TRAINING IN SMART METERING TECHNOLOGIES FOR CONSTRUCTION SITE MANAGERS

(THE COSMET PROJECT)

ELISA PEÑALVO LÓPEZ
Universitat Politècnica de València

FRANCISCO JAVIER CÁRCEL CARRASCO
Universitat Politècnica de València

Ingeniería y Tecnología

3ciencias

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ELISA PEÑALVO LÓPEZ
Universitat Politècnica de València
Camino de Vera, s/n, 46022 Valencia

FRANCISCO JAVIER CÁRCEL CARRASCO
Universitat Politècnica de València
Camino de Vera, s/n, 46022 Valencia

This work has been conducted within the framework of the research project COSMET "Training in Smart Meters for Construction Site Managers" funded by the European Commission within the Key Action 2: Strategic Partnerships in VET, reference number 2015-1-UK01- KA202-013406.

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C/ Els Alzamora, 17 - 03802 - ALCOY (ALICANTE) info@3ciencias.com

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CONTENT

SUMMARY

Training in smart metering technologies for construction site managers (the Cosmet Project)

The new challenge for the traditional construction training sector is to further expand to the newly introduced field of modern environmental technologies. The current status of site managers' skills development in relevance to smart metering is not sufficiently, comprehensively and consistently supported by VET programs at the EU level. The COSMET project aims to support VET provision for site managers in smart metering addressing the needs of VET providers, learners, and the sector by offering a modular comprehensive course (MOOC) that ensure easy and free access to relevant educational material and tools.

This work sample didactic units made for the completion of a course MOOC (http://www.cosmetproject.eu/page=17/training-resources), within the European Union-funded project called COSMET which aims to support the offer of vocational training for work in relation to the smart metering heads offering a comprehensive modular course that ensures easy and free access to the material and relevant educational tools, responding as well to the needs of providers formation of FP, the students and the sector.

There are six partners that are part of this education project. Five centres formed by Professionals or Training Associations and a European University. Specifically, the consortium iscomposed by the following organisations:

* Summit Skills (http://www.summitskills.org.uk/) is the Standard Setting Organisation for the Building Services Engineering (BSE) sector in the UK. As an employer-led and employer-owned organisation, Summit Skills' role is to act as the voice of employers of allsizes across the BSE sector on industry standards and changes to qualifications and apprenticeships, keeping up to speed with policychanges, and ensuring skills development projects meet the day-to-day needs of businesses on the ground.

Summit Skills will be the project coordinator being responsible for the administrative and financial management of the project aswell as the strategic coordination. It will also be responsible for the final delivery of the quality assurance plan, the monitoring ofproject quality, and for supporting the project implementation.

* PROMEA (www.promea.gr), the Hellenic Society for the Promotion of Research and Development Methodologies, aims at thepromotion and enhancement of the knowledge society in Greece and Europe.

PROMEA will support Summit Skills to deliver the day to day coordination. As aresearch and training methodology expert, it will produce the research tools for data collection on training requirements, and willdevelop the COSMET MOOC.

* The Polish Association of Building Managers (http://www.psmb.pl/mbaic-2/) was formed in cooperation with the Association ofEuropean Building Surveyors & Construction Experts (AEEBC) and the Chartered Institute of Building (CIOB) in order to educate andcertificate the managerial building personnel of the Polish construction industry.

PSMB will lead the activities for the mutual recognition of project's results and establish the framework towards a common EUqualification for construction site managers in smart metering. PSMB will also validate the training and assessment material, contribute with national data collection in the identification of training and skill requirements of the sector and the definition oflearning units, and organise the national information day in Poland.

* The Universitat Politècnica de València (http://www.upv.es/) is a public academic institution dedicated to researching andteaching in the field of construction technologies. Maintaining strong bonds with its social environment and a strong presenceabroad, it provides students all-round education related to technological skills.

UPV will be responsible for the research and development of training materials (training and assessment) in smart metering technologies andservices for site managers in the form of OERs and it will contribute to the development of additional pedagogical materials for theMOOC.

* The Vocational Training Institute of the Construction Industry in North-Rhine Westphalia (http://www.berufsbildung-bau.de/englishinformation/)is a training centre specialized in future-proof vocational training and continuing education as a non-profitinstitution for the initial and continuing training of workers in the construction industry.

BFW NRW will contribute together with the rest of the partnership to the collection of evidence on training requirements and in thedevelopment of the framework for the recognition of COSMET learning outcomes towards a smart metering for site managers EUqualification.

* Vilnius Builders Training Centre (http://www.vsrc.lt/joomla/english/about-us.html) is a vocational institution providing vocationaleducation and training for young people (from 15 years of age) and adults (retraining courses). The Centre offers a diverse range of courses and excellent facilities in the main area of Building and Construction.

VSRC will lead the definition of the COSMET learning units by grouping the COSMET learning outcomes in modules and by definingtheir specifications and characteristics. It will also contribute in the development of the COSMET Open Educational Resources bydelivering the trainer handbook.

This work was made possible by the contributions of all the people who are the Cosmet project teams, as well as companies and organisations of which extracted some contents of this work.

This work has been conducted within the framework of the research project COSMET "Training in Smart Meters for Construction Site Managers" funded by the European Commission within the Key Action 2: Strategic Partnerships in VET, reference number 2015-1-UK01- KA202-013406.

INTRODUCTION

With over 250 million smart meters for electricity, gas, water expected to be installed in the EU by 2020, the work of construction site managers is already undergoing change, requiring appropriate up-skilling with combined, green and digital, competences, to supervise the commission, installation, and operation of smart metering solutions. The new challenge for the traditional construction training sector is to further expand to the newly introduced field of modern environmental technologies. The current status of site managers' skills development in relevance to smart metering is not sufficiently, comprehensively and consistently supported by VET programs at the EU level. The COSMET project aims to support VET provision for site managers in smart metering addressing the needs of VET providers, learners, and the sector by offering a modular comprehensive course (MOOC) that ensure easy and free access to relevant educational material and tools.

Course syllabus

- L1: Smart metering basics
- L2: Site management and smart meters
- L3: Smart meter interconnections
- L4: Control protocols and system integration
- L5. It platforms and smart devices

L1: SMART METERING BASICS

Description: This learning unit introduces the learner to smart metering and provides basic facts and principles that improve resource efficiency in or for buildings, covering all types of smart meters. Upon completion of this module, participants will be able to understand the fundamental principles, requirements and environmental impacts of smart meters of all types (power, gas, heat, water and dual systems) as well as to demonstrate how to interact with customers in order to ensure that the right smart metering system is chosen and used effectively.

Learning outcomes

Learning Unit 1: Smart metering basics	
Learning Outcome 1	Describe the fundamental principles of smart meters in or for small and large buildings.
Learning Outcome 2	List at least 3 smart metering technologies or systems for each type of smart meter (power, gas, heat, water and dual systems)
Learning Outcome 3	Explain the environmental impacts of the use of smart meters in the short- and long- term
Learning Outcome 4	State the general requirements to implement smart metering technologies in or for buildings.
Learning Outcome 5	Advise customers on the correct selection of smart metering systems
Learning Outcome 6	Advise customers on the correct use of smart metering systems.

1.1 Fundamental principles of smart meters

What is smart metering? Smart Metering is a system composed of monitoring equipment capable of communicating with a central data centre, receiving orders and taking action based on certain parameters; while smart meters are devices installed in or near the customer's premises, which allow bilateral communication between the utility centre and the customer. The smart meters collect data locally and transmit via a Local Area Network (LAN) to a data collector. This transmission can occur as often as 15 minutes or as infrequently as daily according to the use of the data. The collector retrieves the data and may or may not carry out any processing of the data. Data is transmitted via a Wide Area Network (WAN) to the utility central collection point for processing and use by business applications. Since the communications path is two -way, signals or commands can be sent directly to the meters, customer premise or distribution device.

What can the customer do with a smart meter? The introduction of smart metering in combination with feedback devices can change to the benefit of the customers. Consumers can be informed remotely (historical data) or locally (real-time data) on energy costs and carbon emissions, better manage their resources (electricity, water, etc.), reducing consumption and increasing efficiency and control renewable energy systems installed in the building.

Environmental impact: The Smart Grid offers significant reductions in environmental impact through two sources: conservation and greater renewable generation integration. Greenhouse gas emission reductions can be traced directly to Smart Grid capabilities – such as time-varying rates and customer energy management systems – offering a conservation effect.

1.2 Smart metering technologies and systems

What is a smart meter? A smart meter is an electronic measurement device that collects energy/water data and sends it to the service or data centre. Old meters has dials and measures the total amount of electricity used in a billing period, so customers do not have the ability to track their consumption. A meter is called smart to imply that it includes significant data processing and storage

for various purposes. Smart meters are like traditional meters but with the capacity of communication. They can be connected to other devices to offer the customer a better experience; while they can monitor and control grid activities, ensuring the efficient and reliable two-way flow of electricity and information.

Different types of smart meter technologies and systems: Smart Metering technologies consist of several different technical components which may vary according to the specific market condition but the majority include the following features: a) accurate measurement and transmission of electricity, gas, water or heat consumption data, and b) provision of a two-way information gateway and communication infrastructure between the meters and relevant parties and their systems. Smart Metering systems feature a number of innovations: digital technology, communications, control and better operation of networks. Smart Metering technologies will change the way that metering works completely. They provide customers with much more information on how they use energy and enable those customers to reduce their usage.

1.3 Smart buildings

What is a smart building? A smart building is an automated building designed, installed and operated with advanced and integrated building technology systems. The traditional way to design and construct a building is to design, install, and operate each system separately. A smart building involves the installation and use of advanced and integrated building technology systems. One designer designs or coordinates the design of all the building technology systems into a unified and consistent construction document. This process reduces the inefficiencies in the design and construction process saving time and money. Smart buildings can reduce both the construction cost of the technology systems as well as the overall building operations' costs. The cost savings from the smart building approach results in added value to the building as evidenced by lower capital and operational expenses.

Passive vs Active energy efficiency: There are two approaches to managing energy more efficiently: passive energy efficiency and active energy efficiency. Passive homes, for instance, use insulation, heat recovery, and solar heating to achieve energy self sufficiency. However, the passive approach alone is not enough. Energy efficiency is by nature a long-term endeavour of active demand management.

L2: SITE MANAGEMENT AND SMART METERS

Description: This unit covers what a site/project manager is expected to know about installation and commissioning of smart meters in or for buildings, following health and safety regulations. Upon completion of this module, learners will be able to understand the role of a site/project manager in overseeing the design, installation and commissioning of smart meters in or for new and existing buildings.

