Effectiveness of feedback in relation construction essay

Domestic energy usage to the end user is virtually invisible. Most consumers only have a vague idea or understanding of what they are using for their different needs. Consumers could make day to day changes in their behaviour to try and reduce energy consumption; this is why relevant feedback in relation to energy consumption is so important. Early studies carried out on energy feedback in the 1970's and 1980's were conducted by Psychologists. The feedback that was given was seen more as an intervention. An early example of this typically feedback would involve a note being left on a consumer's window each morning, informing the consumer of what their previous day's energy consumption was compared to a reference level. These studies have shown that energy feedback can have some sort of a measureable effect on consumers, at least for a short period of time (Darby, 2006). In later years feedback has been in the form of utility bills issued by the utility company every few months. The bills have tended to show the amount of energy units consumed but there has been a move towards more graphical images to illustrate the description of energy use (Roberts et al., 2004) conducted qualitative focus groups to explore what was the consumers preferences for energy feedback (Roberts et al., 2004) found that the participants of the focus group considered bar charts the best way of displaying energy use on bills. Feedback ' information about reactions to a product, a person's performance of a task, etc. which is used as a basis for improvement' (oxforddictionaries, 2013)Researcher's begun to emphasise that feedback is part of the learning process and that people are the information processors that make sense of the world (Ellis & Gaskell, 1978). A study by (Hutton et al., 1986) which was carried out in America found that any type of feedback under any condition, directed at any

population, will produce positive results. (Darby, 2006) List’s two types of feedback: direct and indirect feedback. Direct feedback: available on demand and learning by looking or payingSelf-meter readingsDirect displaysInteractive feedback via a P. CPay as you goMeter reading with an adviserCost plugs, energy monitors or similar devices on appliancesIndirect feedback: raw data processed by the utility company and sent to the customers which is said to be learning by reading and reflecting. More frequent billsFrequent bills based on readings plus historical dataComparative and normative feedbackDetailed annually or quarterly energy reports

Contribution of Feedback

Feedback covers a whole range of sources/practices. The idea of feedback is to look at in terms of its contribution to the energy usage. Within this people can take information concerning their own energy use. They can act ie: change their behaviour in some way and they can gain a more understanding of energy consumption.

Direct Metering

Direct metering can be used to give a very basic form of energy consumption feedback. Consumers can compare and graph consumption from one meter reading to the next. However over 25% of homeowners appear to regularly check their meters (Attan, 1985). Using this type of feedback has an advantage but requires a greater level of commitment but it is effective as (Sluce & Tong, 1987) note that with motivated participant’s savings as much as 10-20% can be achieved.

Energy Auditing

The word energy audit is used widely and may have a different meaning depending on the energy service company. Energy auditing of buildings can vary from a short walk through of the facility to a long detailed analysis of the building (Tuan, 2006). Auditing is applied mostly to buildings but can also be applied to transportation fleets and industrial processes. It is an important first step in energy management services (Randolph & Masters, 2008). Sustainable Energy Authority of Ireland (SEAI) describe an energy audit as a review of how, why and when energy is used. (Thumann & Younger, 2008) Defines an energy audit as a process to evaluate where a building or plant uses energy and then identify the areas to reduce the energy consumption. (Gomes et al., 2010) Also agrees with this as they describe an energy audit as a procedure undertaken to identify what, when and how energy is used within a building they also mention that it is the first step in trying to improve the energy efficiency by identifying the areas of in efficiency and possible recommendations to improve the efficiency. The audit should identify the energy use patterns, the potential gaps for energy and cost savings, the audit may include recommendations to improve the energy efficiency which will reduce energy costs. The energy audit may examine the following electricity, gas, oil and water (SEAI, 2013). While (Mohamad, 2008) describes an energy audit as a systematic survey or study to identify how the energy is being used within a building or facility. (Mohamad, 2008) Also mentions that an energy audit provides analysis on the amount of energy consumed during a given time in the form of the following electricity, gas, oil and steam also. Using the information gathered it is then possible to list how the energy was used within the building. (SEAI, 2013) Says that an energy

audit can be carried out internally if sufficient expertise is available, otherwise an independent expert energy consultant can be sourced externally to provide additional assistance. A typical energy audit may cost in the region of 1% of the total energy costs and should identify areas where significant energy savings can be achieved.

Continuous Improvement Cycle

According to (Egan, 2012) a sucesssful energy audit should follow the 5 stage continiuos improvement cycle. http://farm8. staticflickr. com/7117/7681048780_881d65ed0e_b. jpgPolicy and CommitmentManagement commitment, senior manager, team and occupantsPlanningObjectives, targets and resourcesImplementation and operationImplement planChecking and corrective actionCheck installation and correct any defectsManagement reviewMeasure, monitor and audit review

Types of energy audits

In a recent study (Gomes et al., 2010) carried out an energy audit on a school in Portugal and found four types of energy audits. A walk through auditA utility cost analysisA standard energy auditA detailed energy auditWhile carrying out the energy audit on the school a number of opportunities were identified using the information that was collected during the audit. Optimisation with the energy supplierReplace existing electromagnetic ballasts with electronic ballastsReplace indoor fluorescents with more efficient lampsReplacement of existing high pressure sodium with new more efficient lampsInstall motion or P. I. R’s sensors in corridors toilet and other internal areas. Install controls for projectors and interactive

whiteboardsPower Factor correction (improves true power to apparent power)(Gomes et al., 2010) Where then able to identify the amount of savings that maybe achieved if all of the above recommendations were implemented. Firstly the investment costs, maintenance costs, cost per kWh were taken into consideration and payback period. After taking all of the above into consideration the initial investment amounted to €17572, which resulted in a reduction in electricity of 31, 000 kWh per year, which resulted in an annual cost of around €4000. The energy reduction is estimated to reduce CO2 emissions by an estimated 14. 6 tonnes annually.

