INNOVATIVE EDUCATIONAL INTEGRATION OF URBAN PLANNINGS BASED ON BIM TECHNOLOGIES

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Introduction

Currently the construction sector generates between 30-40% of total CO2 emissions. It is essential to calculate and evaluate the environmental impact associated with greenhouse gas emissions in the whole life cycle of buildings in order to define improvement strategies. However, this sector is very inefficient in assessing environmental impacts. Therefore, it is necessary to have tools that improve evaluation, for example, through the design tools based on Building Information Modelling (BIM). In this sense, BIM is able to contain Life Cycle Assessment (LCA) data as indicators for the early design phases.

BIM is a digital data flow based on a 3D parametric model with information about the assets, a methodology of collaborative work that enables architects and engineers to generate a digital model or prototype prior to the actual construction commences and even assess the environmental performance of the building *(Díaz & Álvarez-Antón, 2014)*. The UrbanBIM Erasmus+ project works in this sense, to increase awareness of the benefits of rational use of energy and resource materials for students and professionals of AEC (Architecture, Engineering and Construction) in urban planning. The UrbanBIM is generating teaching tools and studies several design options within a single model based on LCA of construction materials and in order to include environmental information on building materials through a guide implemented in a Handbook, which it will be part of a BIM learning application.

Objective

The UrbanBIM project aims to improve the quality of training systems through the development of innovative contents, methods and procedures for Higher Education Institutions. It is thus proposed to implement the different environmental indicators in the BIM tools.

Methodology

The construction cost database unifies the cost estimate of a construction work and links all the activities that take place in a construction site. This wide spread tool is the mean to introduce environmental assessment in university curricula of engineering and architecture. The calculation are the ecological (HE), carbon (HC) and water (HH) footprints of urbanization projects. A cases study of a sustainable urbanization project in Seville, Spain is analysed for its adaptability.
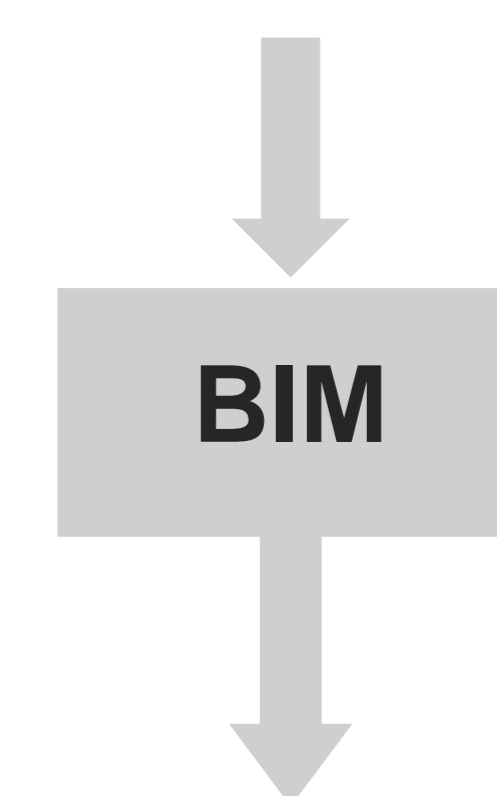
Construction cost

BCCA Banco de costes de la construcción en Andalucía

(Andalusia Construction Cost Database or ACCD)

