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Multi-criteria decision-making for sustainable wall paints and coatings using Analytic Hierarchy Process

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Abstract

To which extent do potential users of construction products take sustainability into account during their decision-making process? How well could they align themselves in all the legislation frameworks and calculation tools for the sustainable construction products? In accordance with the Environmental Product Declaration (EPD) [1], determining of ecological properties of construction products could be accomplished with applying life cycle assessment (LCA). There is a number of tools and frameworks for evaluating the sustainability of construction products for the European experts, which may be used in such a decision-making process. However, for a non-expert user, this could be quite complex. Therefor, the assumption here is that environmental and human health safety are prior in contrast to the market prices when it comes to choosing a decorative paint or coating. In the framework of herein research, an Analytic Hierarchy/Network Process model was designed involving four major merits of the Analytic Hierarchy Process: Benefits, Opportunities, Costs, and Risks [2]. The model which is based on the major characteristics of a decorative wall paint helps emphasising the best alternative with respect to given priorities: low risk of environmental and human health damage, quality, market price, repairability. The model shows values for all the criteria and alternatives with respect to pairwise comparisons. In a future research step, this model will be validated with a questionnaire survey targeting non-expert users, i.e. average consumers, on the construction market in Germany.

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Keywords: Sustainability; Construction products; Life cycle assessment; Wall paints; Analytic Hierarchy Process; Analytic Network Process

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1. Introduction

Choices of a construction product according to the sustainability objectives require basic expert knowledge. This involves reading not only instructions provided on the product packaging, but also material safety data sheets. This research is prepared for the construction market in Germany approaching the Analytic Hierarchy Process [2] within the Super Decisions Software. The outcome of the research is a model of potential user behaviour for choosing decorative wall paint. The model will be further tested with the help of a questionnaire survey for the non-expert users, i.e. average consumers. The main purpose of this research consists in identifying the relative importance of sustainability characteristics in selecting construction products. Particularly, decorative wall paints are considered to be chosen. For this purpose, with an assumption that environmental and health safety is of a high priority, an AHP/ANP model is used for a comparison of three alternative decorative wall paints and coatings.

Nomenclature

AHP	analytic hierarchy process
ANP	analytic network process
BWR	basic work requirements for construction works
B	Benefits
C	Costs
CPD	Construction Products Directive (EU) No 89/106/EEC [3]
CPR	Construction Products Regulation (EU) No 305/2011 [4]
EN	European standard
EPD	Environmental product declaration
kt	kiloton
LCA	life cycle assessment
MSDS	material safety data sheet
O	Opportunities
ppm	part per million
R	Risks
VOC	volatile organic compound

2. Legislation and literature review

There is a wealth of European legislative standards and directives for building in general and construction products in particular, including legislative regulations for decorative paints that are commonly produced, sold and used on the territory of the European Union. These regulations define sustainable construction products and life cycle assessment, set the limit values for hazardous emissions into the environment caused by using decorative paints and coatings, which contain organic solvent. Literature review includes the brightest examples of the decision-making process with respect to construction products.

2.1. Legislation for building and construction products

In accordance with the Environmental Product Declaration (EPD) [1], determining ecological properties of construction products could be accomplished with applying of life cycle assessment (LCA). The difference between ecological and non-ecological construction products could be based on the environmental parameters, such as Abiotic Depletion Potential, Ozone Depletion Potential, Acidification Potential, Global Warming Potential, Eutrophication Potential, and Photochemical Ozone Formation Potential [1], but also from the factors of eco-toxicity and human toxicity over their entire life cycle. All the categories are in good agreement with European standards. There are numerous tools and frameworks for evaluating sustainability of construction products for European users, which may