Learning outcomes

Learning Unit 2: Site management and smart meters	
Learning Outcome 1	Describe the responsibilities of a site/project manager.
Learning Outcome 2	Evaluate the impact of the design of smart meters in or for new and existing buildings.
Learning Outcome 3	Supervise the installation of smart metering technologies in small and large buildings.
Learning Outcome 4	Coordinate the site staff in terms of smart meters installation.
Learning Outcome 5	Organise commissioning of smart meters, according to the workplan.
Learning Outcome 6	Identify health and safety issues during site works regarding smart meters.

2.1 Project Management

Project management for implementing the smart grid: Smart grid project management services include the activities required for promoting quality, curbing costs, managing schedules and mitigating risk. A project's success can be measured by three critical factors, as shown below: performance, budget, and schedule. Ultimately, a successful project delivers benefits and satisfies customers while meeting budget and schedule constraints. Project managers need to work closely with utility clients to facilitate all phases of the project life cycle; including: a) managing the activities of the team, subcontractors and selected vendors, b) confirming deliverables, controlling scope and managing the project schedule, c) providing implementation guidance, d) delivering a quality product on schedule and within budget, and e) foreseeing and mitigating risk.

Impact of the design of smart meters for new and existing buildings - Project conditions & smart metering facility design

Health and safety: The installation of smart meters presents a wide range of potential hazards for construction site managers and workers. Some of these are general hazards that may exist in everyday life and in day-to-day plumbing and heating system work activities and others are slightly different and/or additional hazards that need to be identified to avoid injury to persons and/or damage to property. Where the hazard cannot be eliminated, the risk of injury to persons and/or damage to property must be assessed and the risk managed, including, where appropriate, the use of a safe system of work.

L3. SMART METERS INTERCONNECTIONS

Description: This unit covers technical and organisational aspects regarding interconnection of smart meters, including integration issues with other site infrastructures. Upon completion of this module, learners will be to understand the technical issues related to installing smart metering technologies in or for new and existing buildings, and demonstrate how to prepare smart metering designs and drawings.

Learning outcomes

Learning Unit 3: Smart meters interconnections	
Learning Outcome 1	Explain the technical issues related to installing smart metering technologies in or for new buildings.
Learning Outcome 2	Explain the technical issues related to retrofitting of smart meters with other site infrastructure in or for existing buildings.
Learning Outcome 3	Evaluate the impact of the interconnection of smart meters with other site infrastructure.
Learning Outcome 4	Prepare smart metering designs, drawings.

3.1 New Buildings: Installation of smart meters

Tools and technologies for "smartness": A sensor is a device that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument. For example, a mercury-in-glass thermometer converts the measured temperature into expansion and contraction of a liquid which can be read on a calibrated glass tube. A thermocouple converts temperature to an output voltage which can be read by a voltmeter. For accuracy, most sensors are calibrated against known standards. Sensors are increasingly being installed in buildings to gather data about movement, heat, light and use of space. This information allows building management systems (BMS) to make reactive – and even anticipatory and personalised – real-time alterations to a building's environment to suit its occupants. Smart electricity meters record energy use, feeding information to the provider as well as the building occupant, to help regulate energy use and lower bills. Smart meters are the first step to creating a national smart grid, where electricity will be delivered to customers on the basis of responding to dynamic demands using data.

Smart metering installation process

Smart buildings and smart people: It is important to incorporate the user into the design of buildings and allow them control over their environment. Smart buildings should be responsive to their inhabitants in order constantly to improve living conditions. Close observation of the behaviour of occupants is important when retrofitting smart technologies to existing buildings in order to provide appropriate services. Building occupants, with higher priorities such as work and family, may lack the time, knowledge or inclination to create optimally efficient environmental conditions. This is where smart building technology can step in, learning and anticipating user preferences, and altering conditions to meet user needs more precisely and flexibly than we ourselves can.

3.2 Retrofit existing buildings

Strategy for improving building performance: With existing properties making up 99% of building stock there are no reasons why existing buildings cannot be as smart or as green as new construction. Retrofitting an existing building can oftentimes be more cost-effective than building a new facility. Since buildings consume a significant amount of energy (40 percent of the nation's total U.S. energy consumption), particularly for heating and cooling (32 percent), it is important to initiate energy conservation retrofits to reduce energy consumption and the cost of heating, cooling, and lighting buildings. The following sections describe a strategy to successfully improve the performance of existing buildings.

Risks and challenges: The growing availability of data produced by social media, smart devices and the internet of things raises concerns about privacy, data ownership and security. Loss of user confidence or trust has implications for application usage and the quality of data provided. In addition, as building service networks become more integrated, they also become prone to cascade failures that impinge on the comfort and productivity of building occupants and at worst endanger their safety. Preventing such failures is likely to become the joint responsibility of IT and facilities departments and will require continuous investment on the part of the building owner or tenant.

World's greenest office building: The Edge, in Amsterdam, is officially the greenest office building in the world. It's also the testing ground for a radical, highly connected new way of working, where employees have no set workspaces and can dial in their individual climate and lighting preferences via an app.

L4. CONTROL PROTOCOLS AND SYSTEM INTEGRATION

Description: This unit covers what control protocols are and how they are usually used in smart metering; and how they can be utilized to achieve system integration in or for buildings, according to national and European legislation. Upon completion of this module, learners will be able to understand how control protocols work and enable system integration, following European and national legislation regarding the installation of smart meters in or for buildings.

Learning outcomes

Learning Unit 4: Control protocols and system integration	
Learning Outcome 1	Describe control protocols used in smart metering.
Learning Outcome 2	Explain how control protocols can be used in order to integrate systems.
Learning Outcome 3	State the national legislation regarding the installation of smart meters in or for buildings and how it is applied at work.
Learning Outcome 4	State the European legislation regarding the installation of smart meters in or for buildings and how it is applied at work.

4.1 System integration

Communication protocols: All technology systems in a building are networks consisting of end devices that communicate with control devices or servers to monitor, manage, or provide services to the end devices. Communications between the devices occur via a set of rules or protocols. Connectivity between devices on the network is either through cable or a wireless transmitter/receiver. Smart buildings are built on open and standard communications networks which make the following characteristics possible: (1) inter-application communication; (2) efficiencies and cost savings in materials, labor, and equipment; and (3) interoperable systems from different manufacturers. Building system integration takes place at physical, network and application levels. Integrated systems share resources. This sharing of resources underpins the financial metrics and improved functionality of integrated systems. System integration involves bringing the building systems together both physically and functionally. The physical dimension obviously refers to the cabling, space, cable pathways, power, environmental controls, and infrastructure support. The functional dimension refers to an inter-operational capability, this means integrated systems provide functionality that cannot be provided by any single system, the whole is greater than the sum of the parts.

Network model layers: There are seven layers of network architecture (the flow of information within an open communications network), with each layer defined for a different portion of the communications link across the network. A network device or administrator creates and initiates the transmission of data at the top layer (the application layer), which moves from the highest layer to the lowest layer (physical layer) to communicate the data to another network device or user. At the receiving device the data travel from the lowest layer to the highest layer to complete the communication. When the data packet is initially sent each layer takes the data of the preceding layers and adds its own information or header to the data. On the receiving end each layer removes its information or "envelope" from the data packet.

4.2 European and national legislation

EU regulation and progress in the roll-out of smart meters: Member States are required to ensure the implementation of smart metering under EU energy market legislation in the Third Energy Package. This implementation is subject to a long-term cost-benefit analysis (CBA). To measure cost effectiveness, EU countries conducted cost-benefit analyses based on guidelines provided by the European Commission. A similar assessment was carried out on smart meters for gas. To date, Member States have committed to rolling out close to 200 million smart meters for electricity and 45 million for gas by 2020 at a total potential investment of €45 billion. By 2020, it is expected that almost 72% of European consumers will have a smart meter for electricity while 40% will have one for gas. While cost estimates vary, the cost of a smart metering system averages between €200 and €250 per customer, while delivering benefits per metering point of €160 for gas and €309 for electricity along with, on average, 3% energy savings.

International and national legislation

There are three different types of regulation in Europe: a) mandatory requirements, b) indirect requirements, and c) no requirements.

- Mandatory requirements (M/R): Mandatory requirements demand implementation of energy metering, which will meet a requirement of a given frequency of meter reading (hourly, monthly etc.) for a certain group of final customers. Grouping of the final customers can be related to: a) their size, usually described by their energy consumption (kWh) or capacity (size of the main fuse in Amperes), b) their connection to a network level (feeding voltage), c) possibility of feeding into the distribution network (own power generation), d) installation of new meters or replacement of old ones, and e) the mandatory requirements usually come into force from a specific date.
- Indirect requirement (I/R): The main difference from the previous one (M/R) is that the responsible bodies are somehow encouraged to implement smart metering, even though it is not directly required by the Authorities. The encouragement can be done by authorities via economic regulation of DSOs (where relevant), which will simplify recovery of the initial investments or even direct subsidies. (It has been commented several times that it is difficult to design a regulation regime which will create equally strong incentives for all bodies [ECON 2007]). The encouragement can also have a ―bottom-up‖ approach, when the final customers are allowed to demand installation of smart metering from the responsible body in order to achieve more correct billing and invoicing.

No requirements (N/R): Several countries, participating in the project indicated that there are no requirements for smart metering of final customers in distribution networks. However, the final customers may be required to manually read the meters relatively often. In these countries the deregulation and unbundling processes were recently initiated and are still in progress, so there is no an obvious need for frequent metering of energy consumption.

L5. IT PLATFORMS AND SMART DEVICES

Description: This unit covers what information about programming and comprehending feedback technologies in smart metering is required by Site Managers. Upon completion of this module, learners will be able to understand the digital and technical skills required to incorporate smart metering technologies in or for buildings and how IT and network infrastructures work and connect with smart devices.

Learning outcomes

Learning Unit 5: IT platforms and smart devices	
Learning Outcome 1	Describe the technical skills required for a technician to integrate smart meters of all types in or for buildings.
Learning Outcome 2	Describe the digital skills required for a technician to integrate smart meters of all types in or for buildings.
Learning Outcome 3	Explain how IT and network infrastructures work and connect with smart devices.
Learning Outcome 4	Identify the appropriate IT platform to use, according to project's specific needs.
Learning Outcome 5	Evaluate the efficiency of programming of smart meters.

5.1 Skill requirements

Emerging skill needs and qualifications: Maintenance technicians have commonly been high school and vocational graduates often occupying their jobs seasonally and paid by hour. STEM (Science, Technology, Engineering and Mathematics) degrees are also needed in this line of work with more demanding and expert-focused jobs higher up the chain. Businesses are updating how they search for maintenance team candidates. The skills needed to complete daily work are taught during training and mastered over time, and since there's a major lack of STEM talent they're prioritizing leadership qualities. There aren't any advanced computer skills that are required to manage a smart facility for this position because the solutions for tracking maintenance work are pivoting towards self-service. More and more "smart facilities" are giving their technicians mobile devices for accessing work orders on the go and relying on cloud storage that automatically collects data from machines. This profession isn't done evolving yet, but the IoT trend means generating more data that's more easily accessible. That means supervisors will keep an eye on operation dashboards and there will be more minute-to-minute accountability on technicians to be more efficient. It's less about the technical skills, and more about the motivations to do the job better with more transparency.