BCCA, Basic levels of the cost structure
(Freire et al., 2019)
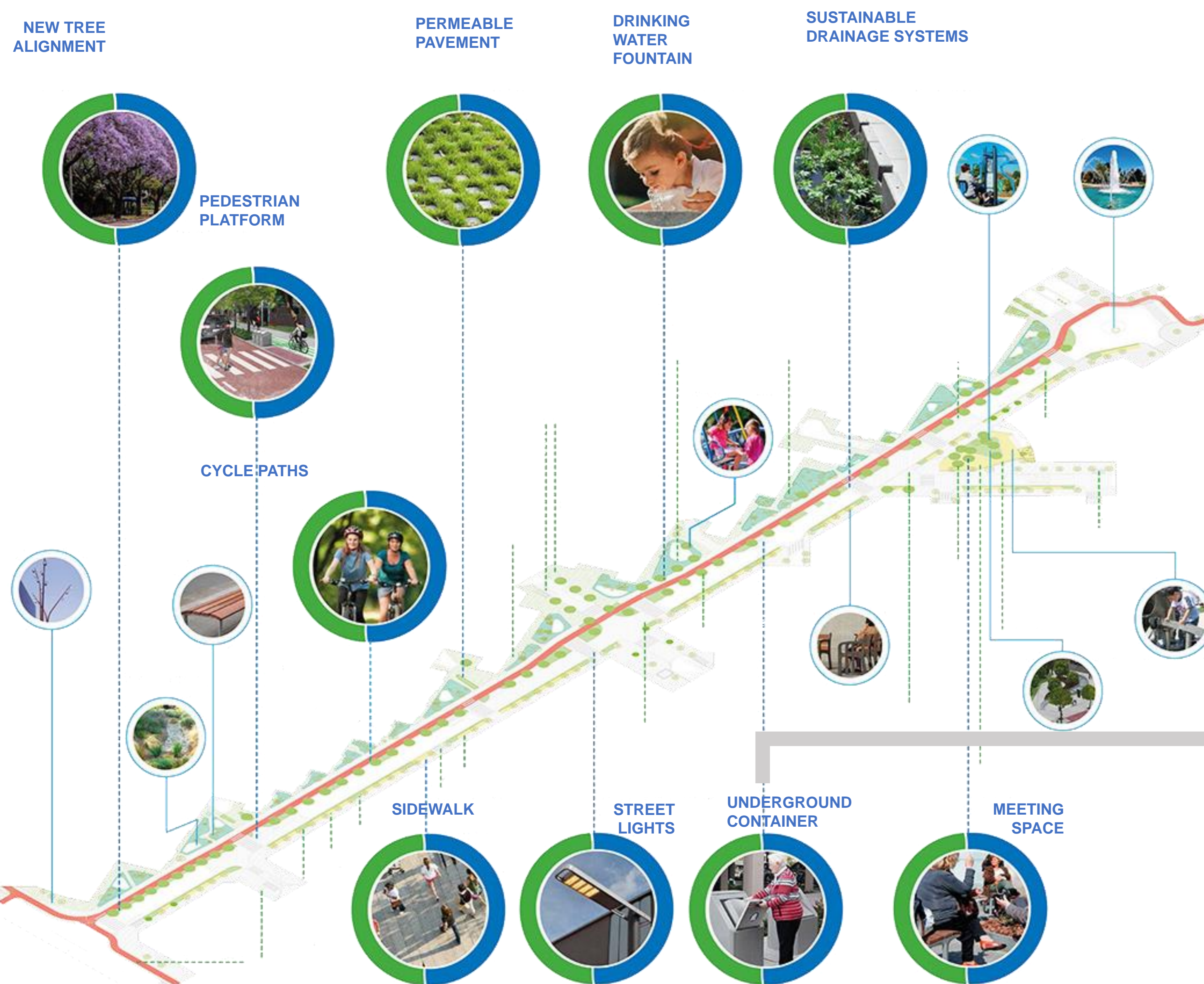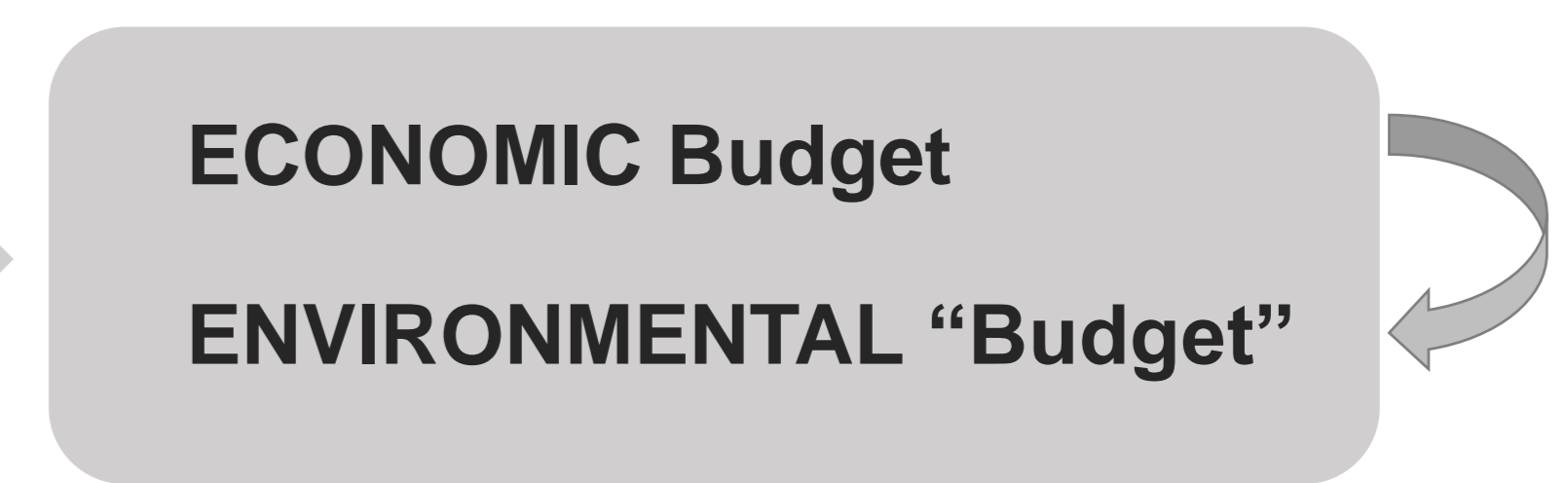