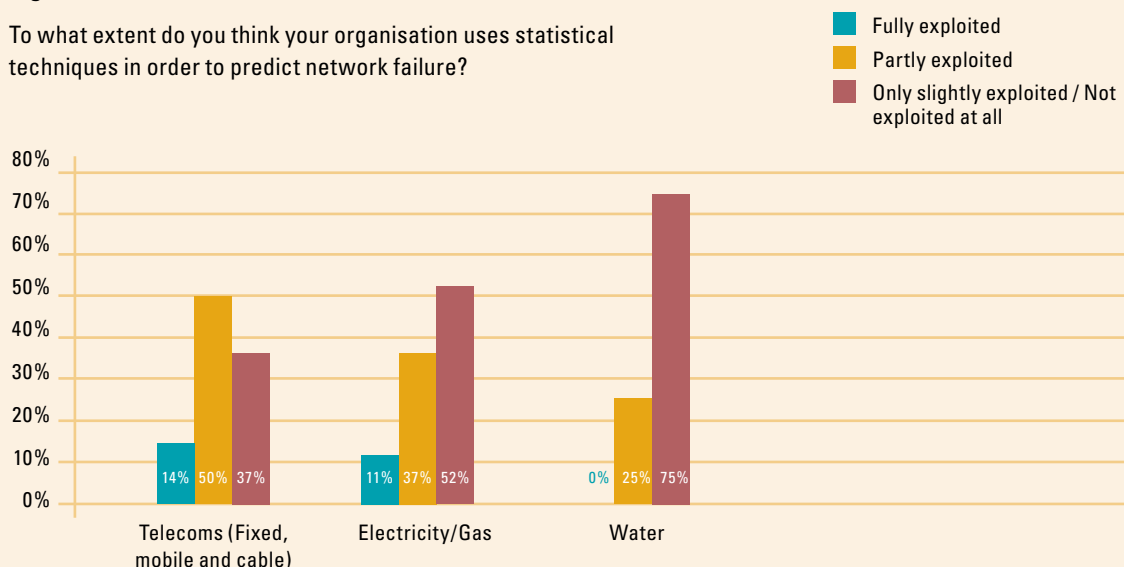


This picture becomes even clearer when we asked people how well they thought their organisations used applied analytics. Even in the relatively obvious problem we asked about (using statistical techniques to predict network failure), a significant minority of organisations either didn't use this approach at all or only slightly (Figure 4). Again, telecoms companies were in the lead: 14% here thought they did this as much as they could. But even here, 27% thought their organisation only scratched the surface of the possibilities, if at all. Only 11% of electricity companies thought they were doing a good job in this respect, while the proportion that thought they weren't rose to just over half. But it was water companies which rated their performance worst: none of the people we questioned believed their organisation exploited this opportunity as much as they could and more than three quarters thought they barely did so, if at all.

All of this suggests that there are significant opportunities for telecoms and – especially – utilities to use applied analytics more and more effectively when it comes to making decisions about operational and capital expenditure.

**Figure 4:**

To what extent do you think your organisation uses statistical techniques in order to predict network failure?



## Part 2:

# Pioneering a new approach

## Applied analytics

Our survey suggests that telecoms companies are in the forefront when it comes to using applied analytics – a point that is reinforced when you talk to leading companies such as BT and Virgin Media. Here, a more scientific approach has helped challenge traditional practices and has proved better able to deal with the variables and interdependencies which make problems so hard to solve. By gathering data from a wider variety of internal and external sources, and by using techniques such as multivariate analysis it has been possible to pinpoint the exact cause of problems and identify solutions.

“This is a large asset business with a combination of structural and network assets, so we’re trying to understand the cause and effect of certain activities and, as a corollary, where to invest to maintain and/or improve performance. Data about the performance of our network is therefore at the heart of our business and we’ve made extensive use of it historically,” explains Paul Weir, Director of Technical Infrastructure Solutions at BT. “The aim has been to link inputs to outputs across all our network management processes and to roll this approach out across the couple of thousand people involved in core operations. The challenge now is to take this to a much greater level of detail, using more granular information about the business, not just a high-level dash-board.”

