A Realistic Evaluation of Universal Water Metering in the United Kingdom's South East

Nicki Sochacka
University of Queensland, Brisbane, Australia
n.sochacka@uq.edu.au

Lesley Jolly
Strategic Partnerships, Brisbane, Australia
ljolly@bigpond.net.au

Lydia Kavanagh
University of Queensland, Brisbane, Australia
l.kavanagh@uq.edu.au

***Abstract**: An increasing number of regions in the United Kingdom (UK) are experiencing water shortages. The universal installation of household water meters has been identified as one way to reduce demand on limited supplies. The general consensus among policy-makers and water practitioners is that meters 'work' by providing a financial incentive to residents to use less water. Recent studies however, suggest that mechanisms that drive changes in water-user behaviours are more complex and context-dependent. Using an approach developed in the field of program evaluation, this paper examines policy-maker and water practitioner understandings of how a current universal metering program in the south east of the UK 'works'. These understandings are then compared to how water meters are managed and accepted at a household level. The findings demonstrate how 'Realistic Evaluation'* (Pawson & Tilley, 1997) *can be used to gain a deeper understanding of how technological interventions 'work' in complex social systems.*

Key words: realistic evaluation; water meters; universal water metering; United Kingdom; rational choice model; environmental education.

Introduction

In spite of its reputation as a country with abundant rainfall, an increasing number of regions in the United Kingdom (UK) are struggling to make water ends meet (Butler & Memom, 2006; DEFRA, 2008; OFWAT, 2006). At a glance the balance sheet appears unyielding on both sides. On the one hand, demand pressure in the UK is set to increase in the next 20 years, driven primarily by population growth, new housing development and reducing household size (Sim, McDonald, Parsons, & Rees, 2005, p. ii). While on the other, the provision of extra water resources through conventional means (the building of new reservoirs, water transfers, groundwater abstraction etc) is becoming increasingly difficult due to escalating economic, social and environmental costs (DEFRA, 2008; FDWS, , 2005). Faced with these challenges, demand management has emerged as the favoured strategy for managing the UK's water needs (UKWIR/ EA, 1997). Demand management seeks to ease pressure on mains water supplies through the implementation of policies which combine economic, technological and behavioural factors to encourage efficient and conservative water use (Kallis & Coccossis, 1999). With the potential to work on all three of these fronts, the Environment Agency has identified water meters as the cornerstone of future water resources management in the UK; setting meter penetration targets of between 60-90% of households by 2030 (Sim, McDonald, Parsons, & Rees, 2005).

A water meter is a measuring device that is typically fitted to external supply piping to enable water companies to charge customers for the amount of water they use. It is generally accepted that meters 'work' in two ways: one is to reduce the amount of water lost through leakage; the other is to reduce the amount of water customers use (Gadbury *et al.*, 1993). This paper focuses on the latter mechanism.

The general consensus among regulators, Government and water companies is that meters 'work' by instigating a chain of reasoning whereby customers will endeavour to use less water if they are paying for it on a measured basis (DEFRA, 2008; Environment Agency, 2007; FDWS, , 2005; Sim, McDonald, Parsons, & Rees, 2005). For instance, in a recent review of water efficiency measures to be implemented into existing homes in the UK, the Environmental Agency (2007) writes that water meters have 'the potential to generate significant reductions in the demand for water, by providing a price signal against which to compare consumption'.

Rational choice model

The logic underpinning this consensus follows an economically-based rational choice model, whereby people are presumed to assess the choices before them in terms of costs and benefits and then select the choice that maximises their net monetary benefits (Australian Government, 2007). The rational choice model can be deconstructed into three key assumptions about social action (Scott, 2000; Zey, 1992):

1. That the choice is rational (in the case of water meters, this choice is assumed to be 'economically' rational);
2. That the individual is the appropriate unit of analysis in social action; and,
3. That choices are made in the pursuit of individual self-interest (Jackson, 2005).