Energy Monitoring

DEHMS Domestic Energy Monitoring System, simple energy savings measures have the potential to reduce 10% of the UK's carbon emissions. Domestic energy accounts for 30% of the UK's CO2 emission output. (Darby, 2006) Notes that smart metering technology, which provides real time feedback on domestic energy, can help reduce 5 to 10% of energy usage. (Cooper et al., 2010) Carried out a study on DEHMS its objective was to integrate and test the effectiveness of strategies delivered through an electronic infrastructure which is able to infer and reason the energy behaviour in households.

System Architecture

The DEHEMS consists of the followingElectrical mains power analyserIndividual appliance monitorOil appliance monitorAmbient temperature sensorBroadband routerDEHEMS gatewayDEHEMS dashboard (HMI)P. C Interface/HMI

Case Study

The DEHEMS system has been installed in 77 household in the UK for a period of 6 months to understand the user behaviours. The primary purpose of the DEHEMS is to gather and communicate energy consumption data from gathered from sensors for comparative analysis. The electrical mains power analyser is connected to the main energy cable. A reading is taken every 6 seconds which is relayed back to the DEHEMS gateway which is then forwarded onto the P. C/HMI. The DEHEMS gateway also forwards all the information back to the main DEHEMS server. User interface should be simplistic, easy to understand and use.‘ Express just enough meaning but not too much. Designers need to respect the value of perceived simplicity as well as the need for enough information and for expressiveness on the part of users’ (Hindus et al., n. d.)In a survey conducted by (Cooper et al., 2010) participants wanted to reduce energy consumption but found that the participants were split unequally as 66. 7% are driven by keeping the bills down while 25. 6% were more focused on reducing their carbon footprint. It was noted that saving energy is perceived as a financial problem.

Constraints that impede energy savings

Financial constraintsLimitation of appliances and building infrastructureLack of information regarding energy efficiency of their appliance(Gomes et al., 2010) While conducting an energy audit found that investing in more energy efficiency lighting can reduce energy cost dramatically over a short period of time with a relatively good payback period.

Benefits of DEHEMS

DEHEMS encourages occupants to reduce energy consumption through real time data acquisition, participants of the study are unanimous that the DEHEMS provides interesting informative information regarding their energy consumption. One participant of the study said that the whole family has become more conscious of their energy consumption. Some families have gone further and have started their own research online to try and reduce their energy consumption even further. Accessing data, the data may be accessed through the P. C and can be accessed remotely over the internet. However one participant said that those that access the data over the internet are computer literate and that the DEHEMS dashboard is more suitable for people with limited computer skills. Benchmarking, can also be done using the DEHEMS as the participants energy data is all sent back to a central server. This is a useful tool as participants can compare energy consumption with similar households with the same amount of occupants. Through the process of benchmarking it is possible to identify any abnormalities and is possible to identify the cause of these abnormalities.

Occupant and user behaviour

User behaviour is a significant contribution to a product’s environmental impact, the end users decision or habits ultimately have a major effect on the energy consumed thus there is a need to investigate and change occupants and user behaviour. Irish buildings consume 40% of the total energy delivered in Ireland (SEAI, n. d.). This figure is predicted to rise in the coming years as we now live in a society that depends on electronic devices (Culley et al., 2007). (Culley et al., 2007) Argue that achieving improvement

measures in the area of energy efficiency requires research into energy efficient products and studies carried out on consumer attitude and behaviour.

Consumer attitudes

(Wood & Newborough, 2002) Found two types of areas that effect energy efficiency. Point of SalePoint of UsePoint of Sale energy savings are influenced by the consumer and are also influenced by government policies such as the European Commission’s eco label (International Energy Agency, IEA, 2003). (Truffer et al., 2001) Found that consumers do not purchase energy efficient products despite their best intentions, 20% of consumers said they would between 10 and 20% extra for energy efficient products however in reality this figure is 1%. Point of Use is an area where little work has been done. One way of reducing energy is by simply putting signs near light switches.

Behavioural change

(Kaiser et al., 1999) Found three different situations where a person had a positive attitude on their behaviour but were prevented from carrying out their behaviour. An example of this is economically or financially constraint, one person may be in a position to replace an appliance with a new energy efficient version when it comes to its end of life, while another may not and will have to commandeer with a less efficient second hand model. People may intend to carry out energy changes but are pressurised by family or friends not to. Lastly people may want to make changes but may not necessarily have the opportunity/infrastructure to do so.

Antecedent information

By providing antecedent information savings can be achieved according to (Dennis et al., 1990) as much as 60% can be saved in unnecessary lighting by putting signs near light switches. (Winnett et al., 1984) Also reports that significant energy savings as much as 10% can be made by simply showing energy consumer a 20 minute TV programme on energy savings techniques. It is important to keep practicing these techniques as the Fallback effect can slowly come into effect, (Wilthe & Ling, 1995) define the Fallback effect as‘ the phenomenon in which newness of a change causes people to react, but then that reaction diminishes as the newness wears off’

Observation

A common problem with observing or studying people is that subjects may behave different because they know that they are being observed or studied, this known as the Hawthorne effect. Another common problem is that subjects may behave differently because they know they are being studied. This is known as the Hawthorne effect [23]. Stern [24] suggests that the conclusions of research on the responsiveness of consumers to general energy-saving information, is heavily effected by the Hawthorne effect. Indeed in both of the studies of Winnett et al. [20] and Dennis et al. [19] all participants were fully aware that they were being observed for their energy-saving habits. Thus, in any human study where useful information is provided, care needs to be taken to account for the Fallback and Hawthorne effect.

Building energy management system (BEMS)