That intention has become all the more urgent because technology convergence is eroding the distinction between telecoms and media companies, creating new and substantial operational challenges. “In the past, we tended to concentrate our analysis on availability, but, with people watching video-on demand services direct to television, we also have to focus on bandwidth and performance. For example, we’re using statistical techniques to find correlations between call volumes and fault codes, so that we can identify issues and target our investment more precisely. Traditional approaches have been based on what people have done before and what appears to work, but we can’t rely on that going forward. The complexity of variables you have to tie together, especially with new services such as video over broadband, is such and the technology so new are such that every decision has to be carefully calibrated.”

Weir believes that this more scientific approach is essential to challenging traditional practices but is also crucial in providing a more holistic perspective. “The structure and nature of complex network assets can make it difficult to understand how all the variables interact. Using statistics to analyse issues builds on our engineers’ intuitive sense of what’s happening. Crucially, it also helps

us understand the relative benefits of different options and build a robust business case for investment.” Weir’s goals are not purely financial, however: understanding and solving this new generation of problems will help BT deliver a better experience for its customers. “It’s a sign of the complex world we now live in that we need to join up the different parts of our customers’ requirements – maintenance, repair and billing – and to think more laterally about the challenges we face.

Like other utilities, the performance of Virgin Media’s network determines the quality of service its customers receive but is also very expensive to run, requiring around 700 engineers across the country to carry out routine maintenance and fix faults. “What we didn’t know was whether we were focusing on the right things,” explains Ian Cummings of Virgin Media. “We had hundreds of engineers working flat-out on a combination of proactive maintenance and reactive repair work, but we didn’t know if we had the balance right. Did carrying planned maintenance make the network more resilient? Should we be spending more time on preventing specific faults? What would be the impact on our network if we did?” There were plenty of people with opinions about this in Virgin Media; some even suspected a large amount of maintenance activity carried out by the field teams had no impact on either fault reduction or network performance. “But the trouble was that none of us could be sure of the answer,” says Cummings. “It was all gut instinct and guess work – and you can’t rely on that when something as central to your business as your network is at stake.” A wrong decision could have resulted in money wasted and, more importantly, a poorer quality of service for customers.

Analysis by Trinity Horne provided Virgin Media with new insights and, just as importantly, facts to back them up, demonstrating that the weather was responsible for almost half the faults on some parts of the network. Some technology was affected by rain, other by high temperatures, meaning that maintenance work can now be focused on different parts of the network at different times of the year. By contrast, routine maintenance had very little impact on network performance: “Even if we did everything right in terms of routine maintenance, we could never achieve more than a 20% improvement in the network,” says Cummings. “Above all else, this work has given us certainty that, when we make changes, we’ll be able to see an immediate, predictable improvement in network performance.” The overall result has been, as Ian Cummings explains it, to move Virgin Media “from perception to fact.”

Although harder to find, there are still examples of how statistical analysis has helped cut costs, raise efficiency and improve customer service in the utilities sector. Yorkshire Water wanted to reduce its environmental footprint, but was unsure how to instigate such a massive initiative. With a network carrying more than 1 billion litres of water every day, the task was an enormous one and conventional approaches, such as running small-scale statistical analysis or talking to the people involved, simply would not be sufficient. Using a more rigorous statistical approach, Yorkshire Water gathered huge amounts of data to which it applied a multi-variance regression analysis. This complex model was perhaps the missing piece of the puzzle in their current practices. It allowed them to view the data through a variety of different perspectives, rather than from one point of view, and that helped them see the whole picture, and make improvements accordingly. "Depending on various environmental factors, the planning algorithm will provide us with some very significant annual fuel savings," said David Owen, Yorkshire Water's Optimal Planning Manager. "We had always assumed that energy consumption could be optimised in the same way as chemical usage, but this turned out to be more complicated."