Overview of skill requirements for site managers: Dual Fuel Smart Meter Installers are responsible for the safe installation, exchange, commission, decommission and ongoing maintenance of Smart metering systems and associated equipment and communication systems. Therefore there is a rigorous requirement for a disciplined, responsible and professional approach to work that provides customer service excellence at all times.

Skill requirements for smart metering
Knowledge

- Current Health, Safety and Environmental legislation and regulations applicable to work in the gas and power industries. - Gas and electrical testing and assessment procedures needed to establish the condition of the equipment. - Gas and electrical theories and procedures involved in the practical application of installation, exchange, commission, decommission and maintenance of Smart metering systems and associated equipment and communication systems. - Relevant electrical/mechanical principles and how they are applied in work processes and procedures. - Up to date knowledge of energy efficiency principles to be able to provide advice and guidance to the customer. - Knowledge of Smart metering systems to be able to discuss and advise the customer.
Skills
- Carry out a thorough and rigorous risk assessment to ensure safety of customer. - Use tools, equipment and personal protective equipment in a safe and appropriate manner. - Install, exchange, commission, decommission and ongoing maintenance of Smart metering systems, associated equipment and communication systems in accordance with industry standards. - Take personal responsibility for maintaining safety standards and achieving job objectives. - Work with focus and clear purpose in all conditions and locations, covering business requirements, usually working alone and safely adapt working methods to reflect changes in working environments. - Work on customer premises/property showing appropriate care, respect whilst focusing on safety. - Use a variety of appropriate communication methods to interact with customers. - Identify where situations or conditions are to unsafe standards and take appropriate actions. - Achieve individual and team tasks which align to overall work objectives.
Competences / Behaviours
- Identify where situations or conditions are to unsafe standards and take appropriate actions. - Have personal wellbeing and the safety of customers and others as a priority. - Be energy aware and deliver appropriate advice to customers on energy efficiency. - Work effectively with people from different trades/disciplines, backgrounds and expertise to accomplish an activity safely, on time, providing confident challenge whilst meeting customer requirements. - Deliver a polite, courteous professional service to all customers whilst safeguarding customer welfare and recognising vulnerability. - Maintain and develop personal learning plans to continually develop knowledge and competence.

5.2 IT platforms

Introduction to IT platforms: IT platforms provides thousands of energy and water meters under a single console and derive useful information for logical reasoning and systematic decision making. Such platforms are engineered for industrial, commercial & residential metering applications to

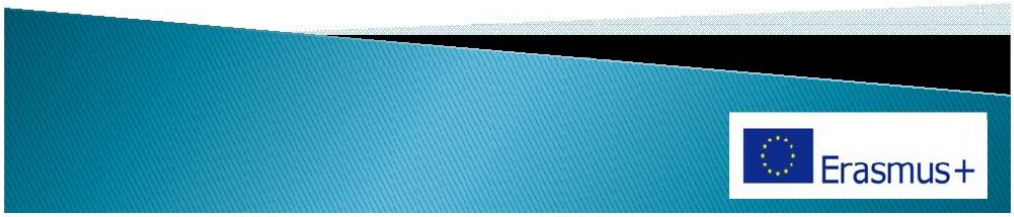
provide better visibility, controlled consumption, enhanced productivity, improved efficiency and reduced operational costs. What is more, IT platforms allow utilities to monitor the power quality, access & report critical information, maximize grid efficiency and perform real-time instrumentation. Platforms allow the management and monitoring of information, which can be accessed from a single point using any device (smartphones, PC, etc.). Users and system managers can have access to different sections of the application where they can check their status, as described above.

Samsung platform: Samsung launched its Smart Home service recently, hoping to expand into home energy management. The new service aims to simplify home automation by using a single application for connecting and controlling home appliances, TVs, and mobile devices. For example, in the United States, compatible products include Samsung's Smart French Door Refrigerator, Smart Front Loading Washing Machine, all 2014 Smart TVs, Gear 2 (watch-like wearables), and smartphones with operating systems above Android 4.0.

L1: SMART METERING BASICS

COSMET

Unit 1. Smart Metering Basics



Description

- This learning unit introduces the learner to smart metering and provides basic facts and principles that improve resource efficiency in or for buildings, covering all types of smart meters.
- Learners should understand the fundamental principles, requirements and environmental impacts of smart meters of all types (power, gas, heat, water and dual systems), and demonstrate how to interact with customers to ensure the right smart metering system is chosen and used effectively.

2

Objectives

- Describe the fundamental principles of smart meters in or for small and large buildings.
- List at least 3 smart metering technologies or systems for each type of smart meter (power, gas, heat, water and dual systems).
- Explain the environmental impacts of the use of smart meters in the short- and long-term.
- State the general requirements to implement smart metering technologies in or for buildings.
- Consult customers to ensure the right selection of smart metering system.

3

1.What is Smart Metering?

Smart Metering is a system composed of monitoring equipment capable of communicating with a central data centre, receiving orders and taking action based on certain parameters.

Smart Meters are devices installed in or near the customer's premises, which allow bilateral communication between the utility centre and the customer.

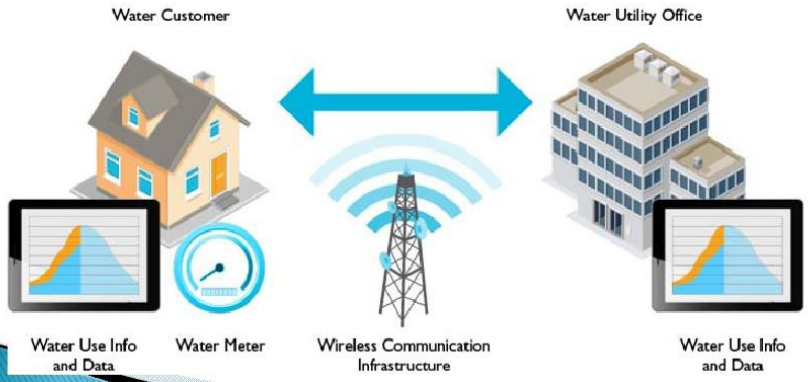


Figure 1. Automated Meter Infrastructure and Smart Water Metering. Source: https://www.metering.com

4

2. Smart Meters

A **smart meter** is an electronic measurement device that collects energy/water data and sends it to the service or data centre.

Figure 2. Examples of smart meters. Source: http://www.endesaeduca.com, www.flickr.com

Conventional meters are mechanical devices, whose data needs to be collected manually; while smart meters allow reading and registering the information remotely.

In order to use smart meters it is necessary to understand the element itself as well as the communication protocol used.

5

2. Smart Meters

Depending on what is going to be measured, there are different types of smart meter technologies and systems.

- Power
- Water
- Gas
- Heat/Cooling

Figure 3. Measurements at home.
Source: ttp://www.xatakahome.com, http://gcomercial.com, http://aizeklima.com, http://guiah.net

6

2. Smart Meters

Power meters

Measured parameters include:

- **Reactive energy**
- **Instantaneous power**
- **Power factor**
- **Voltage**
- **Current**
- **Maximum demand**
- **Exported energy** (active and reactive)
- **Selected power quality characteristics**

Figure 4. Meterus display. Source: http://www.ikz.de

7

2. Smart Meters

Water meters

Measured parameters include:

- **Flow rate of cold water**
- **Flow rate of hot domestic water**

Figure 5. Hydrometer CORONA-E. Source: www.lingg-janke.de

8

2. Smart Meters

Gas meters

Measured parameters include:

- **Energy** (if provided with a calorific value for the gas)

- **Instantaneous flow** (for ultrasonic and similar gas meters)

- **Maximum demand**

Figure 6. Gas Meter Itron. Source: www.lingg-janke.de

9

2. Smart Meters

Heat/Cooling meters

Measured parameters include:

- **Flow rate** - **Pressure**

- **Temperatures** (supply, return and difference)

- **Maximum demand** - **Nominal Flow**

- **Instantaneous power**

Figure 7. Compact Heat Meter SensoStar 2. Source: www.engelmann.de

10

2. Smart Meters

The **metering point** is the location of each type of meter, which should consider the following aspects to optimize monitoring results:

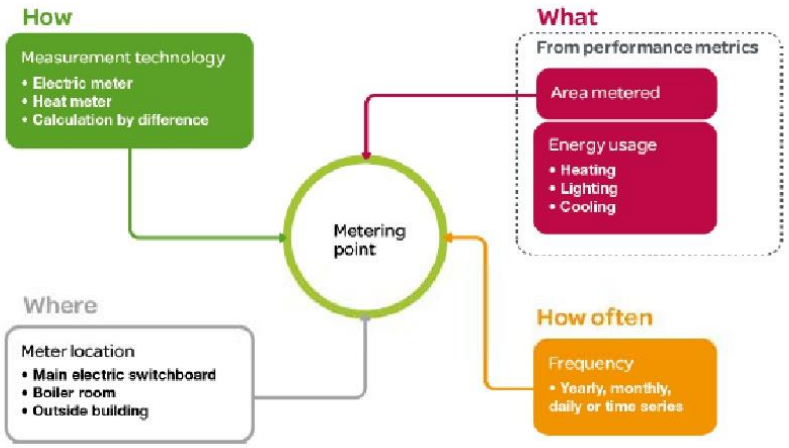


Figure 8. Metering points. Source: Reference [6]

11

3. Customer feedback

What can the customer do with a smart meter?

- Access real bills.
- Access real-time information measured by the meters.
- Better manage their resources (electricity, water, etc.), reducing consumption and increasing efficiency.
- Understand and choose an adequate tariff that suits them.
- Detect errors.
- Control renewable energy systems installed in the building.
- Understand their or the occupants' behaviour.

Figure 9. Electronic billing in Endesa. Source: http://www.energia-info.es

12

3. Customer feedback

Customer feedback is based on the measured data :

- Consumption, instantaneous and cumulative.
- Cost, instantaneous and cumulative.
- Prediction of the next bill.

Moreover, these devices provide additional information according to each application: electricity (disaggregated consumption data), gas (smoothed consumption data approximating to the steady heat output), heat/cooling (disaggregated by zones consumption data), water (leakage).