Criticisms of the economically-based rational choice model as the primary determinant of water use decisions made by metered customers can be categorised as responses to one or more of the above assumptions. For example, Strang (2004) describes a highly complex relationship between citizens and water, in which diverse cultural meanings and values 'exert a powerful influence over every decision involved in water use […] and that they are difficult to alter'. While Sharp (2006) notes that the policy-makers' process of demand management presented as a matter of choice between different instruments which influence customers decisions ignores 'the important and complex relationships between the consumers and producers of water'. Both perspectives question the assumption that the individual is the appropriate unit of analysis and that choices are made in the pursuit of individual self-interest; Strang (2004) places the water user in relation to 'values' held by society, whereas Sharp highlights the water user's relationship with water producers. Similarly, Strang's (2004) emphasis on the powerful influence of cultural meanings and values calls into question the assumption that choices relating to water use are based on economic rationalism.

Education campaigns

Change initiatives underpinned by rational choice theory are typically operationalised through the provision of information communicated to customers via education campaigns. These campaigns work under the assumption that while the potential for economic gains provides the impetus for altered patterns of behaviour, education campaigns provide users with strategies for achieving those gains. For example in the context of metering, the House of Lords (2006) holds the view that, '…if metering is to make a long term difference, it must be accompanied by a programme of awareness raising about the importance of water efficiency'. Abundant research however, shows that attempts to increase knowledge, perceptions, or attitudes through environmental education or media campaigns in order to change behaviour are often ineffective (Kollmuss & Agyeman, 2002).

Historical metering trials

Water consumption data from historical metering trials is often called on as evidence to support rational choice model understandings of how meters 'work'. Herrington (2005) reviewed four large-area, compulsory metering trials in the UK from 1970 to 1996 which showed average demand reductions in the 10%-15% range (Herrington, 2005); a figure that is often quoted by proponents of water metering. Herrington (2005) also reviewed results from the National Metering Trials (NMTs) (1988-92) which confirmed this range. Close examination of the findings from these trials, however, reveals limitations in both the accuracy of the results and their transferability to other metered areas. In two of the four reviewed reports (Isle of Wright and Malvern/Mansfield), Herrington (2005) cites the possible influence of social and historical context on post-metering water consumption, cautioning the

transfer of the reported ranges to the present day 'without other supporting evidence'. The method of derivation used for the third of the four trials (Anglian Water) was unable to be located, while the true metering impact effect for the fourth trial (Fylde) was revised up to take into account the increase in water consumption recorded at unmeasured properties adjacent to the test area during the trials (Herrington, 2005). With respect to the NMTs, a report published a year after the trials cited 'a need to improve its knowledge about the confidence that could be placed in National Metering Trials data…' (WRc, 1995). This need was subsequently translated into two recommendations for further review and re-working of the results from the trials. However at the time of writing his own review, Herrington (2005) had received no response from the relevant water companies as to whether either of these recommendations had been acted upon.

Where to from here?

The aim of the above discussions is not to argue against the widespread installation of household water meters in the UK. Rather, it is to demonstrate two important points. First, as the historical metering trials demonstrate, it is not a straightforward exercise to estimate the precise impact of metering on water demand; 'not least because, by definition, those households switching to metered charging have not been metered in the period immediately preceding their switch' (Sharp, 2006). Second, the effectiveness of water metering depends on the *social contexts* into which they are implemented. Both points highlight the need to treat historical 'average reduction in demand' estimates with caution. While the second point underscores the need for policy-makers to seek an understanding of prevailing social conditions which may influence how meters are accepted and managed at a household level.

It follows that responses to widespread water metering in the UK are likely to vary. As Jeffrey and Geary (2005) write 'different groups of water users clearly respond to economic instruments in different ways at different times'. Thus the task of research is to uncover *how* water meters 'work' for *whom*, and in *which* circumstances (Pawson & Tilley, 1997). In this paper we use an approach developed in the field of program evaluation to examine the response to an on-going universal metering program in the south east of the UK. The main contribution of this paper is a demonstration of how the 'Realistic Evaluation' (Pawson & Tilley, 1997) approach can be used to explain causal connections between contextual conditions and behavioural outcomes.