## Four reasons to change

Utilities and telecoms companies that are still relying on traditional methods for analysing network problems might like to consider that a more scientific, statistical approach:

- **Brings a new perspective to old problems:** The essence of applied analytics is to look at the available data from a number of different perspectives in order to find an overall picture. That's certainly what Carl Grose at Arqiva finds valuable. "It's vital that we bring the different elements of our business together, rather than treat them as discrete units. Applied analytics allows us to see both the value and customer perspective, and the way they relate to each other."
- **Tests assumptions rather than accepts them:** One of the best ways to improve the productivity of any organisation is to look at it with fresh eyes. People bring a wealth of knowledge and experience but can also be too wedded to the vagaries of the way they do things. Andrew Watson, Operations Director at Southern Water, found this when he wanted to reduce operational spend and study labour efficiency: "When we started the process, I thought the problems lay with the workforce, but as it turned out, it wasn't like that at all." In fact, the labour force was being dragged down by long operational processes and poor planning. "Statistical analysis played a pivotal role in diagnosing the underlying problem."
- **Sizes the prize:** In many large organisations, when studying an asset, network or labour force, scale and complexity make it hard to understand how all the variables interact. While directors might have an intuitive sense of how it all works, gathering data provides them to support their beliefs. Pat Cheshire, Capital Programme Manager at Eircom had a hunch, but no way of substantiating his claims. When the data backed up his ideas, he finally had what he needed: "The data gave me huge confidence when going in front of the Board, you can be a lot more convincing in your argument. You can't argue with statistical analysis, I don't think anyone should be investing money based purely on intuition."
- **Yields a measurable difference:** But perhaps the biggest advantage of this approach is that organisations can quantify success. If statistical methods can be used to isolate the precise cause of particular problems and estimate the improvement when one or more of the relevant variables are changed, then they can also be used to measure the level of improvement. "We significantly closed the gap on completion rates (the speed with which new customers are installed) and we're now top in the whole country when it comes to fixing problems within 24 hours," says Paul Street, Virgin Media's Head of North London and Home Counties, "and that means we're meeting the expectations of even our most demanding customers."

## Part 3:

# Overcoming the barriers

So why have some organisations been able to make effective use of applied analytics when so many others, according to the results of our survey, struggle to do so?

It might be tempting to blame the availability of data – and a few years ago this might have been justified. But investment in new IT systems across the telecoms and utilities space now means that information is the last thing organisations are short of. Recent investment means that we now tend to gather data as we go along,” says Cheshire. “Storing data is comparatively cheap, whereas going back to gather data we didn’t capture can be hugely expensive.” Overall, fewer than 4% of the executives we surveyed cited this as a reason for not using statistical modelling techniques.

*Telecoms is a very data intensive industry: there’s a universe of data that we could study*  
– Paul Weir, BT

Reliable data, though, is a different matter. This is less a problem among telecoms companies (only 17% here cited it as such), but was the number one issue for electricity companies (Figure 5). When Guy Jefferson at Scottish Power wanted to improve productivity in his workforce, he found that their systems did not get hold of the quality of information required. “We had to use consultants to set up processes to get the data themselves. It’s useful if you have the data to hand, it is a lot harder to go and find the data yourself,” he says. Steve Wilson at Welsh Water makes a similar point: “It’s hard to get the consistency and quality of inputs, which affects the analysis process.” Directors are naturally concerned that embarking on a large scale project with limited data is a risky business: taking the plunge is one thing, but it’s always good to know how deep the water is.

As Donal O’Hehir, Trinity Horne’s expert in statistical modelling and someone who has worked extensively in the telecoms and utilities sectors, points out, analytics projects are, of course, dependent on data, and if key data is simply not available, then there is a problem. “But, in our experience, the data available across the organisation (not just from well-formatted databases, but from numerous local specialist sources and records) is much richer than most managers realise, and greatly underexploited.”