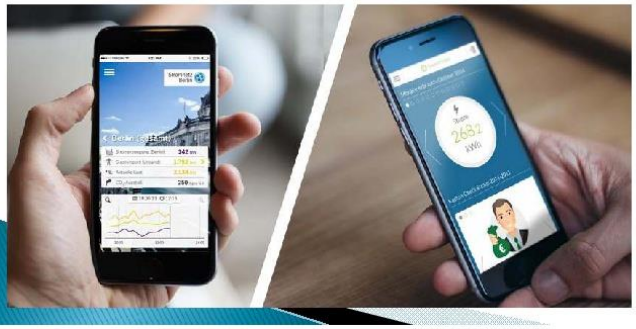


Figure 10. Example of app to consult all the information provided by the smart meter to the customer.
Source: http://www.greenpocket.de

13

3. Customer feedback

Benefits:

- No estimated bills.
- Historical data on bills.
- Possibility of achieving savings on energy bills.
- The ability to switch more easily between energy suppliers.
- The ability to adapt energy consumption patterns.
- The ability to install microgeneration measures.
- The possibility of prepaid or post-paid schemes and easier credit.

14

3. Customer feedback

Disadvantages:

- Smart metering is more vulnerable to criminals, vandals and hackers.
- Incorrect operation of smart meters may increment consumption and bills. It is necessary to understand measured data in order to improve the bills.

15

4. Smart Metering

Additional **functionalities** for electricity:

Customer:
- Provide direct readings.
- Update the readings frequently enough to achieve energy savings.

Metering operator:
- Allow remote reading.
- Provide two-way communication for maintenance and control.
- Update remote readings frequently enough to allow network planning.

Commercial aspects of energy supply:
- Support advanced tariff systems.
- Allow remote on/off control of the supply and/or power limitation.

Distributed generation:
- Provide import/export and reactive metering.

Security and data protection:
- Provide secure data communications.
- Fraud prevention and detection.

16

4. Smart Metering

Electronic devices can be connected with each other using different **communication** schemes:

Hard-wired

- Telephone networks
- Cable television
- Internet
- Fiber optic
- Waveguide (electromagnetism)

Wireless

- GSM
- GPRS
- 3G, 4G, 5G
- WiMax
- Low Power Radio
- WiFi
- Bluetooth
- Power Line Carrier (PLC)
- ADSL / Broadband
- ZigBee
- Z-Wave

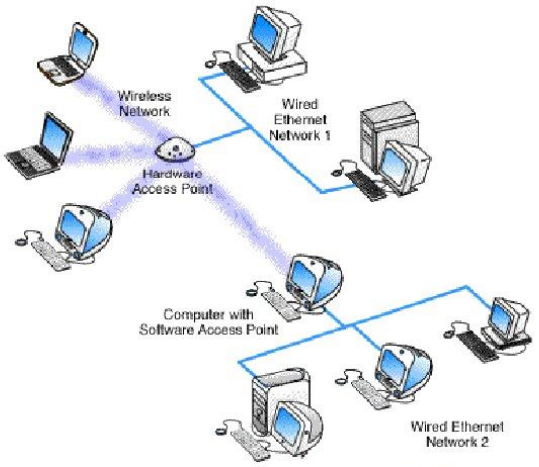


Figure 11. Office communication. Source: www.ourcyberoffice.com

17

4. Smart Metering

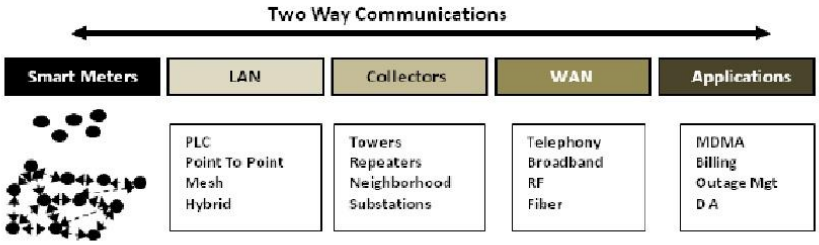


Figure 12. Smart Meter System Basic Architecture. Source: Reference [1]

Smart meters collect data locally and transmit it via LAN to a data centre.

Data is transmitted via WLAN to the utility data centre for processing. It can the be used throughout business applications.

18

4. Smart Metering

Figure 13. Sensors.
Source: http://plcbangladesh.com

Figure 14. Controller.
Source: http://www.cates.com

Figure 15. House.
Source: http://inmobiliaria56.com

Measuring equipment → sends data to → **Controllers** → changes → **Environment**

- Element for measurement.
- Data storage capacity.
- Set-up for data registering.

- Contains the control logic of the whole system.
- Collects and transmits only the necessary data.
- Compares data collected with measurements patterns for anomalies.

- CO_2 emissions avoided.
- Energy savings

19

5. Smart Buildings

A smart building is an automated building designed, installed and operated with advanced and integrated building technology systems.

Smart Buildings are critical in the rational use of resources (water and energy). Automated systems, such as HVAC and lighting control, power management and metering play a major role in determining the operational inefficiency of a building.

Figure 16. Smart buildings. Source: www.theonegrouputah.com, aptgadget.com

20

5. Smart Buildings

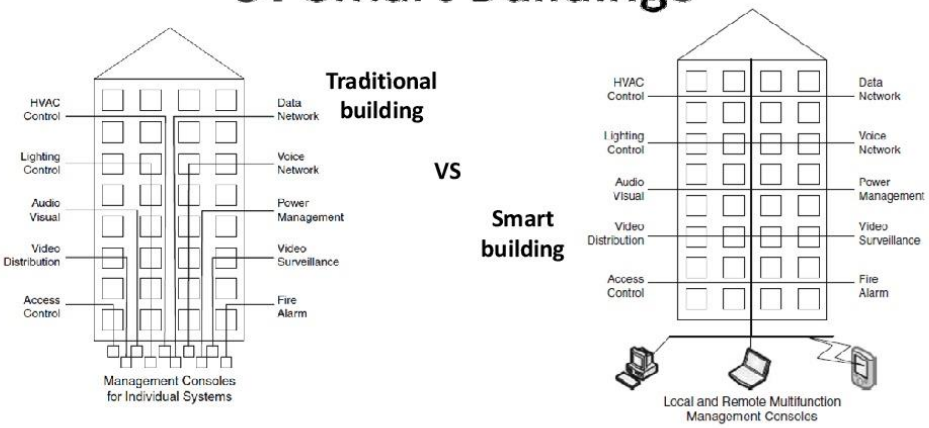


Figure 17. Multiple proprietary building systems vs Integrated building systems. Source: Reference [9]

Designing, installing, and operating each system separately.

Unified design of all building technology system and their interconnection.

21

5. Smart Buildings

Introducing advanced technology in buildings reduces costs not just in its operation period, but also in the construction stage.

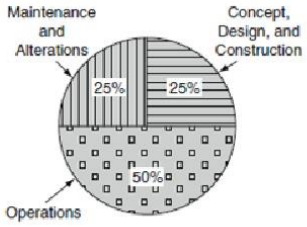


Figure 18. Life-cycle cost of a building. Source: Reference [9]

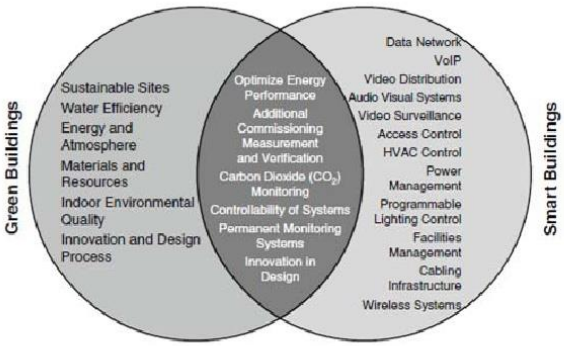


Figure 19. Commonality of smart and green buildings. Source: Reference [9]

22

5. Smart Buildings

Active vs. Passive energy efficiency

(There are two ways to manage energy more efficiently)

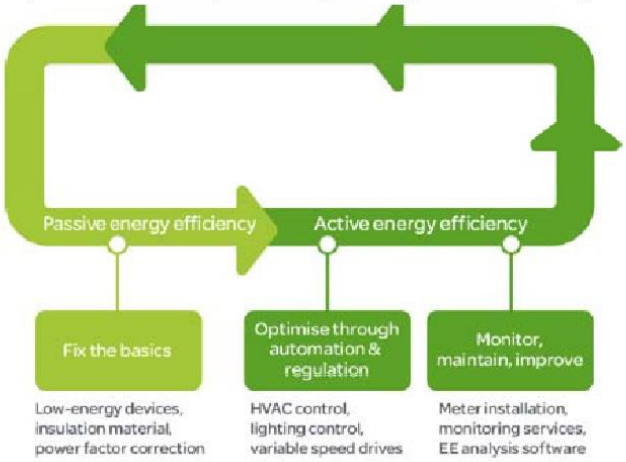


Figure 20. Energy Audit & Measurement. Source: http://www.schneider-electric.es

23

6. Environmental Impact

The only environmental impact is the **Electromagnetic Pollution.**
However, it is a topic not sufficiently studied.

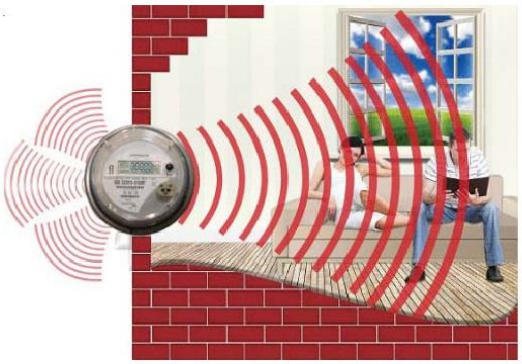


Figure 21. Smart Meter radiation. Source: http://www.wakingtimes.com

24

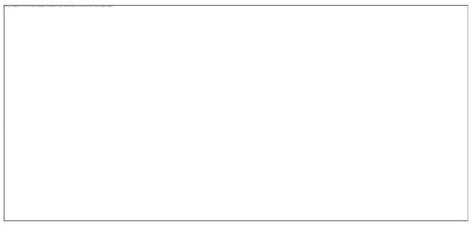
6. Environmental Impact

Correct implementation and use of smart meters in buildings reduces the consumption of resources (power, water, gas, heating and cooling), avoiding CO_2 emissions due to use and resources production.

Figure 22. Green World. Source: www.news.lk

7. Videos

Video 1. The Smart home.
Source: https://www.smartgrid.gov/the_smart_grid/smart_home.htmll



Video 2. The Smart Grid.
Source: https://www.smartgrid.gov/the_smart_grid/smart_grid.html

More videos:

https://www.smartgrid.gov/the_smart_grid/smart_home.html

Video 3. Operation centers.
Source: https://www.smartgrid.gov/the_smart_grid/operation_centers.html

8. FAQs

What do smart meters look like?
Smart meters are similar to traditional meters but with a digital display instead of an analog display.

