How to apply the life cycle thinking in the construction sector at local policy level: a survey from the European F.R.E.S.H. project

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Abstract In the context of the European F.R.E.S.H. project (Interreg IVC Programme), this paper presents the results of the survey on Eco-design planning tools, i.e. any tool which can be used to plan or develop an eco-design strategy using the life cycle thinking at local policy level, with regard to the construction sector. A questionnaire was distributed to the eight partner regions involved in the project and six good practices, referring to different aspect of the construction supply chain, emerged to be relevant. For every good practice at least three aspects to be transferred have been identified and discussed, with regard to both technical matters and policy level. Through this in-depth analysis we concluded that what can help local authorities in the definition of their innovation strategy is spreading the adoption of tools, both at regulatory and management level, that help in the assessment of all the aspects of sustainable construction supply chain.

1 Introduction

The purpose of this paper is to present part of the results of the ongoing European project F.R.E.S.H. (Forwarding Regional Environmental Sustainable Hierarchies), financed by the EU inside the Interreg IV C Programme, which started in January 2010 and is planned to finish in February 2013. It involves 12 partners, coming from 8 European countries, including regional development agencies (Kainuun Etu Oy -FI-, being the lead partner, London Thames Gateway Development Corporation -UK-, West Regional Development Agency -RO-, Lubelskie Voivodeship -PL-), universities (Lappeenranta University of Technology, Lahti Unit -FI-, University of Limerick -IE-, University of Padova, Department of Chemical Processes Engineering, Quality and Environment research Center -IT-)

and regional authorities (Joint Authority of Kainuu Region -FI-, Regional Council of Päijät Häme -FI-, MidWest Regional Authority -IE-, SouthWest Regional Authority, -IE-, Veneto Region -IT-).
The overall aim of the project is to strengthen Sustainable Value Creation (SVC) – based development at regional level. This is done by strengthening the position of SVC in the overall regional planning (in the form of objectives and overall performance indicators) and by embedding eco innovation strategies into the regional innovation strategy. The result is the improvement of the triple bottom line-based regional development. The rationale behind the FRESH approach is that by promoting a comprehensive methodological approach at policy level, constructed around proved solutions, regions are better equipped and have better chances to perform in eco innovation in both the long run and the short run. The overall framework of the project is shown in Fig. 1.

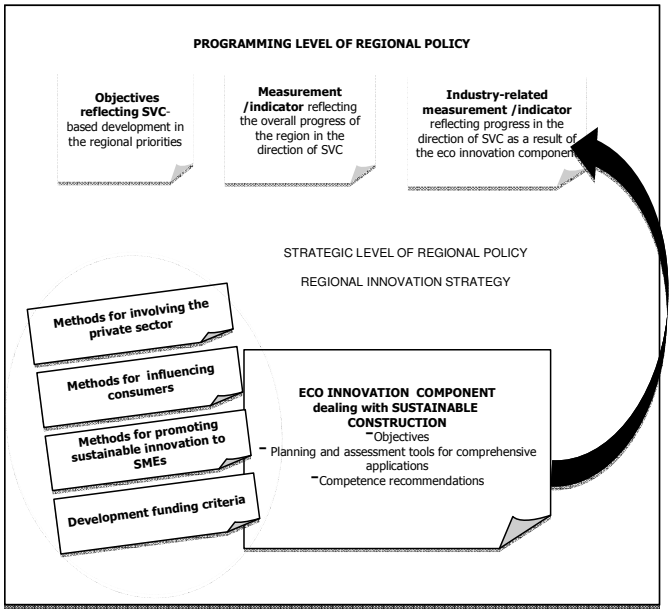

Fig.1: Programming level of regional policy and overall framework of the F.R.E.S.H. project [1].

1.1 The focus on sustainable construction

The project partners have decided to focus on the sustainable construction sector, which is recognized as a very important innovation area in the EU. Sustainable

construction consists of eight key sustainability issues: environmentally friendly construction materials, energy efficiency in building, construction and demolition waste management, health in buildings, building related transport aspects, urban sustainability, sustainable architecture, societal impacts arising from arising from construction activities and the built environment [2]. As sustainable construction is one of the six Lead Market Initiatives (LMI) which are part of the EU innovation policy [3], it also benefits from tailored demand-side policy measures (standardisation/certification/labelling, legislation, public procurement, complementary measures).
FRESH project is aligned with all these, which, however, need to become operational in each one of the partner regions' contexts. FRESH is not aiming at modifying the national building regulations; rather, its objective is to help provide the development environment that these regulations can benefit from and perform in the context of sustainable construction.