Methodology

Theory

Realistic Evaluation (RE) (Pawson & Tilley, 1997) is a methodological approach designed to evaluate social programs; where social programs are defined as 'merely a special case of social change… [consisting of]… a spiral of new ideas and transforming conditions' (Pawson & Tilley, 1997). RE seeks to answer the question '*what* is it about a program that 'works' for *whom* and in *which* circumstances?'. This line of enquiry is based on the principle of generative causation. That is, outcomes (e.g. reductions in domestic water use) are generated as a result of mechanisms being fired in particular contexts (**Figure 1**). In other words, programs are said to 'work' (have successful 'outcomes') only in so far as they introduce the appropriate ideas and opportunities ('mechanisms') to groups in the appropriate social and cultural conditions ('contexts') (Pawson et al. 1997). Social programs are thus based on ideas about how interventions 'work'. Ideas have their time and place. It is this conjunction that RE aims to capture with the notion of a context-mechanism-outcome (CMO) configuration (Pawson & Tilley, 1997).

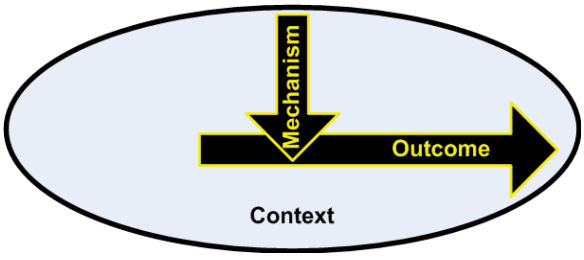

Figure 1: Generative Causation

In this paper, we liken water metering to a social program. We argue that metering shares a characteristic similar with all social programs, that being; that, apart from facilitating the detection of leaks, there is nothing about water metering which intrinsically reduces the amount of water that customers use. Rather, meters 'work' (or don't 'work') by 'instigating a chain of reasoning and reaction' (Pawson & Tilley, 1997). As discussed in the previous section, the ways in which policy instruments, such as water meters, 'work' is a contested issue. Below we begin by articulating policy-maker and practitioner understandings of how an on-going universal metering program in the south east of the UK program is designed to 'work' and then compare these understandings to how water meters are managed and accepted at a household level.

To this end, data collection for this study was driven by the following two research questions:

1. What mechanisms for change are triggered by the implementation of water meters and how do they counteract existing water usage patterns? And,
2. What social and cultural conditions are necessary for these change mechanisms to operate?

Methods

This study focused on a universal metering program implemented by a company in the south east of the UK (Company X). Data collection was undertaken during a three-week period in July 2008. Methods included: in-depth interviews, a survey, document analyses and observational field notes.

In-depth interviews were conducted with the following stakeholders:

- The metering and water efficiency program coordinator at a Company X (n=1);
- Employees at Company X responsible for the installation and management of water meters (n=2); and,
- Residents living in the area serviced by Company X (n=21).

A survey (n=18) was undertaken in a town where, at the time of the study, Company X had recently completed installing household water meters. Documents, including Company X business reports and website, water saving educational material provided to customers by Company X, and relevant government publications were also analysed.

Findings were validated against a qualitative study of domestic water metering conducted in 2007 by researchers from the University of Bradford (Knamiller & Sharp, 2007).

Findings

Policy-maker understandings of how universal water metering 'works'

The first step in this study was to uncover policy-maker understandings of how universal metering programs 'work'. These were derived from the Company X website and business reports, as well as relevant government publications. Policy-maker understandings from these sources were distilled into *over-arching program theories* (Pawson & Tilley, 1997), or conjectures, describing how universal metering programs 'work'. In **Table 1** we articulate these conjectures in realistic terms, that is, in terms of context-mechanism-outcome configurations.

