OPTIMIZING ENERGY EFFICIENT LIGHTING USING MULTICRITERIA ANALYSIS

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ABSTRACT

Aim of this paper is the optimal selection of energy saving solutions implementing multicriteria analysis in order to reduce artificial lighting consumption in buildings. The method is applied to an educational building in which solutions such as luminaires with energy efficient lamps, occupancy sensors, photosensors and electronic ballasts are proposed to increasing energy saving without making large-scale renovations and disturbing its operation. According to "ELECTRE I" method, a consistent set of criteria comprised of the features mentioned above is specified for each alternative selection. Each criterion is attributed to a certain weight. The concordance and discordance indices are computed associating each solution for energy saving. Moreover, concordance and discordance thresholds are defined. As a result, the outranking relations between each implementation are found, the outranking graph is constructed and the kernel is deducted.

APPLICATION OF ELECTRE I IN EVALUATION OF FLUORESCENT T5 LAMP LUMINAIRES (4x14W)


Gallis Alpha


Gallis Agora 4


Gallis Edra


Gallis Vita


Gallis Agora

Technical specifications of the alternatives

Criteria	Weights	LL 1	LL 2	LL 3	LL 4	LL 5
DIN Classification (φ_{su})	0.4	3	6	4	4	5
Efficacy (lumen/W)	0.3	82.4	94.3	88.6	66.7	69.3
Lamp lifetime (h)	0.2	24000	24000	20000	10000	8000
Cost (€)	0.1	509	418	365	150	170

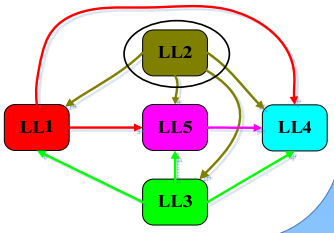
Concordance index

	LL 1	LL 2	LL 3	LL 4	LL 5
LL 1	1	0.1	0.3	0.6	0.6
LL 2	0.9	1	1	1	1
LL 3	0.7	0	1	0.6	0.6
LL 4	0.4	0	0.4	1	0.2
LL 5	0.4	0	0.4	0.8	1

S=0.6

Outranking graph

Kernel: LL2
Optimal alternative: LL2



APPLICATION OF ELECTRE I IN EVALUATION OF ELECTRONIC DIMMABLE BALLASTS & PHOTOSENSORS


Osram Dim MULTI 3


Osram MULTI 2 Dim


Siemens Brightness Controller GE 252


Tridonic smartDIM sensor 1


Tridonic smartDIM sensor 2

Technical specifications of the alternatives

	Weights	PB 1	PB 2	PB 3	PB 4	PB 5
Saturation (lux)	0.3	3000	1350	17000	2700	1500
PSCC	0.2	1.68	1.66	1.85	2.06	1.45
PF at 20% of dimming level	0.2	0.78	0.89	0.72	0.93	0.71
Consumed power (% nominal)	0.2	27	25	32	36	23
Cost (€)	0.1	245	208	115	209	408


Quicktronic Intelligent DIM T5


Tridonic Dimmable DALI T5

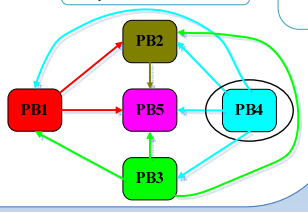
Concordance index

	PB 1	PB 2	PB 3	PB 4	PB 5
PB 1	1	0.8	0.3	0.4	0.9
PB 2	0.2	1	0.3	0	0.6
PB 3	0.7	0.7	1	0.3	0.9
PB 4	0.6	1	0.7	1	0.9
PB 5	0.1	0.4	0.1	0.1	1

S=0.6

Outranking graph

Kernel: PB4
Optimal alternative: PB4



APPLICATION OF ELECTRE I IN EVALUATION OF OCCUPANCY SENSORS


DSC


GE


Honeywell


Visonic


Philips

Technical specifications of the alternatives

	Weights	OS 1	OS 2	OS 3	OS 4	OS 5
Coverage (m)	0.4	12	10	8	9.5	9.5
Detection speed (m/s)	0.3	10	3	20	18	3
Cost (€)	0.2	65	83	82	60	84
Battery lifetime (Y)	0.1	9	5	3	4	5

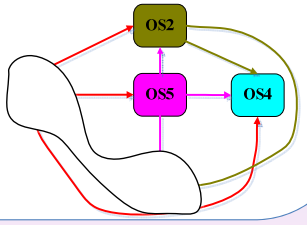
Concordance index

	OS 1	OS 2	OS 3	OS 4	OS 5
OS 1	1	0,8	0,5	0,7	0,8
OS 2	0,2	1	0,7	0,7	0,4
OS 3	0,5	0,3	1	0,5	0,3
OS 4	0,3	0,3	0,5	1	0,3
OS 5	OS 1	OS 2	OS 3	OS 4	OS 5

S=0.6

Outranking graph

Kernel: OS1 & OS3
Optimal alternative: OS1



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