Practical Demonstrator 4
Aldershot – Reading School – Swaythling

IDEA
The aim of the network is to create an industrial network of suppliers and disposal options that reduces the sector's consumption of resources. Tools such as Eco-Design, Industrial Symbiosis and Site Waste Management Plan (SWMP) were used to implement such a network.

RESULTS

- Reduction of GHG emissions: 58%
- Reuse and recycling of waste: 93%
- Reduction of freshwater utilisation: 43%

PARTNERS

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About ZeroWIN

Project Motivation
Waste prevention has been assigned the highest priority under European waste management law. However, the initiatives which have been taken so far have not reduced the regular increase in total waste arisings across Europe.

Goals
The ZeroWIN project develops innovative approaches and effective strategies for the prevention of waste in industrial networks based on industrial symbiosis. Expected results are a reduction of at least 30% of greenhouse gas emissions, 70% of overall re-use/recycling of waste and 75% of fresh water utilisation.

Consortium
The ZeroWIN consortium has 30 partners from 11 countries (AT, DE, ES, FR, HU, IE, PL, PT, RO, UK, TW), dominated by industry – 6 large companies (one of which is the electronics cluster in the Basque region) and 10 SMEs.

Project Facts
Coordination: SAT
Consortium: 30 partners from 11 countries
Duration: May 1, 2009 – April 30, 2014
Budget: 9,5 Mio. €
1. Introduction

Practical Demonstrator 4 aims to develop a construction resource efficiency stakeholder network that adopts the concept of sustainable construction in the UK. The stakeholder network includes the client, designer and main contractor of a construction development. The aim of the stakeholder network is to create an industrial network of suppliers and disposal options that reduces the sector’s consumption of resources. As part of this practical demonstrator, work is being carried out on three construction sites operated by Wilding Butler. Each of these sites is known as Phases 1, 2 and 3 respectively. Wilding Butler is a medium-sized construction contractor, based near Winchester, Hampshire and is also a ZeroWIN project partner. Phase 1 was developed to collect baseline data to assess Wilding Butler’s greenhouse gas emissions, reuse and recycling rates and fresh water consumption. These figures provided the baseline to measure environmental improvements on phase 2 and 3 construction sites. The sites in Phases 2 and 3 focus on improving the reduction of resource use in the construction process by working with different actors in the industrial network to address the gaps and to adopt environmental best practice identified in Phase 1.

Phase 1 (baseline): Step by Step, Crimea Road, Aldershot, Hampshire

Project details: Build only
Classification: Mixed use development – four floors
Client: Housing association (Step by Step)
Project type: Demolition and new build
Construction type: Concrete frame
Cost: £ 2.3 million
Floor area m²: 1395
Total site area m²: 350
Timescale: March 2010 – June 2011

Phase 2 (improvement 1): Reading School, Addington Road, Reading, Berkshire

Project details: Build only
Classification: Education
Client: Education trust
Project type: Demolition and new build
Construction type: Load bearing masonry
Cost: £ 1.2 million
Floor area m²: 450
Total site area m²: 580
Timescale: July 2011 – April 2012
Phase 3 (improvement 2): Talisman Homes 100-102 High Road, Swaythling, Southampton

Project details: Design and build
Classification: Residential flats
Client: Talisman Homes (Solent) Ltd
Project type: New build
Construction type: Concrete frame
Cost: £ 860,000
Floor area m²: 840
Total site area m²: 800
Timescale: September 2012 – June 2013

2. Implementation

Prevention Practices – From the company to the network level

Process design vs. network design
Waste materials generated from construction sites are processed by waste management companies. These are licensed by the Environment Agency to collect, sort, recycle and dispose of these materials. The key within the industrial network is to work with the main construction contractor (Wilding Butler) to separate the waste streams in order to provide clean uncontaminated waste materials to the waste management companies. The waste management company is then supported to expand the industrial network to include organisations that can provide improved environmental end uses for the segregated materials. For example segregating wood on site will allow the waste management company to access higher value markets animal bedding manufacture or reuse rather than sending mixed wood waste for energy production or to landfill.