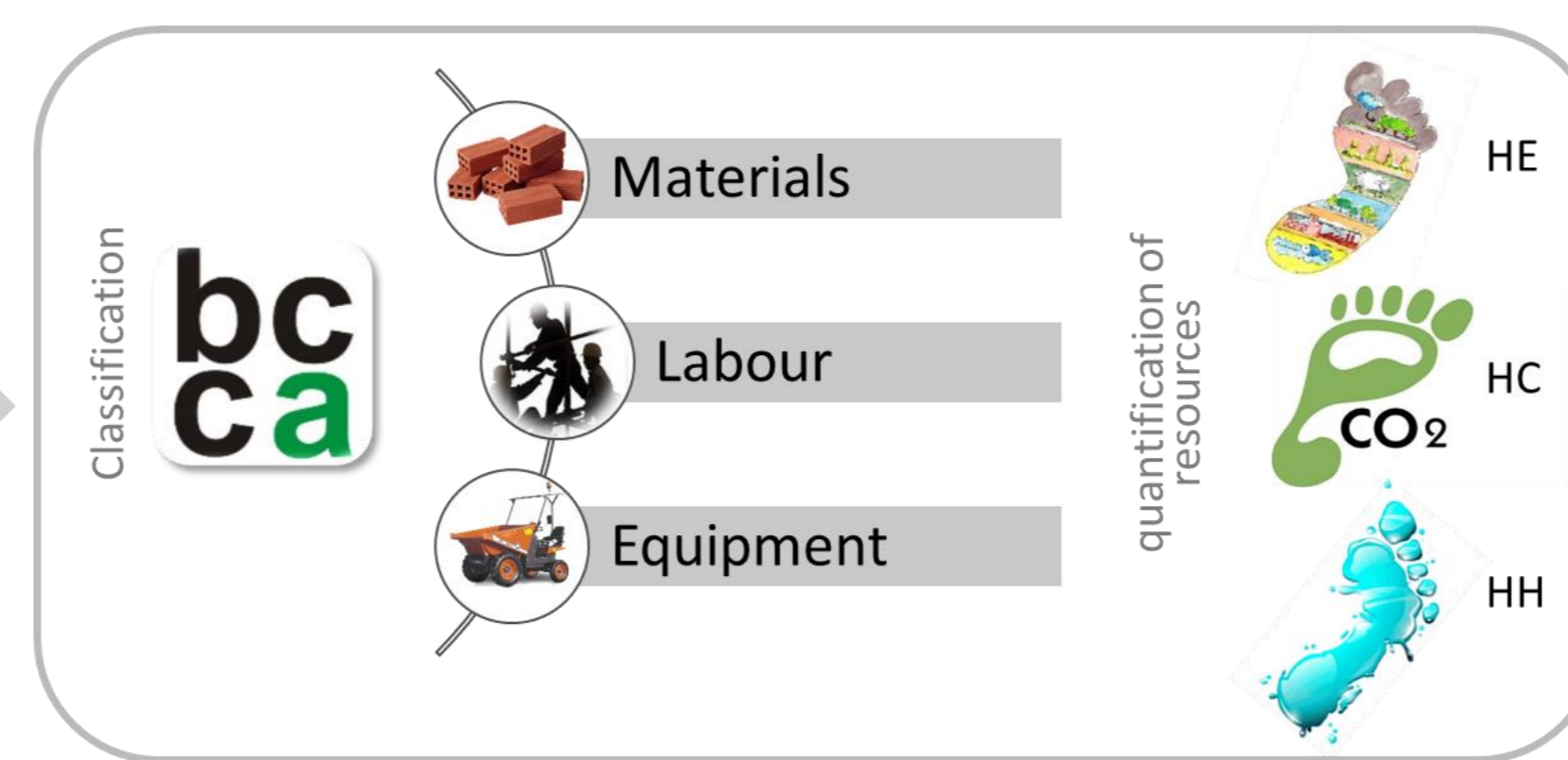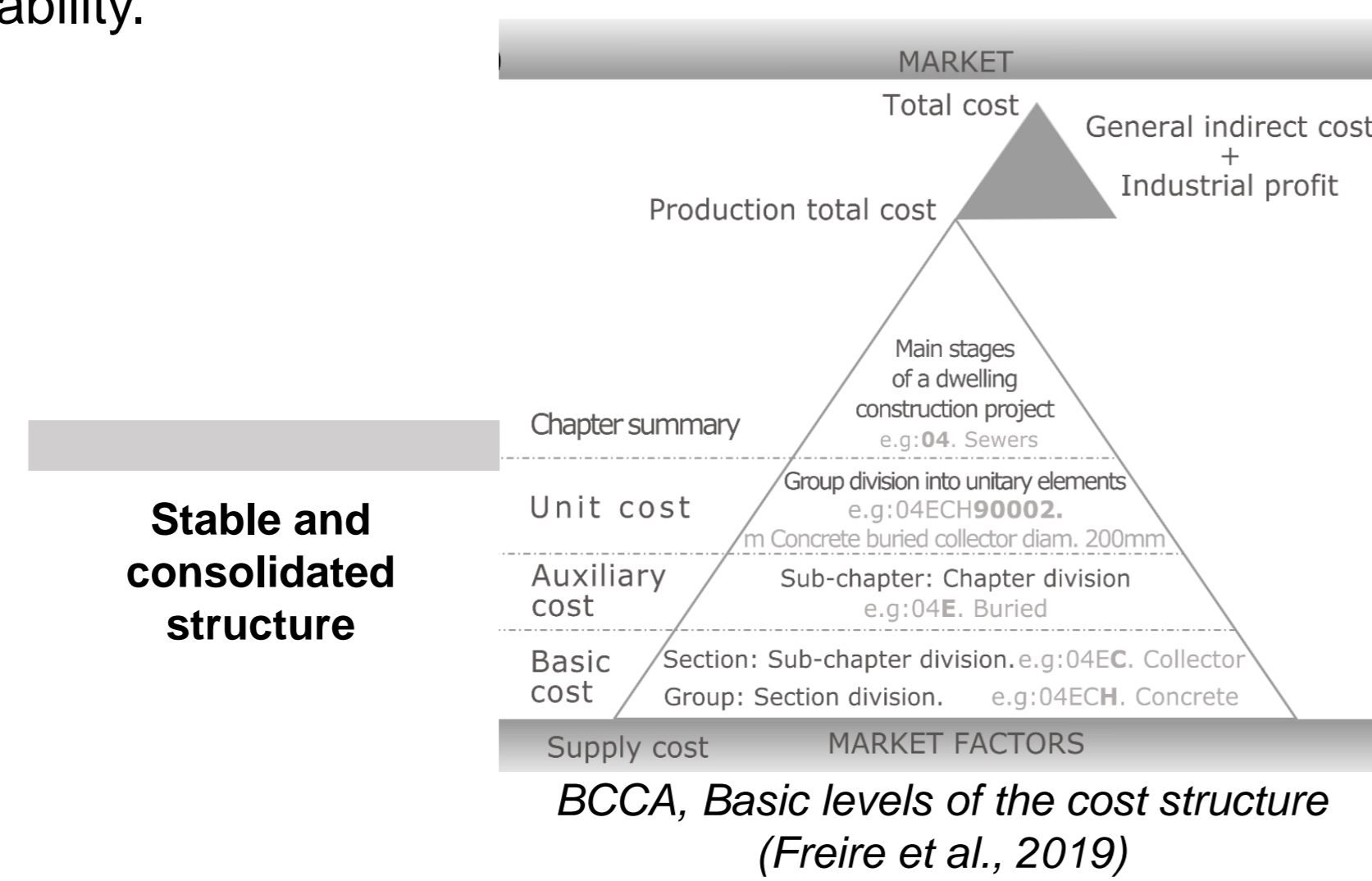
It is necessary to implement the different environmental indicators in the BIM tool with the aim of creating an open platform for researchers, architects and engineers to increase the skills in the use of these indicators through BIM tools.