4%

**The proportion of telecoms and utility companies that say they don’t have enough data**

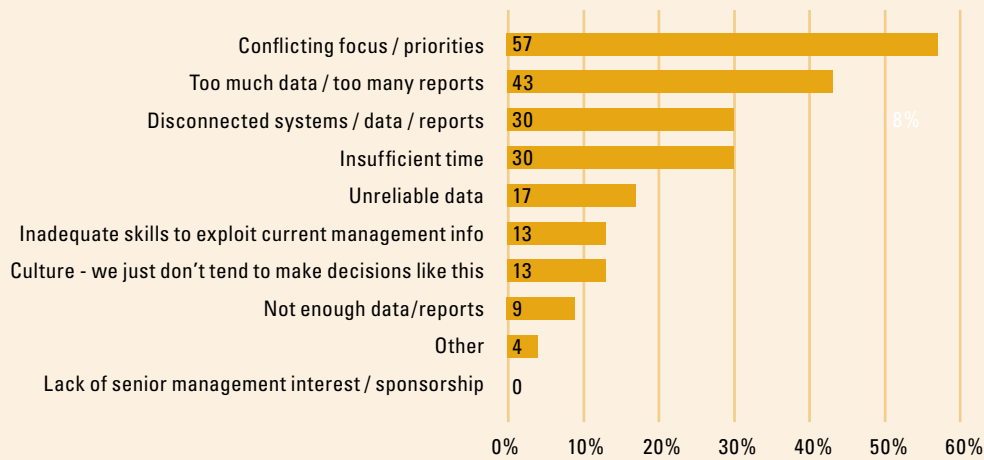
40%

**The proportion that says they have too much**

In fact across all three sectors we surveyed, telecoms, electricity and water, managers were ten times more likely to say that too much data was more of a barrier than too little. One of the critical success factors in using applied analytics is making sense of what is there. “It’s about identifying and collating these many rich sources and exploiting them like never before to uncover deep insights and transformational change,” says O’Hehir. Similarly, more of a problem than unreliable data is the fact that so much information exists on different disconnected systems: a third of telecoms companies mentioned this and more than a third of electricity and water companies.

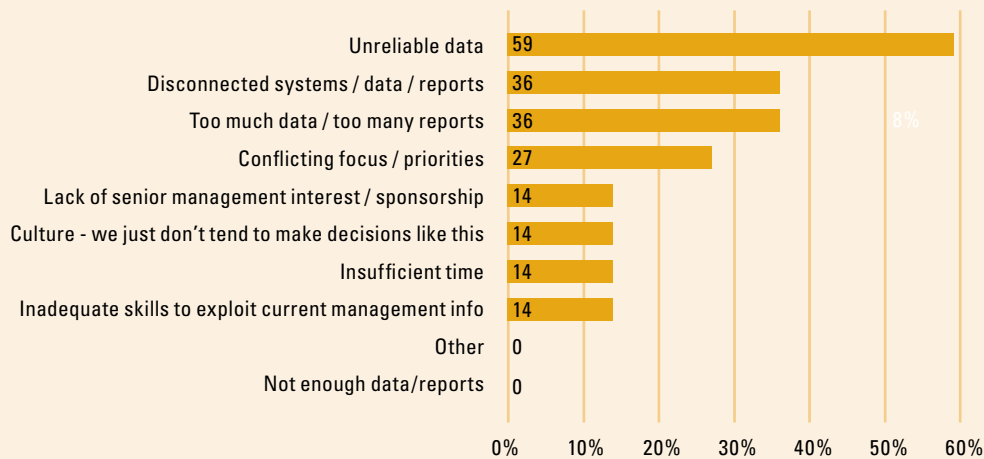
**Figure 5a:**

The main barriers to effective use of applied analytics in the telecoms sector



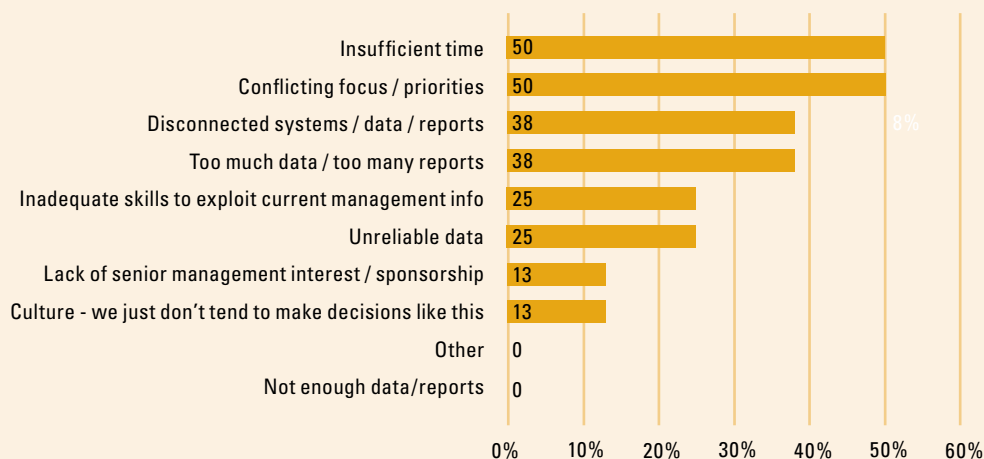
**Figure 5b:**

The main barriers to effective use of applied analytics in the electricity sector