How exact are smart meters?
Smart and traditional meters have a similar accuracy.

Will I still receive my bills?
Yes, all customers will still receive their energy/gas/water bills like they do currently. The in-home display is used as a complementary information resource and won't replace the regular bills.

Could smart meters invade my privacy?
No, because energy suppliers use only the basic data to carry out their legal task. Furthermore, grid operators and energy suppliers protect this data against unauthorised access and manipulation.

How do smart meters operate differently from traditional meters?
Traditional meters provide the data by manually reading and measuring total electricity consumption in a billing period (one or two months), so customers can't track their usage. Smart meters provide real-time access to your consumption and data is collected remotely.

27

8. FAQs

Can I read my meter data and use it to save on my bill?
Consumers can see through the website of their electric supplier company, their usage on a daily, weekly and monthly basis (among other data) if they have installed a remote management meter. With this information you can know the distribution of energy consumption, make efficient use of it and decide the best rate according to the profile.

Where will the new measuring equipment be installed?
It will be installed in the same place as the current meter because the size of the new one is similar. So, it should be a quick and simple replacement.

When changing the meter, is it necessary to cut the power?
Any equipment change requires supply interruption for a short period of time.

What are the benefits of the new system?
Real data estimation readings are no longer necessary; Times of supply disruption due to breakdown will be reduced; and allow contractual changes without intervention in the meter room.

Can smart meters combust?
No. As they conform to EU standards there isn't any risk of fire or explosion.

28

9. References

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[3] www.citipower.com.au/smartmeters

[4] www.powercor.com.au/smartmeters

[5] Josco C.P. Kester (ECN), María José González Burgos (ENDESA INGENIERÍA), John Parsons (BEAMA). ***"Energy Saving and the Customer (Edition 2010)"***. Smart Metering Guide, 16 Nov 2009.

[6] http://www.schneideruniversities.com

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9. References

[7] Jean-Paul Genet, Cliff Schubert. ***"Designing a metering system for small and medium-sized buildings"***. Schneider Electric, 2013.

[8] Vincenzo Giordano, Ijeoma Onyehi, Gianluca Fulli (JRC IET), Manuel Sánchez Jiménez, Constantina Filiou (DG ENER). ***"Guidelines for Cost Benefit Analysis of Smart Metering Deployment"***. JRC scientific and technical research, 2012.

[9] James Sinopoli. ***"Smart Building Systems for Architects, Owners, and Builders"***. Elsevier, 2010.

[10] http://www.domobiotik.es

[11] https://www.smartenergygb.org

[12] http://my-smart-energy.eu

[13] https://www.iberdroladistribucionelectrica.com

[14] http://stopsmartmeters.org

30

COSMET CONSORTIUM

SummitSkills - The Standard Setting Organisation for Building Services Engineering, United Kingdom

www.summitskills.org.uk

PROMEA – Hellenic Society for the Promotion of Research and Development Methodologies, Greece

www.promea.gr/

UPV – Universitat Politècnica de València. Department of Architectural Constructions

www.upv.es/

PSBM - Polish Association of Building Managers, Poland

www.psbmgmt.com/

BFW NRW - Vocational Training Institute of the Construction Industry in North-Rhine Westphalia, Germany

www.bfw-nrw.de/

VSRC - Vilnius Builders Training Centre, Lithuania

www.vsrc.lt/

31

L2: SITE MANAGEMENT AND SMART METERS

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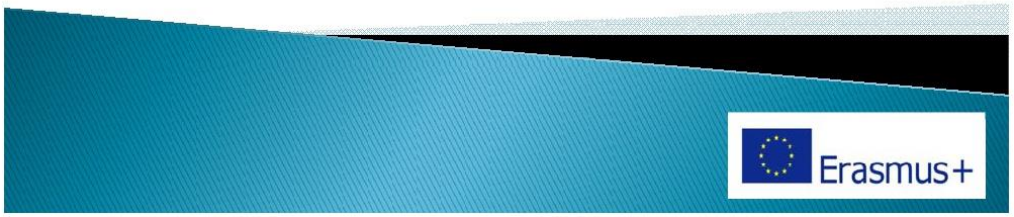
Unit 2. Site management and smart meters



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Description

- This unit covers what a site/project manager is expected to know about installation and commissioning of smart meters in or for buildings, following health and safety regulations.
- Learners should understand the role of a site/project manager in overseeing the design, installation and commissioning of smart meters in or for new and existing buildings.

Objectives

- Describe the responsibilities of a site/project manager.
- Evaluate the impact of the design of smart meters in or for new and existing buildings.
- Supervise the installation of smart metering technologies in small and large buildings.
- Coordinate the site staff in terms of smart meters installation.
- Organise commissioning of smart meters, according to the workplan.
- Identify health and safety issues during site works regarding smart meters.

Project Manager

A project's success can be measured by three critical factors, as shown below: performance, budget, and schedule.

This is the goal that has to be accomplished by the project manager: obtaining good quality results sticking with an established budget and a schedule.

Project Manager

The principal responsibilities of a project manager are:

- Resource management.
- Budget accomplishment
- Leadership

To reach this aspects, the project manager has to bring his knowledge and skills supporting him in methods, tools and technology to achieve his objectives offering quality results.

Project Manager

Impact of the smart meters design

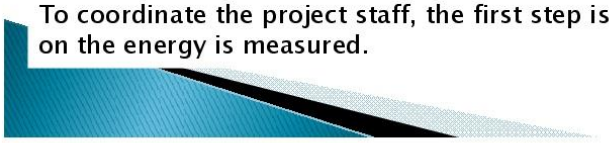
It is necessary for the customer's satisfaction to take into account a principal aspect:

- Simplicity

It is known that people don't like to spend too much time in learning to use a difficult program, especially old people.

Therefore, the platform where it will be shown all the information about the electricity bill and other data, needs to be simple and intuitive to make this task easy. This characteristic will be seductive to the people that don't have one yet.
As it was shown in unit 1, smart meters can measure power, water, gas…

To coordinate the project staff, the first step is to make groups depending on the energy is measured.



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Project Manager

Features and functionalities of smart meter (i)

- A smart meter is a digital, electronic meter for residential, commercial and grid applications.
- Smart meters can be used to measure electricity, gas, water and heat.
- Meters can measure and record consumption at small intervals, for example every 15 or 30 minutes.
- The meter is capable of two-way communication between the point of consumption and the energy utility.

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Project Manager

Features and functionalities of smart meter (ii)

- Communication is via Power Line Carrier (PLC), mobile network (2G/3G) or radio waves.
- Information on power quality and power outages is also provided.
- Smart meters are also able to measure energy generated, such as from solar panels or microgeneration.
- Smart meter settings and software can be remotely managed and updated by the utility.
- The end-consumer has access to their energy information via an In-Home Display or web portal.

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Project Manager

Impact of the design of smart meters in or for new and existing buildings (i)

- Provide consumers with frequent and real time access to standardized, meaningful and comprehensible information on consumption and related costs, as well as on types of energy sources.
- Facilitate the selection of suppliers with transparency rates to compare different cost, and without obstructing the supply shifting due to extra costs.
- Protect consumers from the new energy market, specially from disloyal commercial practices.

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Project Manager

Impact of the design of smart meters in or for new and existing buildings (ii)

- Offer consumers the possibility to act responsively in the energy consumption and get advantages from it. This will help to balance the variability of renewable energies throughout demand response strategies or storing energy in local devices (such as batteries).
- Maintain metering and consumption data in the control of consumers. In case they decide to allow the access to the data to other stakeholders (ex. supplier), the data access and use should be protected.

Project Manager

Impact of the design of smart meters in or for new and existing buildings (iii)

- Ensuring that intelligent household appliances and components are fully interoperable and user-friendly. Also, guaranteeing that smart meter systems are suitable for the purpose for which they are intended and have the recommended functionalities in order to maximize their benefit to consumers.
- Ensuring an economically efficient and stable network operation; Ensure non-discriminatory treatment by distribution system operators or by any other entity responsible for measurement data with potential commercial value.

Project Manager

Conformity of products, equipment and materials used in smart metering [1]

- Construction products which are permanently incorporated into buildings, according to their intended use, shall bear the CE marking in accordance with Directive 89/106 / EEC on construction products or other European Directives applicable to them.
- In certain cases, and in order to ensure its sufficiency, the technical characteristics of products, equipment and systems incorporated into buildings shall be established without prejudice to the CE Marking applicable and in accordance with the corresponding European Directives.
- Marks, stamps, certificates of conformity or other voluntary quality labels that facilitate compliance with the basic requirements may be recognized by the competent Public Administrations.

Project Manager

Project conditions (i)

- The project will describe the building and define the execution works with sufficient detail so that they can be interpreted unequivocally during its execution.
- In particular, the project will define the installation of smart metering projected with the necessary detail, so that it can be verified that the proposed solutions meet the basic requirements of the applicable regulations. This definition shall include at least the following information:

Project Manager

Project conditions (ii)

a) Minimum technical characteristics that must be met by the products, equipment and systems, as well as their supply conditions and quality assurances;

b) Technical characteristics of each work unit, indicating the execution conditions and verifications protocols to be carried out to verify its conformity with what is indicated in the project. The measures to be taken during the execution of the works and the use and maintenance of the building shall be specified to ensure compatibility between the different products, elements and construction systems;

Project Manager

Project conditions (iii)

c) Verifications and the service tests which, if necessary, must be carried out to check the final performance of the building;

d) Instructions for use and maintenance of finished smart metering building facilities, in accordance with the applicable regulations.

Project Manager

Initial information for smart metering facility design (i) [2]

It will indicate the starting data, the objectives to be fulfilled, the benefits and the bases of calculation.

Aim and Initial data.

- *Definition and location based on measuring areas, services (electricity, water, gas, etc.) and intended uses.*
- *Conditions of supply (voltage, water flow, refrigeration needs, etc.)*

Project Manager

Initial information for smart metering facility design (ii) [2]

Design.

- *Description: operation, layout and main characteristics of the installation.*
- *Summary of the facility data: Total installed power and maximum power allowed, nominal voltage, estimated water, gas, etc. ratio of expected loads for different cooling or heating uses, etc.*
- *Commercial Facilities: identification and conditions of implantation process.*
- *Materials and equipment: definition of their characteristics.*

Project Manager

Work safety at smart metering facilities

Main action to mitigate the electrical risk in facilities is the people's attitude:

- Attitude towards risk
- Attitude towards self and other security
- Attitude towards design, assembly, maintenance and operation procedures
- Attitude toward compliance with technical standards

Figure 2. Placement of smart meters by an Endesa operator in the Smartcity in the framework of Málaga Project. Source: [3]

References

[1] Building Tehnical Code Part I.
[2] Quality manual of an architectural project.
[3] Endesa. Smartcity Málaga. A sustainable energy management model for the cities of the future.