NEW TREE ALIGNMENT — PERMEABLE PAVEMENT — DRINKING WATER FOUNTAIN — SUSTAINABLE DRAINAGE SYSTEMS — PEDESTRIAN PLATFORM — CYCLE PATHS — SIDEWALK — STREET LIGHTS — UNDERGROUND CONTAINER — MEETING SPACE

Incorporation of environmental information in the BCCA/ACCD code.

BIM

Results/ Conclusions

Classification equivalences are possible which include the calculation of environmental indicators: ecological, carbon and water footprints. The first approach to adapt construction cost data bases and environmental assessment combined is possible by developing equivalence elements to BIM objects.
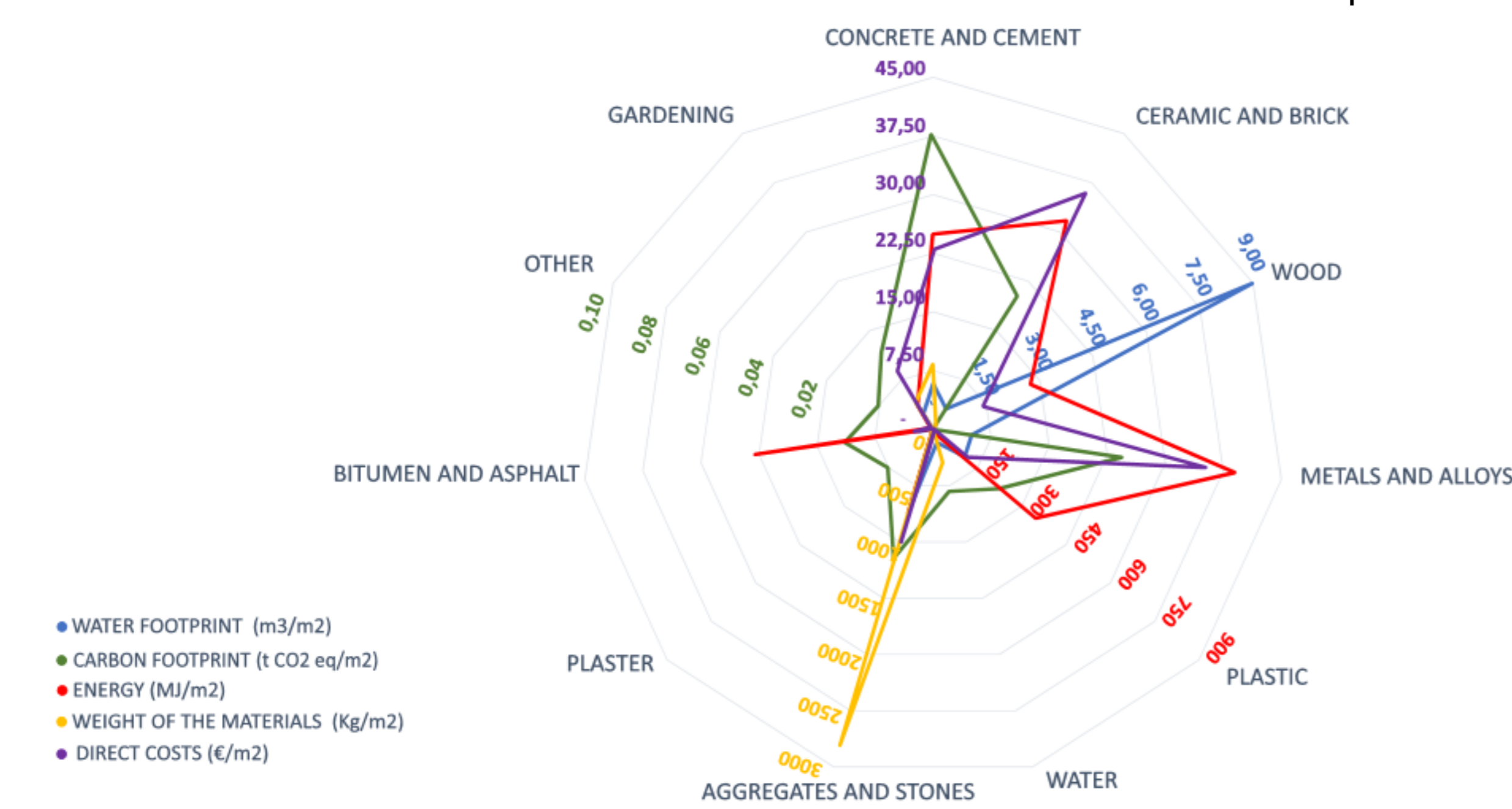
BIM classification		Code		Unit	Element definition	Environmental impact			Budget
Element IFC	UrbanBIM	ACCC	Uniclass		Description	(t CO2eq/Unit)	(m3/Unit)	MJ/Unit	EUR/Unit
IfcSlab	Pavement	15PPP50120	EF_30_60	m2	Pavement in parking area with paving blocks	0,078	1,230	491,540	54,374
	Pavement	15PPP50250	EF_30_60	m2	Pavement in children's play area with artificial grass and absorbent l	0,025	1,580	371,890	41,207
	Sidewalk	15PPP50110	EF_30_60	m2	Sidewalk with concrete paving blocks	0,081	1,290	471,420	31,912
	Cycle paths	15PPP50180	EF_30_60	m2	Cycle paths	0,098	1,960	669,740	33,217
	Driveway	15PPP50110	EF_30_60	m2	Bituminous Concrete Driveway	0,047	1,930	515,010	22,637
IfcTank	Tanks	15ADD50005	Pr_60_50_96_15	m3	Rainwater tank	0,313	64,171	5612,002	326,915
	Container	15UR50050	Pr_40_50_07_22	u	Underground container 4000 litre	6,719	584,790	34708,583	5950,121