The segregation of waste materials on a construction site can lead to a reduction in disposal cost for the main contractor and an increased income for the waste management company.

Input substitution vs. primary resources substitution
The key to developing an industrial network in this practical demonstrator that meets the targets of the ZeroWIN project is the supply and use of materials that have a reduced impact on the environment compared to traditional materials. This includes products and materials manufactured using natural and recycled materials, using renewable energy sources during manufacturing; and also the reuse of unwanted products and materials. Manufacturers that supply sustainable versions of high impact products such as concrete, steel and bricks should be brought into the network to provide the input material.

The balance is identifying suppliers that are local to the construction site that can provide the products at a comparable cost to traditional non-sustainable materials. The decision to specify is mainly made on locality due to high fuel costs and the cost of purchasing products.

Plant improvement vs. network infrastructure improvement
The use of efficient and sustainable plant can reduce carbon emissions and resource use on site. For example there are generators and machinery like forklifts and diggers that run on bio fuel instead of diesel. This reduces the depletion of fossil fuels and reduces emissions. The use of large mortar mixing silos on site instead of mixing by hand can reduce the amount of water consumed and reduce the amount of waste produced.
Including organisations in the network that have optimised their manufacturing processes to minimise resource use and waste generation will improve the efficiency of the construction site. For example specifying products with a recycled content or manufacturing part of the building off-site will improve the efficiency of the network.

**Good housekeeping vs. cooperative network responsibility**

Regular training should be provided to subcontractors working on site to make them aware of the objectives of the industrial network and how they can help meet its targets. Health and safety tool box talks are already provided when each subcontractor starts work on site. Additional training should be provided during these sessions to explain their role within the network and to provide them with guidance about meeting "zero waste" targets.

A short 5 minute training module has been created for subcontractors involved in this practical demonstrator to highlight best practice in reducing energy and water usage on site. This includes advice on controlling generators, efficient use of construction plan, turning off lights and equipment when not in use, turning off taps when not in use, etc. Also guidance is provided on waste disposal and recycling. This includes highlighting the waste materials that are being segregated, where they are being stored and the penalties for contaminating segregated waste.

**Reuse, recovery & recycling vs. exchange of resources**

Waste materials generated from construction sites are processed by waste management companies. These are licensed by the Environment Agency to collect, sort, recycle and dispose of these materials. This makes it difficult to exchange waste resources as they must be handled by a licensed operator. However, some materials like bricks, blocks wood and other over ordered materials are provided to reuse centre who then sell them on to other construction companies or the DIY market (Do-it-Yourself).

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**Resource Productivity Themes – From the company to the network level**

**Effective resource utilization and materials efficiency**

An increasingly important aspect of design is creating a building that can be easily disassembled at the end of its life or easily adaptable to a change of use. Designers must consider the methods of construction, material specification and the layout of buildings in order to maximise reuse and recycling rates during demolition and/or enable it to be easily converted to extend the life of the building.

Buildings manufactured using modular methods of construction can be easily deconstructed with panels or parts of the building being simply unbolted. These materials and units can be reused in other applications or the building can be moved relatively easily to a new location. Also the use of lime mortars and concrete that doesn't use steel reinforcement can allow for certain sections of the building to be deconstructed and made available for reuse.
The phase one project on this practical demonstrator was designed to allow a change of use. The building was created as a youth centre, but the internal partitions were design so they weren’t structural and therefore could be easily removed. In the future the building can be converted into an office block or a block of flats quickly and easily with minimal waste.

Reduction of process waste and enhancement of by-product values

The enhancement of by-product values is covered in the "Process design vs. network design" response above. The reduction of process waste from construction can be achieved through various activities undertaken by network members. The ordering and delivery of materials can reduce the amount of process waste generated. A significant proportion of waste generated from a construction site is made up from unused or damaged materials. Material suppliers should be engaged that offer take back schemes or delivery systems that reduce the amount of unused or damaged materials on site.