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www.summitskills.org.uk

PROMEA – Hellenic Society for the Promotion of Research and Development Methodologies, Greece

www.promea.gr/

UPV – Universitat Politècnica de València. Department of Architectural Constructions

www.upv.es/

PSBM - Polish Association of Building Managers, Poland

www.psbmgmt.com/

BFW NRW - Vocational Training Institute of the Construction Industry in North-Rhine Westphalia, Germany

www.bfw-nrw.de/

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L3: SMART METER INTERCONNECTIONS

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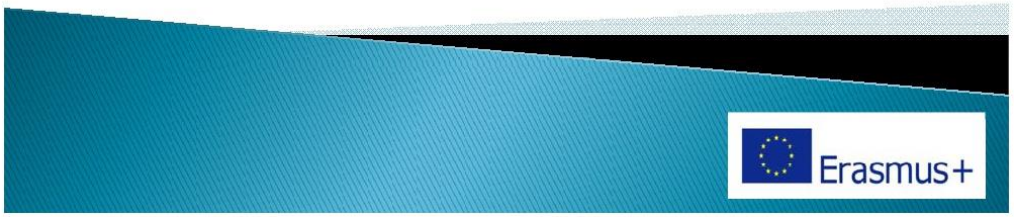
Unit 3. Smart meters interconnections



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Description

- This unit covers technical and organizational aspects regarding interconnection of smart meters, including integration issues with other site infrastructure.
- Learners should understand the technical issues related to installing smart metering technologies in or for new and existing buildings, and demonstrate how to prepare smart metering designs and drawings.

Objectives

- Explain the technical issues relating to installing smart metering technologies in or for new buildings.
- Explain the technical issues relating to the retrofitting of smart meters with other site infrastructure in or for existing buildings.
- Evaluate the impact of the interconnection of smart meters with other site infrastructure.
- Prepare smart metering designs, drawings.

1. New buildings: Tools and technologies for 'smartness'

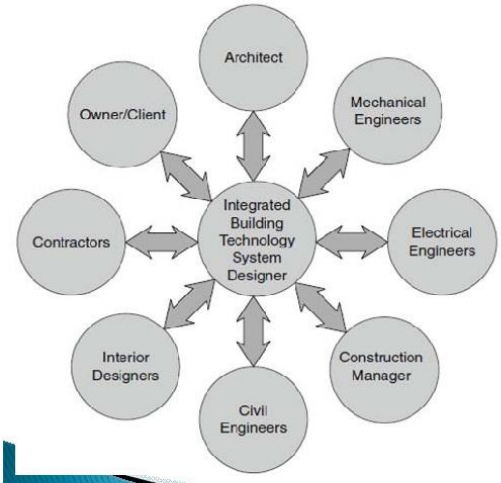
Image 1. Sensors. Source: https://josenieves.files.wordpress.com

Sensors → used to collect and gather data. Integration of sensors in building management systems allow reacting to signals taking real time actions to optimise energy savings and comfort.

Smart meters and smart grids → Facilitate monitoring and managing energy use, sending information to the provider which should be accessible to building occupants.

Image 2. Sensors. Source: https://www.sse.co.uk

1. New buildings: Tools and technologies for 'smartness'



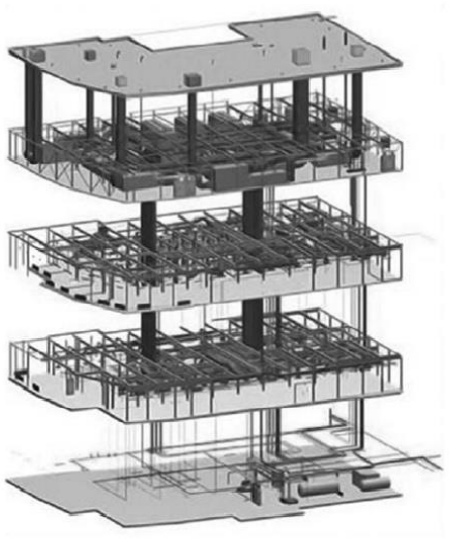


Image 4. Integrated Building Techonology System Designer. Source: Reference [2]

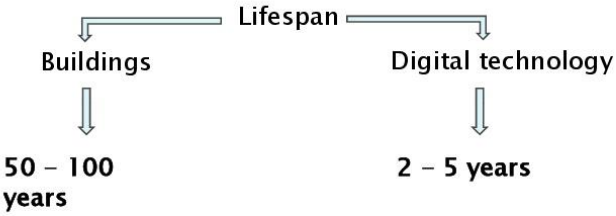
2. Smart buildings and smart people

Smart buildings require smart people. This means that building' users should be involved in the process of resource optimisation in building sector, from designing to daily comfort operative.

Building occupants may lack the time to optimise their comfort preferences. Monitoring and collecting data from users allow smart building technology learning their preferences and automatically set their preferred conditions in real time.

Image 5. Smart Building. Source: www.daintree.net

2. Smart buildings and smart people



In the new construction paradigm, buildings are seen as a core infrastructure where applications can be plugged, similar to smartphones and their apps.

3. Existing buildings

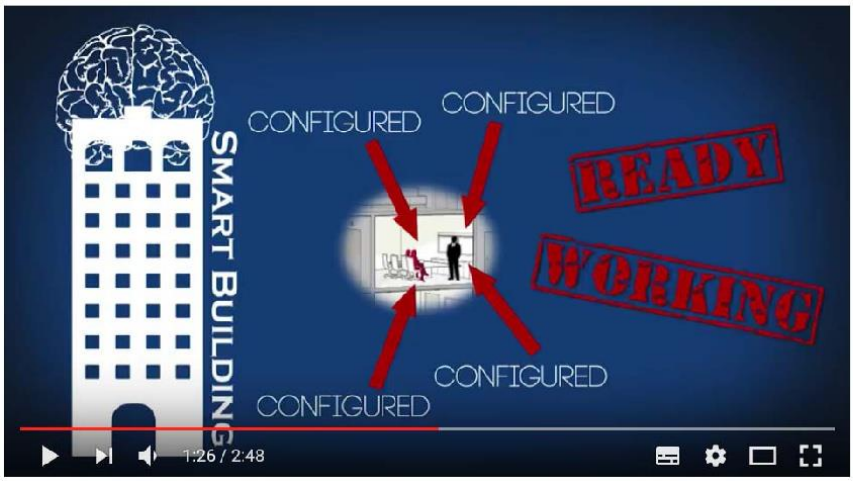
In existing buildings, some strategies to improve building's performance are:

- **Go through a discovery process.** Gather data and analyse it.
- **Benchmark the building's performance**. Have a baseline to evaluate effectiveness of the measures.
- **Energy Certification**. Obtain energy certification to raise economic value of the building.
- **Prioritize and fund the effort**. Organise the potential measures based on the financial return and technical analysis.

3. Existing buildings

- **Control strategies**. Prior to any element or equipment upgrade, control systems may facilitate key information about the systems and its usage, facilitating the selection of appropriate new equipment.
- **Re-commission the resource contract**. Re-negotiate resources contracts based on the information obtained from the resource monitoring.
- **Upgrade monitoring, management and operation systems**. Building system data is essential for continuous optimisation of building's performance. Thus, it should be constantly upgraded it to guarantee its maximum effectiveness.
- **Upgrade the building security, resource-related and technology amenities**. Resources' metering requires adequate cibersecurity to protect data and system's access.

3. Existing buildings



Video 1. What is a Smart Building?. Source: https://www.youtube.com/watch?v=NKBwJtq-TQo

4. Risks and challenges

Privacy and the security of data

Concern raising about privacy, data ownership and security due to the growing data availability. Preventing security breaches requires regulatory framework, but also dedicated software engineering and maintenance standards.

Image 6. Security data. Source: http://observationbaltimore.com

Image 7. Maintenance. Source: https://es.123rf.com

Maintaining systems

Building management system must be well-maintained to prevent unexpected failures.

4. Risks and challenges

Detection of fraud/theft

It is possible to tamper smart meters to record lower electricity consumption.

Image 8. Smart meter manipulator. Source: http://cadenaser.com

5. Examples

MGS CLOUD & IBM TRIRIGA

Image 9. Smart building. Source: www.ondemandgroupuk.com

5. Examples

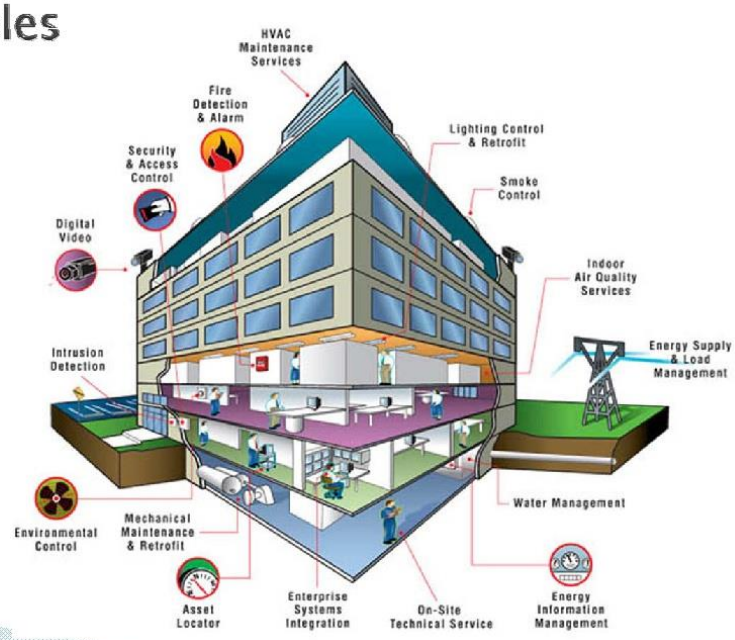


Image 10. Intelligent Building Monitoring. Source: www.arobs.com

5. Examples

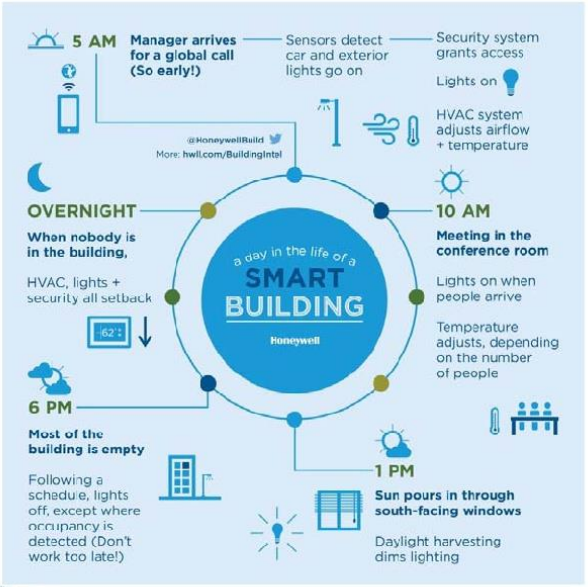


Image11. 24h in a smart building. Source: https://buildingcontrols.honeywell.com

5. Examples

Video 2. The most intelligent building in the world. Source: http://www.bloomberg.com/news/videos/2015-09-23/see-the-world-s-greenest-office-building-the-edge