IfcUrbanFurniture	Streetlight	15EPP00105	Pr_70_70_48_73	u	Galvanized steel streetlight 6m LEDS light	3,425	70,992	56601,628	1023,065
	Bench	15UPA0010	Pr_40_30_29	u	Bench, METALLIC SUPPORT and nordic pine seat	-0,041	0,227	655,704	256,290
	Bin	15URP00010	Pr_40_50_07_96	u	Metallic public bin	0,271	4,348	1979,086	457,779
	Bench	15UPA0005	Pr_40_30_29	u	White concrete bench	2,052	28,071	13531,694	940,840
	Fountain	15UFF50010	Pr_40_20_87_24	u	Drinking fountain	0,066	107,280	6684,950	1379,350
	Fountain	15UFF50011	Pr_70_55_98_30	u	Street fountain	25,402	5456,970	363222,888	45732,756
	Rocker	15UPB00100	Pr_40_30_61_88	u	Children`s rocker	0,396	7,351	4847,629	1005,295
	Traffic light	15CSS50120	Pr_70_75_70_14	u	Transfer traffic light 6m height	2,240	78,850	25973,480	4589,570
	Sign	15CRR10102	Pr_70_75_72_30	u	Vertical traffic sign	0,310	6,141	4513,018	114,121
IfcPipeSegment	Pipe	15ACW50110	Pr_65_52	m	Stoneware pipe DN 600	0,278	17,190	5300,200	211,390
IfcFooting	Trenches	15ACV50140	Pr_65_52_07_89	m	Trench to draining pipe DN 200 up to 3m deep	0,1464	26,0905	3381,52	138,45934
	Wells	15APP50145	Pr_65_52	u	Concrete well for DN 600	1,8605	101,35	15380,32	1126,88

CONCRETE AND CEMENT — CERAMIC AND BRICK — GARDENING — WOOD — OTHER — METALS AND ALLOYS — BITUMEN AND ASPHALT — PLASTIC — PLASTER — AGGREGATES AND STONES — WATER

- WATER FOOTPRINT (m3/m2)
- CARBON FOOTPRINT (t CO2 eq/m2)
- ENERGY (MJ/m2)
- WEIGHT OF THE MATERIALS (Kg/m2)
- DIRECT COSTS (€/m2)

Bibliography

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