Negotiating reverse logistics with suppliers on a small construction site can be difficult due to relatively small volumes that do not qualify for take back. To create the required economies of scale Wilding Butler has created a consortium of 4 construction companies (Baxall Construction, Paddock Wood Kent; Coombs of Canterbury, Canterbury Kent; ER Armfield, Chertsey Surrey) to negotiate improved ordering and delivery terms for materials and products. This has allowed them to start negotiating take back schemes with some of their materials suppliers.

The industrial network is being developed to include suppliers that deliver using an 80:20 ordering system for the supply of materials to site. To minimise waste generated through over-ordering of materials suppliers will be required to supply materials in smaller batches with 80% of the material being delivered to site and 20% held back and delivered to site if needed. If the additional materials are not needed, the supply will be withheld to prevent these materials from becoming waste.

Reduction of water use and impacts

The onsite training programme aims to highlight simple practices and measures to reduce the amount of water wasted on site. The effectiveness of the training is being measured during phase 3 of this practical demonstrator. There is also specific machinery available that reduces the amount of water used during mortar mixing and recycles water used to wash vehicles wheels. The practical demonstrator is exploring the savings that can be achieved from using this machinery on site.

The use of recycled water and/or grey water is difficult to achieve because there needs to be a sufficient and local supply of water that can easily and cost effectively be transported to site or harvested on site.

Reduction of energy consumption and greenhouse gas emission

As above the onsite training programme aims to highlight simple practices and measures to reduce the amount of energy consumed on site. This includes a switch off campaign which encourages on site staff to turn off machinery and electrical appliances when they are not in use.
Improvement of control of minor elements and toxic materials

The availability of space is a key barrier that prevents the segregation of waste materials on site. Many construction sites that have limited space for waste storage prefer to use mixed waste skips as all non-hazardous waste materials generated can be placed in one skip. The skip is then taken to a materials recycling facility where it is sorted by hand or mechanically to separate the recyclable fractions. Although mixed waste skips tend to cost more than segregated skips site manager tend to prefer them as there is less handling and sorting of waste on-site.

The disadvantages of using mixed waste skips is that the waste streams become contaminated which reduces the opportunities for sending the materials to high end recycling and reuse outlets.

Remade is working with Wilding Butler to explore alternative segregation solutions that can be used when site space is limited on-site. This includes researching different sizes of containers for example the use of mini skips, 1100 litre bins and dumpy bags. Different sizes containers can be used at various stages of the project to segregate materials.

3. Assessment

To find promising measures for waste as secondary resource for the production of basic construction materials on the one hand and the use of waste flows from demolition as secondary resources have been the core tasks of the construction and demolition studies of which practical demonstrator 4 is a part of.

Nearly all targets could be reached by the construction and demolition case studies. Especially the reuse and recycling rate was the first achieved goal by all case studies. Proper waste management strategies on and off-site enable the success on this indicator.

Most challenging was the reduction of fresh water utilisation. Direct on-site water consumption has negligible influence on the life cycle water consumption. Thus, improvements can only be achieved through material exchange or very thorough selection of products. EOL (end-of-life) related case studies could achieve the goal of reduced fresh water utilisation due to the avoided primary production caused by recycling and reuse.

Finally the most promising measures for the improvement of C&D projects in terms of greenhouse gas emissions and reduced fresh water utilisation are:

- Reuse: Reuse avoids waste as well as the production of new product. Thus, reuse is the best option to significantly reduce the environmental burden of a building.
- Metals have the highest environmental burden: Separate collection on-site is the best solution for high recycling rates
- Aluminium recycling: Common C&D waste sorting plants have a low sorting efficiency of aluminium. This must be changed as aluminium has the highest environmental burden of all investigated metals.
- Timber and paper recycling: Timber shall be recycled instead of thermally treated. Recycling leads to storage of biogenic CO₂.
- Transport efficiency: Volume reduction on-site has to be investigated in the future to reduce the transport impacts.

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