**Figure 5c:**

The main barriers to effective use of applied analytics in the water sector



“It’s vital to have clear data architecture,” says BT’s Paul Weir. “People often complain that they don’t have the right data or that too much of it is contradictory, but organisations should be more precise from the offset about what they actually need to measure. You have to be clear about what the design limits are so you don’t end up chasing down improvements with limited payback and keep an open mind for new variables or new problems entering the environment, especially when you’re launching new services.”

But large volumes of unconnected and sometimes unreliable data is not the greatest hurdle.

There are some things we might have expected to be cited as hurdles but which didn’t feature significantly:

- Only 8% of people said they thought that lack of senior management interest in and/or sponsorship of applied analytics is a barrier and nobody in the telecoms sector thought that is the case – suggesting that most organisations recognise the value of applied analytics at least in theory.
- Similarly, culture – that organisations simply don’t base their decisions on hard data – was a factor in only 13% of cases.
- A sixth of people cited lack of analytical skills. “The technical skills are often less of an issue than finding the right mindset,” says Weir. “You need people who can discard complexity to focus on simple, relevant correlations. That’s where you get the biggest bang for your buck.”

More of an issue is time. Applied analytics requires rigour: it takes time and often considerable effort to collect the data required and analyse it. “It’s a comprehensive, many-faceted approach, and that takes time,” says O’Hehir. “Typically the first half of the project is concerned with engaging with SMEs and through them identifying and collecting hundreds of relevant variables across thousands of files and, often, millions of individual data points. These are then bolted together into a huge multivariate dataset which becomes the engine for the analysis and improvement. It is this painstaking cross-functional trawl and collation that clients would not typically have undertaken before – and it’s where the real value of the approach lies. For simpler, narrower problems, shorter interventions and/or tailored training programmes can be delivered.” More than a quarter of those we questioned said that insufficient time was a major barrier to using these techniques in their organisations.

But the biggest barrier of all is conflicting priorities. “You often find managers caught up in administrative work, or writing reports on the activity their team should be doing,” says Tony Farnfield at Trinity Horne. “This means their focus might not be sufficiently invested in improving operational performance.” The data may tell them what to do but acting on it may not be their current priority – a classic case of urgent, less important issues crowding out far more important, but less immediate ones.

# 43%

**The proportion of organisations that said that conflicting priorities was a major barrier to using applied analytics**

## From analysis to execution

That the biggest barrier to the effective use of applied analytics is not data but lack of focus points to a much more fundamental truth: even the most sophisticated number crunching still relies on people to implement the findings. Applied analytics may provide the diagnosis, but it is not the cure: "It's like going to the doctor, finding out what is wrong and being given the appropriate pills or medicine to take," observes Padraig O'hleacada at ESB. "But that's a long way from being cured. Implementing the changes, sticking to them, and being able to truly see their value takes a lot of time and hard work."

Maximising the practical value applied analytics can add to organisations, especially those as large and complex as telecoms and utility companies, depends on translating the numbers into action. This is certainly the view of Brendan Cahill at Trinity Horne "There is no substitute for well-informed, intellectually-sound management action. The role of applied analytics should be to ensure that those making decisions have the insights they need to make the best balanced choices."

"Applied analytics definitely works: we've been using this approach for several years now," says Simon Parker at Yorkshire Water. "But it's crucial not to treat the analysis as a one-off exercise but to maintain the benefits by ensuring it and our working practices are continually updated." In the future, he expects systems will continually provide the business with real-time data so that people can react almost as it happens. "I'm trying to add some continuity to the process," he said. "We hope to set up a business process which gives us regular health checks on our practices. We want to be able to predict what's happening rather than have to react to things that have already occurred." If this is where applied analytics ends up – with companies able to collect, gather and analyse vast quantities of data with minimal intervention, it could be the start of something quite extraordinary: the self-diagnosing business.