2 Survey on "Eco-design planning tools": materials and methods

The FRESH project focuses on policy impact, namely the interregional exchange, involving eleven categories of good practices, which can be summed up into three main area: regional development plan level, strategy level and implementation level.
As far as the strategy level is concerned, one of the main phases of the project deals with the identification, collection and analysis of good practices (GP) of the so-called "Eco-design planning tools", i.e. any examples of tools which can be used to plan or develop an eco-design strategy using the life cycle thinking approach in the regional innovation strategies.
In order to fulfil this purpose a questionnaire was distributed to the project partner with the aim to collect examples of good practices of eco-design planning tools in the field of sustainable construction.
The questionnaire was divided into many sections. Project partners were asked to give a name to the good practice, briefly describe it (location, category, namely product, process or service good practice), defining at which stage of the construction process it is, i.e. defining the project idea and basic aspects, the detailed planning and the selection of materials, the construction, the testing of the project or the life of the project.
Furthermore, the list of the environmental aspects addressed by the GP, the description of the situation before the application of eco-design planning tool, the

people involved, the duration of the project and funding and cost of implementation were required. Project partners were also asked to list the evaluation criteria related to the environmental impacts considered in the definition of the eco-design planning tool good practice, the results and benefits gained, possible difficulties in data collection and implementation.
They were also asked to give their opinion on the transferability of their good practices to other regions.

3 Results from the survey

As a result of the survey, six good practices emerged to be relevant in the field of sustainable construction. All of them revealed to be an application of life cycle thinking, even if they refer to different aspect of the construction supply chain, namely the building design, building construction design, plans and programmes , product level or the whole construction supply chain.

3.1 Description of the identified good practices

In Table 1 there is a brief presentation of the six identified good practices: the name each partner gave to its own good practice, the region in which the GP was implemented and a description of the main features of the GP.

Tab.1: Summary of the six identified good practices in the context of the survey on Eco-design planning tools

Name of GP	**Region**	Description of the GP
SEA	Joint Authority of Kainuun Region (FI)	National law which apply an EU directive
EcoProfit	Regional Council of Päijat Häme (FI)	Workshops, club meetings and consulting oriented towards companies
Design statement	South West Regional Authority (IE)	Design statement to be completed by the design team as part of a formal planning application, based on a questionnaire
Regional law 4/2007	Veneto Region (IT)	Regional law which gives incentives via contributions, according to a score-based evaluation
BRE	London Thames Gateway Development Corporation (UK)	A "type III" environmental labelling scheme for construction products and elements
Integrated design	West RDA (RO)	Comparative LCA study in the building construction

The SEA (Strategic Environmental Assessment) by the Joint Authority of Kainuun Region (FI) is a national law which apply an EU directive (SEA Act, 200/2005).
It started to be implemented from the 1st June 2005. According to this law, the authorities must investigate and assess the environmental impacts of the plans, programmes and policies they are preparing, if the implementation of these may have a significant effect on human health, the natural environment and biodiversity, the built environment, the landscape or natural resources. In the process of evaluation are also involved the stakeholders, which are given an opportunity to express their opinion. The assessment process results in an environmental report, which presents information on the plan or programme and the alternatives investigated, with an evaluation of their environmental effects.
The EcoProfit - Sustainable Economic Development through Eco-efficiency in Public Private Partnership - by the Regional Council of Päijät Häme (FI) is a cooperative approach between the regional authority and local companies involved in the construction supply chain, with the goal of reducing cost for waste, raw materials, water, and energy. The rationale behind is that a reduction in these areas can also reduce the environmental aspects of business. EcoProfit consisted of workshops, club meetings and consulting. Workshops were covering following topics: motivation and goals for EcoProfit, analysis of material flow, development of waste management, saving energy, environmental risks and work safety, environmental marketing and communication, environmental legislation, monitoring and further development. It lasted 7 months (October 2000 – April 2001) and was piloted in 9 companies in Päijät-Häme Region, thanks to the coordination by the University of Helsinki in collaboration with Helsinki University of Technology and Lahti Science and Business Park.
The "Design Statement to Accompany Planning Applications for Commercial Developments in excess of 100m2 gross floor area and Housing Developments of 10 units or more" by the South West Regional Authority (IE), which is still in the process of being officially implemented, is a design statement to be completed by the design team as part of a formal planning application, based on a questionnaire, covering twelve design criteria. This checklist shall be completed by the case planner and is for internal use only, as an assessment tool. A marking scheme is used to score the overall development proposal out of 100. There is no pass or fail mark, instead the rating achieved shall allow specific strengths and weakness to be shown. The purpose of the design statement is to ensure that best practice principles are at the core of future design of new developments and to reinforce the linkage between national strategy and local implementation. The following are some questions included in the questionnaire with regard to the energy efficiency aspect, which can be used in the design phase in order to prefer less impacting solutions in a life cycle perspective [4]:

- “Does the development include the use of materials that have a low energy input in their manufacture/ sourcing?”
- “Have renewable energy technologies been incorporated into the design and layout?”
- “How has this design and layout addressed the energy performance standards as set out in the building regulations?”
- “Does the proposed development exceed the energy performance standards as set out in the building regulations?”

The "Regional law 4/2007 - Regional policies to foster sustainable constructions" by Veneto region (IT) is a regional law which gives incentives via contributions, according to a score-based evaluation. It started to be implemented in 2007 and it is ongoing. The guidelines to apply for a contribution are based upon an assessment of the following variables [5]: external environmental quality, resource consumption, environmental weight, indoor environmental quality, service quality, management quality and transports. The basic idea consists of identifying some criteria in order to evaluate the sustainability of the project, giving it a global score which is the sum of the scores connected with the criteria and the fact contribution are given on the basis of this evaluation process. Many criteria are connected with the energy efficiency of the building, and for each of them a performance indicator was selected. Here below are some examples of them (in brackets are the performance indicators) [5]:

- energy for winter heating (Primary energy for annual demand of winter heating/minimum law requirement for annual demand of winter heating),
- reducing energy consumption for sanitary hot water though solar energy (Percentage of the medium annual demand of thermal energy for the production of sanitary hot water through renewable energy),
- control of solar radiation (Shading factor according to the standard UNI EN 832),
- natural lighting (Medium factor of daily light),
- electricity from renewable sources (Percentage of the medium annual demand of energy through renewable energy).

The score system in the case of the energy efficiency aspect is based on a system of 7 levels, starting from -1 (worst case) to 5 (best scenario) adding 1 point for each further level. Special attention should be given to the fact that this kind of criteria are valid for residential housing.

The "Environmental Profiles Methodology - Building Research Establishment (BRE)" by the London Thames Gateway Development Corporation (UK) is a "type III” environmental labelling scheme for construction products and elements, whose purpose is [6]:

- to provide a measurable and verifiable input for the assessment of the environmental performance of buildings,
- for interested parties, to compare the environmental impacts of different construction products as they are used within a building, based on units of equivalent functionality,
- to provide a means of collecting relevant data for the preparation of tools for comparing the environmental impacts of construction products.

The methodology was first published in 1999 and was most recently update in 2007. This tool can be applied by housing developers, local authorities, material suppliers. The methodology crosses all parts of the process of the use of a construction product:

- cradle to gate,
- cradle to site,
- cradle to grave.

The "Integrated Design of Buildings" by the West Regional Development Agency (RO) includes a series of comparative LCA studies in the building construction. There have been performed several applications (mainly on dwellings) of building design including environmental impact assessment in the period 2006-2010, in order to point out the building systems that could offer an eco-friendly design. The basic idea is that an integrated design should include also the environmental impact. In this logic the structural design should be based on the following philosophy: among the solutions that assure the safety and functionality of a building, one should choose those conducting to a minimum cost and a lower impact on environment. Further, the Life Cycle Assessments (the analyses integrated the maintenance of building system and also the consumed goods for the building during its life-cycle) offered the possibility of identification of the assemblies (building parts) that could be tampered for a better environmental efficiency.