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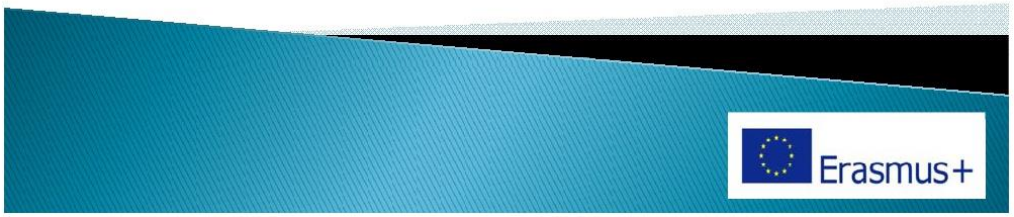
L4: CONTROL PROTOCOLS AND SYSTEM INTEGRATION

COSMET

Unit 4. Control protocols and system integration



Description

- This unit covers what control protocols are and how they are usually used in smart metering; and how they can be utilized to achieve system integration in or for buildings, according to national and European legislation.
- Learners should understand how control protocols work and enable system integration, following national and European legislation regarding the installation of smart meters in or for buildings.

Objectives

- Describe control protocols used in smart metering.
- Explain how control protocols can be used in order to integrate systems.
- State the national legislation regarding the installation of smart meters in or for buildings and how it is applied at work.
- State the European legislation regarding the installation of smart meters in or for buildings and how it is applied at work.

1. Progress in the roll-out of smart metering across the EU

Finland, Italy and Sweden are advanced in installing smart meters and the UK is catching up fast. Another thirteen Member States have declared their intention to proceed with large-scale roll-out of smart meters by 2020.

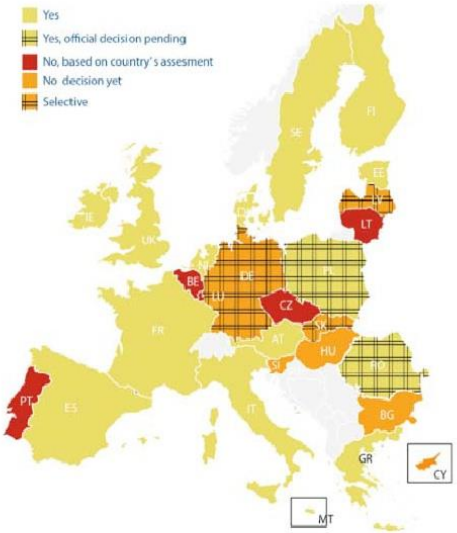


Image 1. Deployment of smart electricity meters in EU Member States by 2020. Source: Reference [1]

1. Progress in the roll-out of smart metering across the EU

Estimated cost of installing smart electricity meters → from 77 € to 776 € per customer.

Image 2. Saving techniques. Source: http://www.enunaservilleta.es

Image 3. Savings. Source: comunidadfinanciera.es

The Commission's benchmarking report expects savings with smart meters.
It's estimated a reduction of energy costs from 3% to 10% depending on the kind of consumer.

2. Integration

Communication networks in smart buildings make this possible:

(1) **Inter-application communication**.
(2) **Efficiencies and cost savings** in materials, labour, and equipment.
(3) **Interoperable systems** from different manufacturers.

Integrated systems share resources that improve functionality.

System integration involves bringing the building systems together in both perspectives:

Physical perspective→ cabling, space, cable pathways, power, environmental controls, and infrastructure support.
Functional perspective → interoperational capability.

2. Integration

Network device → transmit the data from the highest layer to the lowest layer to communicate it to another user.

Image 4. Integrations. Source: http://emfsafetynetwork.org/smart-meters/

2. Integration

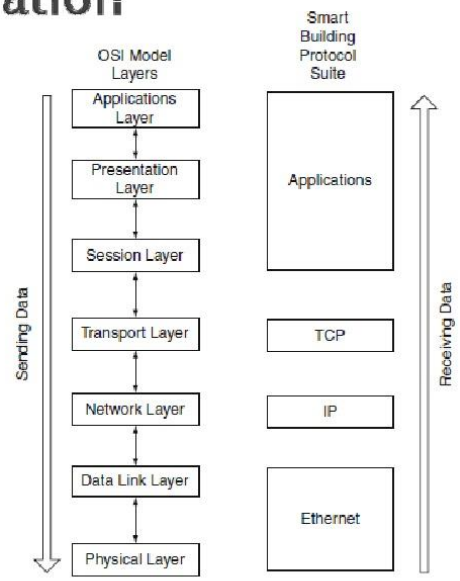


Image 5. Network model layers. Source: Reference [2]

3. Legislation

Different **types of regulation** in Europe:

- Mandatory Requirements (M/R).
- Indirect Requirements (I/R).
- No requirements (N/R).

Image 6. The law Source: www.picserver.org

Challenges:

- The main concern is that majority of the current standard analogue meters' in use today will be obsolete in less than 30 years so will all require replacement.
- There is a potential of hundreds millions of new meters that have to be introduced across Europe. By introducing smart meters gradually, it tries to reduce the impact of the problem.

3.1. International legislation

European directive, 2009/72/EC common rules for the internal market of electricity, 2009/73/EC common rules for the internal market of gas and 2006/32/EC about the efficiency of the final use of the energy and the energy services.

Smart Meters must accomplish the principal function of recording energy usage. Two standards define the accuracy expectation of metering equipment for electricity use:

- ANSI C12.20, USA, classes for electric meters.
- IEC 62053 European UNE-EN62053, particular requirements.

3.1. Examples of International legislation

Smart Meters have to meet the standards that let them communicate with DM and with the net HAN del usuario:

- HAN y *Energy Gateway*:
  - IEEE802.15.4 o ZigBee.
  - Bluetooth de baja energía.
  - IEEE 802.11 o Wi-Fi.
- Communications with the concentrator and DM, *Last-Mile Communication*:
  - IEEE802.15.4 o ZigBee.
  - IEEE 802.11 o Wi-Fi.
  - *Worldwide Interoperability for Microwave Access* WIMAX.
  - *Power Line Communications* (PLC).
  - *General Packet Radio Service* (GPRS), Short Message Service (SMS).
  - Device Language Message Specification (DLMS) - COmpanion Specification for Energy Metering (COSEM).

3.1. Examples of International legislation

SPAIN: Some prominent standards are:

UNE-EN 13757→ remote reading of meters and its communication systems.
Series of standards that talks about remote reading of meters and communication systems.

UNE-CEN / TR 16061 IN → gas meters. Smart gas meters.
Technical report that describes recommendations for smart gas meters.

UNE 178XXX → Smart Cities.
To drive the deployment of smart cities in Spain with a management system and a network of multiservice telecommunications, establishing interoperability requirements.

3.2. National legislation

The Smart Energy Code (SEC) is a multi-Party agreement which defines the rights and obligations of energy suppliers, network operators and other relevant parties involved in the end to end management of smart metering in Great Britain.

The SEC comes into force under the Data and Communications Company (DCC) Licence, which has been established to manage the smart metering communications infrastructure. The former Department of Energy and Climate Change (now the Department of Business, Energy and Industrial Strategy) issued the designation of the SEC and the Charging Methodology on 23rd September 2013 following the granting of the DCC Licence.

The designation letter identified the members of the SEC Panel and Gemserv as the company which will act as the Code Administrator and Secretariat

3.2. National legislation

- In the UK Smart Metering for Gas and Electricity fall under the Regulatory control of OFGEM
- OFGEM have a mission to work with other European countries through a number of different groups including:
- ACER – (Agency for the Cooperation of European Regulators) in order *to foster cooperation among European energy regulators and ensure market integration and harmonisation of regulatory frameworks*
- CEER – (Council of the European Energy Regulators) a not-for-profit European association established in 2000 in Brussels. CEER brings together the independent national energy regulators from the European Economic Area (EEA)
- ICER – (International Confederation of Energy Regulators) *Its main purpose is to facilitate cooperation amongst energy regulators on the global scale and to raise public awareness of energy regulation and its role in tackling environmental, socio-economic and market issues.*

3.2. National legislation

- The UK government plans to install smart meters in all homes across England, Scotland and Wales by 2020 which will provide consumers with greater information on their use of electricity. The technical specification for these meters includes the ability to measure exported electricity. As older meters are replaced fewer consumers are expected to be affected by issues with micro generation to their properties that occasionally happen with the older meters.
- Most UK suppliers will start offering smart meters from Autumn 2016, they are contacting consumers as part of a structured programme to confirm when each customer will be swapped across. Smart meters aren't compulsory and consumers can choose not to have one.

3.2. National legislation

- By the end of 2020, around 53 million smart meters will be fitted in more than 30 million premises (households and businesses) across Wales, Scotland and England. The programme is already underway. We're in the first stages and nearly five million smart meters have already been installed across Great Britain. This is the biggest national infrastructure project in our lifetimes and it will enable a more energy efficient system for Great Britain.
- The UK government expects that smart meter installations will:
- - rise sharply in 2016, when all the final common standards come into force
- - result in 20 million meters being fitted between 2016 and 2018
- - peak in 2019 and finish in 2020
- Technological factors mean that different housing types and locations will be fitted at different times.

3.2. National legislation

- Smart meters help enable the smart grid, which is a whole new way of running energy networks. It's a bit like an internet for gas and electricity and will make the UK more secure and help us manage our energy usage.
- The UK energy network was designed for a time when gas and electricity needs were much simpler. We're using more energy and have to find ways to reduce our carbon emission so we need to integrate new technologies, like electric cars and solar and wind energy.
- The smart grid will be much better at integrating green technologies, from electric cars to home rooftop solar panels and heat pumps. In particular, we need the smart grid to help us get the most from variable power sources like wind and solar. For example, smart meters should open the door to flexible pricing that means we can use solar and wind energy when it's plentiful.

FAQs

What are the technical standards that smart meters have to meet?

Smart meters are covered by strict UK and EU product safety laws. These ensure that smart meters all have the same high quality and safety standards, regardless of your energy supplier.

How accurate are smart meters?