*There is real organisational learning in applied analytics, and this permeates the DNA of those involved and informs future business situations and needs. The skills of the people supporting the analysis evolve as the project does*

*– Donal O'Hehir, Trinity Horne*

Taking a project from applied analytics to practical performance management requires a combination of skills and experience, from project management, facilitation, and communication through data processing, analysis design and hard-core statistical analysis, believes Trinity Horne's Tony Farnfield. "Skills such as these cannot usually be transferred during a relatively short project. However, there are real lessons beyond the identified insights and changes. The whole project is a cooperative learning process built on the three-legged stool of data, subject matter expertise from the client and methodology expertise from the consultant. We work closely with a small core team throughout the project, and learn together about what really matters to the question at hand. Through this process, the subject matter experts come to see their data and work in a different light – and that brings real longer term business benefits. In addition, people on the client side are trained in the use of the causal model that results from the analysis, and this can be employed in support of many other business decisions beyond the scope of the initial project."

"Implementing and sustaining the change is everything," agrees his colleague, Donal O'Hehir. "In some situations, the changes are self-sustaining – for example, a decision to do more of one type of maintenance activity, which had been shown to be highly effective, and to stop carrying out other work, which had been proved to be ineffective, is generally easy to implement and maintain. But the key to long-term success is to avoid complacency, to monitor performance relentlessly and to constantly challenge accepted thinking."

## Acknowledgements

As well as the 50 senior managers that participated in our survey, Source would like to thank the following for their contribution to this report:

Arqiva	Carl Grose
BT	Paul Weir
Eircom	Pat Cheshire
ESB	Padraig O'hIcelandha
Scottish Power	Guy Jefferson
Southern Water	Andrew Watson
Trinity Horne	Tony Farnfield
Trinity Horne	Donal O'Hehir
Virgin Media	Ian Cummings
Virgin Media	Paul Street
Welsh Water	Steve Wilson
Yorkshire Water	Simon Parker
Yorkshire Water	David Owen

### About Source

Source is a leading provider of information about the market for management consulting. Set up in 2007 and based in London, Source serves both consulting firms and their clients with expert analysis, research and reporting. We draw not only on our extensive in-house experience, but also on the breadth of our relationships with both suppliers and buyers. All of our work is underpinned by our core values of intelligence, integrity, efficiency and transparency. It helps:

- Clients to buy consulting services more efficiently and effectively
- Consulting firms to keep in touch with trends amongst major buyers and competitors

Source ([www.sourceforconsulting.com](http://www.sourceforconsulting.com)) is owned by Source Information Services Ltd, an independent company, which was founded by Fiona Czerniawska and Joy Burnford. Fiona is one of the world's leading experts on the consulting industry. She has written numerous books on the industry including: *The Intelligent Client* and The Economist books, *Business Consulting: A Guide to How it Works and How to Make it Work* and *Buying Professional Services*. Joy Burnford was Marketing and Operations Director at the UK Management Consultancies Association between 2003 and 2010, and prior to that worked at PA Consulting Group and has extensive experience of marketing consulting services.

### About Trinity Horne

Trinity Horne specialise in evidence based business transformation primarily to the Telecoms, Utilities & IT Sectors but also to the Finance & Government sectors. Their outcome driven approach, industry leading methodologies and proven ability to implement sustainable change uniquely position Trinity Horne to drive tangible results in operational environments.

[www.trinityhorne.com](http://www.trinityhorne.com)

© Source Information Services Ltd 2011

Source Information Services Ltd and its agents have used their best efforts in collecting the information published in this report. Source Information Services Ltd does not assume, and hereby disclaims any liability for any loss or damage caused by errors or omissions in this report, whether such errors or omissions result from negligence, accident or other causes.

Notice: No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electrical or mechanical, without the prior written permission of Source Information Services Ltd. This document is protected by copyright law. It is illegal to copy, fax or email any of the contents of this document - even for internal use - without permission



288 Bishopsgate • London • EC2M 4QP  
Tel: +44 (0)20 3178 6445  
Email: [info@sourceforconsulting.com](mailto:info@sourceforconsulting.com)

[www.sourceforconsulting.com](http://www.sourceforconsulting.com)