The main idea is to offer a possibility of deducing the potential environmental impact of a building in certain circumstances (site conditions, other boundary conditions). The results offer all the possible potential environmental impacts (climate change, energy, ozone depletion potential, acidification potential etc.) while the decisions are taken in function of local/regional/national constraints.

3.2 Transferability of the good practices

For every good practice at least three aspects to be transferred have been identified, with regard to both technical matters and policy level, i.e. examples on

how to involve the decision makers and the companies at strategic level, or the definition of criteria to assess the sustainability of a project in the design phase. This allowed to identify the more relevant aspects of the eco-design planning tools, which can be a basis to develop or strengthen the life cycle approach in the sustainable construction sector of every partner region, as shown in Table 2.

Tab.2: Summary of the transferability aspects of each identified GP

Name of GP	Aspect 1	Aspect 2	Aspect 3
SEA	Involvement of different National and local authorities	Evaluation of environmental impact on a broader extent	Public involvement
EcoProfit	Piloted with companies from different sectors	Increase financial profit by decreasing the expenses	Figure out the positive relation between ecological awareness and economical results
Design statement	Linkage between nation policy to local development assessment process	Useful in the initial planning stage	Necessity to be adapted
Regional law 4/2007	Linkage between evaluation process and contribution	Involves all levels of the construction supply chain	Staring point to assess the triple bottom line
BRE	Common basis for comparison	Number of standards and approaches in one place	Gives unbiased, accurate and verified information
Integrated design	Minimum cost and lower environmental impacts	Starting point to develop planning and assessment tools and policies	Integrated design through LCA applications

3.3 Discussion about the transferability of the good practices

As far as the SEA is concerned, there is the involvement of different National and local authorities, namely the Centres for Economic Development, Traffic and Environment, and, when necessary, of the local health and environmental authorities. In the case of extremely extensive or significant plans and programmes, also opinions from the Ministry of the Environment and the Ministry of Social Affairs and Health are required. Secondly, significant secondary and accumulative effects, joint impacts and short, medium and long term permanent and temporary, and both positive and negative effects on issues such as the population, human health, living conditions and quality of life, biodiversity, fauna, flora, soil, water, air, climatic factors, community structure, buildings, landscape, townscape, material assets, cultural heritage including architectural and

archaeological heritage, utilisation of natural resources and the interrelations between the above factors, are taken into account. Furthermore, the public is given an opportunity to express opinions. This tool can be considered an example of application of life cycle thinking, as the evaluation of the environmental impacts is done in a life cycle perspective. The potential to be transferred is connected with the fact that in regional strategic planning, it is challenging to draw convincing alternatives and to assess them.

EcoProfit, as a method and procedure, has been tested and piloted with companies from different sector including subcontractors to construction industry.

Its second strength is the idea that by taking better care of different processes in the manufacturing or service you are able to gain better profit to the company. This means increasing the financial profit by decreasing the expenses ("Less spending bring Better profit"). The third important issue is that EcoProfit can help companies to figure out the positive relation between ecological awareness and economical result. It is an application of life cycle thinking as the environmental impact assessment consider materials, building construction, building use and waste management. This can give a connection between policies and companies involved in the innovation process, with particular regard to the construction supply chain.

The proposed design statement questionnaire links national policies to the local development assessment process, giving greater clarity to the criteria already used by professional design and land experts. It can be amended as required to incorporate revised policies and new or adapted technologies. It is easy to use, clear and concise. The marking scheme at the end is beneficial as it gives a scored result to the application. The questionnaire can be used at the initial planning stages, so that changes can be made when it is cheaper and more efficient; it can also highlight strengths and weaknesses in the design. This analysis looks at planning under 13 different headings, and aims to select materials that are sourced locally. It also looks for buildings to be designed for ease of regular maintenance.

In order to transfer this tool, the following actions are needed:

- examination of current National and local policy in that location,
- adaptation of questions, to accurately reflect the national policy,
- distribution to the local governments agencies involved with planning.

It can be considered an important application of life cycle thinking, because it will ensure that future developments are of a more sustainable nature, in terms of design, energy usage and societal impact.