Smart meters are as accurate as traditional meters. Energy suppliers receive very few complaints about them.

By law, all smart meters have to be certified by the National Measurement Office to prove their accuracy, but if you do think there's a fault, you can report it to the Energy Ombudsman in the same way you would now.

Does a smart meter mean my energy can be cut off more easily?

No. You're protected by strict regulations against your energy supplier switching off or disconnecting your gas or electricity supply. This protection remains as strong with smart meters as it is with traditional meters.

FAQs

I'm on prepay and access to my meter is not always easy. Can smart meters help?

Yes. A smart meter with a prepay function, means you don't need a different kind of meter for prepay and you'll no longer need to access your meter. You'll be able to see how much credit you have left via your in-home display and top-up in a number of ways, including online; via telephone; text; smartphone app or in person at a local shop/outlet. Credit will be automatically added to your account without any need to put a key or card back into your meter.

Will the in-home display cost me anything to run?

Less than £1 a year in electricity.

Will the in-home display only receive information from my meter?

Yes, your in-home display is paired with your smart meter by your smart meter installer, so it only shows information from your own smart meter not a neighbours so obviously you won't be able to take it and use it in another house.

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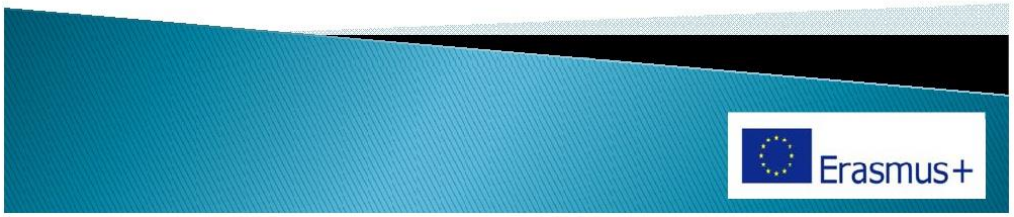
L5: IT PLATFORMS AND SMART DEVICES

COSMET

Unit 5. IT platforms and smart devices



Description

- This unit covers what information about programming and comprehending feedback technologies in smart metering is required by Site Managers.
- Learners should understand the digital and technical skills required to incorporate smart metering technologies in or for buildings and how IT and network infrastructures work and connect with smart devices.

Objectives

- Describe the technical skills required for a technician to integrate smart meters of all types in or for buildings.
- Describe the digital skills required for a technician to integrate smart meters of all types in or for buildings.
- Explain how IT and network infrastructures work and connect with smart devices.
- Identify the appropriate IT platform to use, according to project's specific needs.
- Evaluate the efficiency of programming of smart meters.

Skills

- Maintenance technicians (high school and vocational graduates).
- Science, Technology, Engineering and Mathematics degrees.
- Leadership qualities.

Image 1. Techinician. Source: commons.wikimedia.org

Technicians collect data from machines keeping an eye on its operation. That gives them more minute to minute control to make their tasks efficiently.

Skills

Gaining technical skills

- Retooling existing employees
- Hiring new specialized talent

Image 2. Retool employees with new and different skills. Source: http://www.cmo.com

Skills

When	• At regular periods across the apprenticeship.
What type of Assessment	• Interviews and discussions.
Why	• To ensure developmental needs are met and supported. • Continuing implementation of agreed training plan.
Who	• Line manager/training providers, utilising feedback from team members, mentors and training providers.
Graded	• Assessment organisation scoring criteria will apply.

Image 3. Suggested training/development. Source: Reference [5]

Skills

There are some requirements that Smart Meter installers must have for a disciplined, responsible and professional approach, because they are responsible for the work:

- Use tools, equipment and personal protective equipment in a safe and appropriate manner.
- Install, exchange, commission, decommission and ongoing maintenance of Smart metering systems, associated equipment and communication systems in accordance with standards.
- Use a variety of appropriate communication methods to interact with customers and others.
- Integrating television, lighting, computers and security systems in residential networks.
- Work effectively with people from different trades/disciplines, backgrounds and expertise to accomplish an activity safely, on time, providing confident challenge whilst meeting customer requirements.
- To maintain and develop personal learning plans to continually develop knowledge and competence in order to be able to provide advice and guidance to the customer.

IT platforms

Platforms allow the obtaining of information from a single point using any device (smartphone, PC, etc.).

Users and system managers can approach to different parts of the app where they can check that information that they are looking for.

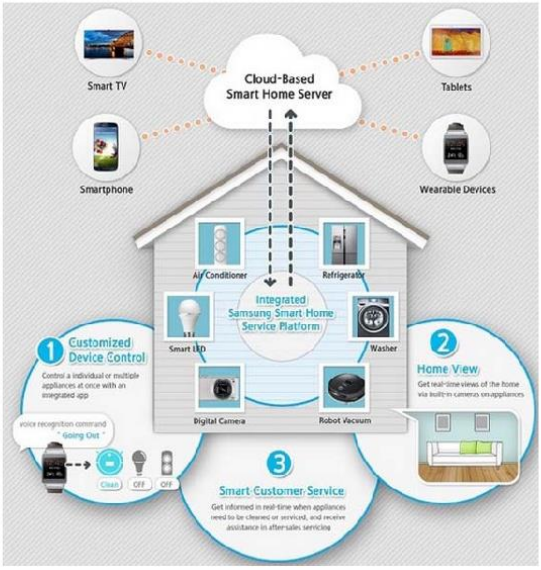


Image 4. Information in platfomrs. Source: news.samsung.com

IT platforms

Some functions that can be done with platforms are:

- Showing the electricity demand evolution and the quality parameters of electricity supply.
- Enabling the detection of incidents in real-time .
- Management of supply in order to allow the modification of consumption patterns.

The efficient management of massive volumes of information is the main objective.

IT platforms

Principles

- **Scalability**
- **Modularity**
- **Interoperability**
- **Integration**
- **Cybersecurity**

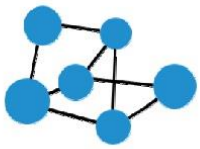


Image 5. Interoperability. Source: https://upload.wikimedia.org

Image 6. Castle privacy policy security. Source: https://pixabay.com

IT platforms

- Integration of information technologies and control.
- Extreme Transaction Processing Platform (XTPP).
- Monitoring and management in real-time of energy demand of buildings.
- Audit consumption.

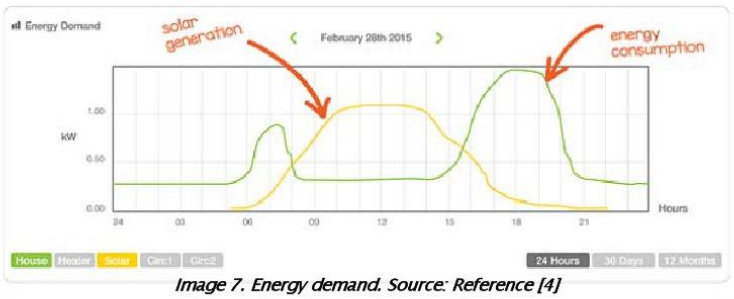


Image 7. Energy demand. Source: Reference [4]

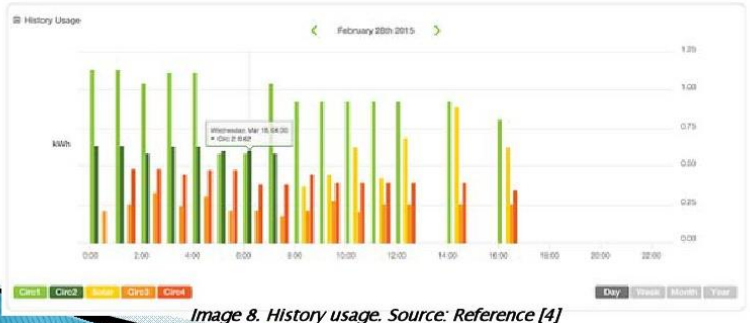


Image 8. History usage. Source: Reference [4]

IT platforms

Check the energy use in your home anytime, from anywhere.

All the information you need: energy demand, usage history, energy now, budget, cost so far, etc.

Download the daily, weekly, monthly or average data.

Monitor and manage your energy usage in real-time on desktop, smartphone and tablet app. By this way, you can reduce carbon emissions and save money on your bills.

Make choices about the energy saving objectives having a support information to decide.

Videos

Video 1. EFERGY platform. Source: https://youtu.be/3ZLqlPxvWGo

POWERLEY platform: https://youtu.be/tFoZcWXmVdo
IRIS platform: https://youtu.be/l-xJ6FZeHso
SAMSUNG platform: https://youtu.be/4_zv3q4JaM4

FAQs

Could my in-home display be interfered by other wireless devices?

It's possible if wireless devices operate on the same signal frequency, but your data will always be protected. If this happens, you can see where it works better trying to use your in-home display in different positions or moving it closer to the meter.

Will I still be sent energy bills?

Yes. Your in-home display is for information only. You will still receive regular energy bills in the same way you do now, whether that's in the post or online. Only now they'll be accurate, without you having to submit a manual meter reading. Depending on your energy supplier, you may also receive some energy efficiency advice.

How secure are smart meters?

The smart meter security system is very secure. Security has been at the heart of the whole smart meter rollout programme from its very inception and right through the design process.
Smart meters have their own closed, dedicated communications system that employs technology widely used by, for example, the banking industry. Smart meters have been designed with top cyber security experts, including the government and GCHQ, to ensure that security best practice has been incorporated at every stage.

FAQs

Will in-home displays work for people who have disabilities or impairments?

In-home displays are being designed for people who have disabilities or impairments, including sight, dexterity, perception and memory. Following extensive consultation with the RNIB, an audio enabled in-home display will be available by early 2017.

How is my personal data kept safe when I have a smart meter?

Your name, address and bank details are never stored on the meter, only the energy you use. And even this data is transmitted safely, using a dedicated and secure wireless network (not the internet).
No third parties will be able to access your energy usage data without your consent. For example, you might want to share your information with price comparison sites in order to get the best deal, but you will need to give your consent for this.

Can my energy supplier use my data for marketing purposes?

Your supplier will not use any data from your smart meter for sales and marketing purposes, unless you've given them permission to do so.

FAQs

What data do smart meters store?

Your smart meter has information about how much gas and electricity you've used, but doesn't store other personal information that could identify you, such as your name, address or bank account. All this information about your energy use is strongly protected. The law puts strict controls on your data, who can access it and how you choose to share it.

It's your data – you choose what you want to do with it and you can change your mind about how much you share, and how often, at any time. So, you can choose:

- how often your smart meter sends data to your gas and electricity supplier (monthly is minimum, daily or half-hourly are optional)
- whether to share data about your energy use with other organisations, like price comparison sites
- if your supplier can use your meter readings for sales and marketing purposes

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