Table 1: Policy-maker understandings of how universal metering 'works'

Context	+	Mechanism	=	Outcome
One of the driest parts of the country **(C1)** with limited natural resources of water to draw upon **(C2)**. Climate change is resulting in warmer weather which is further reducing water supplies **(C3)**. Residents currently use 'a lot of water' which can be easily reduced by 10-15% without affecting lifestyle **(C4)**.		Water meters **(M1)** provide an incentive to customers to save money **(M2)** by using less water **(M3)** and repairing any leaks on their apparatus **(M4)**. Unmetered customers do not have the same clear incentive. **M1**-**M4** are facilitated by educational campaign material **(M5)** which include various water saving/ efficiency strategies **(M5A)** and information relating to **C1, C2, C3** and **C4 (M5B)**.		When mechanisms **M1**-**M5** are introduced into contexts **C1**-**C4**, customers will reduce their water use by 10-15% on average, compared to un-metered customers **(O1)**. These reductions in household water use will secure supplies for the next ten years and beyond **(O2)**.

A key point to note here is how the RE approach facilitates a contextual understanding of social programs. As discussed in the previous sections, the effectiveness of water metering programs is typically attributed to rational choice theory. In realist terms, rational choice theory is represented by mechanisms M1-M4 which are assumed to lead to outcomes O1-O2, regardless of context. The above analysis thus constitutes a first step towards investigating the influence of social and historical context, as alluded to by Herrington (2005) in his review of historical metering trials in the UK.

Practitioner understandings of how universal water metering 'works'

In **Table 2** we complement these over-arching program theories with one example of a practitioner understanding of how universal water metering 'works'. The realist theory presented below was derived from in-depth interviews with employees at Company X.

Table 2: Practitioner understanding of how universal metering 'works'

Context	+	Mechanism	=	Outcome
C1-**C4** + Unmetered customers are "wasteful" with water **(C5)**.		**M1**-**M5A, M5B** + Educational material headlined with messages such as: "*Save it! Don't take water for granted*", and "*Are you wasting money?*" **(M5Ai)**.		Introducing mechanism **M5Ai** into context **C5** will lead to outcomes **O1** and **O2**. Mechanism **M1** led practitioners at Company X to believe that "we are not very popular here in water metering" **(O3)**.

In **Table 2**, we see how program theories can change when enacted by practitioners. The key difference illustrated above is the contextual assumption that unmetered customers are "wasteful" with water. Subsequently, it is possible, in fact even probable, that this position played a role in the design of educational materials which urge customers to waste less water and/or money. The assumption that unmetered customers waste water immediately places the unmetered customer's present behaviour at fault, as compared to Company X who is tasked with correcting this fault. With this relationship between the 'consumers and producers of water' (Sharp, 2006), it is unsurprising that practitioners at Company X believed that they were generally not popular with newly metered customers.

Customer/ household level understandings of how meters 'work'

In **Table 3** we present a realist theory of how meters are accepted and managed at a household level. This theory emerged from interviews with residents living in the area serviced by Company X and was triangulated against survey results and a qualitative study undertaken by Knamiller *et al.* (2007). Contrasting, or counter-, understandings to previously identified contexts, mechanisms and outcomes are denoted with ''', e.g. C1' would indicate that customers *do not* believe that they are living in one of the driest parts of the country.

Table 3: Customer understandings of how universal metering 'works'

Context	+	Mechanism	=	Outcome
Customers feel they do not use **(C4')** or waste much water **(C5').** "Others" [customers] waste water **(C5'A).** Company X wastes water through leakage **(C6).**		Educational campaigns which target water wastage **(M5Ai)** are for "others" who waste water **(M5Ai').**		Water meters **(M1)** may reduce or increase water bills. This however, is largely out of the customer's control as they are already not using much water **(C4')**. Thus counter mechanisms **M2', M3', M4'** lead to limited changes to water consumption (**O1'**). Mechanism **M5Ai** is ineffective when introduced into contexts **C4', C5'** and **C5'A** which may also lead to **O1'.** Mechanism **M5Ai** may be further comprised if introduced into context **C6,** again leading to **O1'.**