Others could be interested in this application, because it is easy to use, clear and concise. The marking scheme at the end is beneficial as it gives a scored result to the application.

The first strength of the regional law 4/2007 is the basic idea of identifying some criteria in order to evaluate the sustainability of the project and the fact contribution are given on the basis of this evaluation process.
Secondly, the application can be done at all the levels of the construction supply chain, and the assessment of the identified environmental aspects is the starting point to assess the triple bottom line.
Some aspects which should be considered in order to transfer it is that a Pact could be a necessary (but also a convenient) condition to have a bottom-up policy. Further, the risk about the contribution should be assessed: it can create a lack of incentives to innovate at the corporate level.
It is an application of life cycle thinking as the contribution is given on the basis of a life cycle perspective evaluation.
As far as the BRE methodology is concerned, it enables the comparison of different environmental products and materials based on a life-cycle assessment, which is independently verified. The innovation in the BRE methodology was to bring a number of standards and approaches together in one place. It is, indeed, essential that there is uniformity in the means of expressing environmental product declarations. This includes having a consistent way of arriving at the declaration and providing the information. The user expects unbiased, accurate and verified information, which is consistent with the best current practice and understanding. A type III labelling scheme has all these aspects. This is not a statutory planning tool, that is developers and local authorities are not required to use it.
As far as the transferability aspect is concerned, it has to be considered that this tool can be applied by housing developers, local authorities or material suppliers. The mechanism and facility needed for transfer are translation, assessment of which elements of methodology are applicable to host country. The constraints and risks of applying this tool is the need to consider whether application would not be suitable due to current levels of standards in other countries.
It is an application of life cycle thinking as the environmental declaration considers the whole life cycle of the building materials.
Finally, the main idea of the Integrated Design of Buildings is to offer a possibility of deducing the potential environmental impact of a building in certain circumstances (site conditions, other boundary conditions) with regard to all the possible environmental impacts (climate change, energy, ozone depletion potential, acidification potential etc.), while the decisions are taken in function of local/regional/national constraints. Among the solutions that assure the safety and functionality of a building, one should choose those conducting to a minimum cost and a lower impact on environment.
The integrated design approach is based on the life-cycle approach in buildings. Consequently, to apply it there is a need of information for emissions produced by

a relatively high number of (building) products and processes. Generally, the majority of the products/processes found in European databases are not defined for the study-case under consideration and very often they are not present at all.
The results obtained by this application can be considered as a starting point to develop planning and assessment tools and policies (e.g. regional contributions can be given according to the best options in terms of reduction of environmental impacts). The integrated design of buildings should become a general procedure at the regional policy level. The applicability of an integrated design in buildings needs normative regulations. The stage of documents at present time are under the form of Pre-Normative standards (PrEN 15000 series).

4 Conclusion

One of the main results of survey on Eco-design planning tools, which was conducted inside the Interreg IVC F.R.E.S.H. project is the identification, description and analysis of six good practices, which in the sustainable construction sector can be considered as application of life cycle thinking.
For each good practice at least three aspect to be transferred have been detected: through an in-depth analysis of this transferability elements, we concluded that what can help local authorities in the definition of their innovation strategy is spreading the adoption of tools, both at regulatory level and management level, that help in the assessment of all the aspects of sustainable construction supply chain. Examples of tools can be questionnaires, reports or check-lists for self assessment, which can be useful in the initial planning stage in order to detect where to intervene for optimizing the environmental performances of buildings.
Furthermore the adoption of tools at product level, i.e. environmental product declaration or Life Cycle Assessment studies, can help in the decision making process. Last but not least, the idea of giving incentives via contributions based on the results of the assessment at project, process or product level, could be profitably implemented.
Starting from there results, further analysis will be done in the next step of the project in order to identify the most relevant aspects to be transferred by each partner region. In order to achieve this important aim, it is necessary to identify the types of important knowledge competences for the partner regions according to what the partners will decide to prioritize in their eco-innovation strategy.
The future perspective in the project is also to include the remarks by the CEN-TC 350 “Sustainability of construction works” about the development of measuring and configuring tools for environmental, economic and social impact of all types

of buildings, for the assessment of the performance of new buildings over the entire life cycle, and of existing buildings over their remaining service life and end of life stage.

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6 References

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