Table 3 illustrates how the RE approach can be used to diagnose areas for improvement in the implementation of social programs. Of particular interest above is the general belief held by customers that *they* do not waste water, in fact, that many currently use only the bare minimum. This belief coexists with the assumption that "others" waste water and may serve to explain why there are few vocal objections to educational materials that target wastage; these materials would, after all, be informative for the many customers (the "others") who *do* waste water. Moreover, one could speculate that even if some customers were to concede that they could reduce their water consumption, a portion of these customers may decide not to do so, on the basis that Company X wastes far more water through leakage.

Conclusion

The above analysis demonstrates first, that the success of social programs depends on the contexts into which they are implemented, and second, the importance of exploring differing program understandings held by policy-makers, practitioners and program targets, in our case, customers of Company X. In these ways, realistic evaluation provides a means to gain a deeper understanding of how technological interventions 'work' in complex social systems.

References

Australian Government. (2007). *Changing Behaviour: A Public Policy Perspective*. Barton.

Butler, D., & Memom, F. A. (2006). *Water Demand Management*. London: IWA Publishing.

DEFRA. (2008). *Future Water: The Government's water strategy for England*. Retrieved. from.

Environment Agency. (2007). *Water Efficiency in the South East of England: Retrofitting existing homes*. Bristol.

Folkestone and Dover Water Services Limited. (2005). *Water Scarcity Status Application*.

Gadbury, D., Morton, G., Harris, K., Harries, C., Archibald, G., Harrison, D., et al. (1993). *The National Metering Trials Working Group - Final Report*. London: UK Water Industry Research Limited.

Herrington, P. (2005). *Critical review of relevant research concerning the effects of charging and collection methods on water demand, different customer groups and debt*. London.

House of Lords Science and Technology Committee. (2006). *Water Management: 8th Report of Session 2005-2006*. London.

Jackson, T. (2005). *Motivating Sustainable Consumption: a review of evidence on consumer behaviour and behavioural change*. Surrey: University of Surrey.

Jeffrey, P., & Geary, P. M. (2005). Consumer reactions to water conservation policy instruments. In D. Butler & F. A. Memom (Eds.), *Water Demand Management* (pp. 305-330). London: IWA.

Kallis, G., & Coccossis, H. (1999). *Sustainable Use of Water in Metropolitan Areas: An Intergrated Framework for Policy Analysis*. Paper presented at the Conference Name|. Retrieved Access Date|. from URL|.

Knamiller, C., & Sharp, L. (2007). *Compulsory water meter installation in Lydd, Kent: a qualitative study of the water user's experience*: University of Bradford.

Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research, 8*(3), 239 - 260.

OFWAT. (2006). *Security of supply, leakage and water efficiency: 2005-06 report*. Retrieved. from.

Pawson, R., & Tilley, N. (1997). *Realistic Evaluation*. London: Sage Publications Ltd.

Scott, J. (2000). Rational Choice Theory. In G. Browning, A. Halcli, Hewlett & F. Webster (Eds.), *Understanding Contemporary Society: theories of the present*. London: Sage.

Sharp, L. (2006). Water demand management in England and Wales: Constructions of the domestic water user. *Journal of Environmental Planning and Management, 49*, 869-889.

Sim, P., McDonald, A., Parsons, J., & Rees, P. (2005). *The Options for UK Domestic Water Reduction*. Leeds: University of Leeds.

Strang, V. (2004). *The meaning of water*. Oxford: Berg Publishers.

UKWIR/ EA. (1997). *Forecasting Water Demand Components - Best Practice Manual*: Environment Agency.

WRc. (1995). *Further Analysis of National Metering Trials Data: Final Report*. Swindon.

Zey, M. (1992). *Decision-making: alternatives to rational choice models*. London: Sage.