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## Advancement of highly environmentally sustainable business management concepts with contexts embedded in construction markets

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# Advancement of highly environmentally sustainable business management concepts with contexts embedded in construction markets

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**Abstract.** Sustainable is defined to be capable of, relating to, or designating forms of human economic activity and culture that do not lead to environmental degradation, especially avoiding the long-term depletion of natural resources. Herein, the aim is to advance the design of business management (BM) concepts with contexts embedded in construction markets along the environmental sustainability dimension. The paper is part of the on-going reviewing of research on construction-related BM. The reviewing has resulted in the identification of 79 construction-related BM concepts published between 1990 and 2017. Thereof, only 16 (20%) authors have designed their concepts along the environmental sustainability dimension. There are 3 (4%) high-sustainability BM concepts including sustainable business goals, offerings, advantages, synergies, competitiveness, processes, organizations, and/or project portfolios, followed by 1 (1%) medium-sustainability and 12 (15%) low-sustainability BM concepts. In the future, the design of high-sustainability BM concepts could be advanced by (i) creating and distributing value in sustainability for all stakeholders, (ii) re-designing strategies and leveraging knowledge about and competences in sustainability through value chains, (iii) making sustainability a priority for decision makers, (iv) empowering middle managers, experts, and employee teams, and (v) redefining businesses and public services as well as collaborating inside and across borders.

## 1. Introduction

This paper is part of the on-going reviewing of research on construction-related business management (BM). Readily, this reviewer has conducted the two focused reviews on the environmental sustainability as part of 62 construction-related BM concepts published between 1990 and 2009 [1] and as part of 71 such concepts published between 1990 and 2013 [2].

In the same vein, the aim of the paper is to advance the design of BM concepts with contexts embedded in construction markets along the environmental sustainability dimension. The sub-aims include (i) the introduction of the pioneering reviewing of construction-related BM concepts and the overview of 79 construction-related BM concepts published between 1990 and 2017, (ii) the reporting on the conduct and results of the third focused review of the design of these 79 construction-related BM concepts along the environmental sustainability dimension, and (iii) the suggestions for the advancement of the design of high-sustainability, construction-related BM concepts in the future among various concept designers.



## 2. Reviewing of 79 construction-related BM concepts published between 1990 and 2017

The six review rounds have been carried out in 1999-2003, 2006, 2010-2012, 2014, 2017, and 2018. Cooper's approach and the original limitations have been re-adopted to protect the review validity [3]. The **coherent nature** has been maintained by focusing on research on firms that are based in the OECD countries. Exceptionally, references originating from Singapore and Hong Kong have been included due to these authors' British Commonwealth heritage and interests in international construction. Hart's guidelines have been relied upon [4]. The synthesis and use of the **method for the reviewing of conceptual research**, i.e. ways of searching, browsing, in-/excluding, retrieving, coding, describing, analyzing, and interfering have been reported upon in [5], [6]. The search for eligible BM concepts has been conducted comprehensively within the volumes of 28 construction-related journals published between 1990 and 2017 and those of 47 business administration journals published between 1990 and 2013. Concerning the other formal channels, the degrees of the comprehensiveness of the search have varied markedly [7]. This reviewer will submit the coverage of the channels including the lists of the journals on request.

Construction relatedness includes the ownership, financing, life-cycle, design, implementation, and servicing aspects of capital investments in natural resources usage, energy supply, manufacturing, telecommunications, transportation, infrastructure, real estate, and general building concerns. Herein, the terms "construction" and "construction-related" are used to encompass all kinds of built environments as well as real estate and investment concerns [2].

So far, the reviewing has resulted in the identification of 79 construction-related BM concepts published between 1990 and 2017. Discipline-wise, 37 (47%) BM concepts belong to construction management (CM), 16 (20%) BM concepts belong to industrial/international management and marketing, 15 (19%) BM concepts belong to project management (PM), and 14 (15%) BM concepts belong to real estate ownership and management. Business-wise, 25 (32%) concepts address project-based business, contracting, complex product systems, or engineering, purchasing, and construction (EPC) projects, 26 (33%) construction or building, 14 (18%) real estate management and services, 6 (8%) design and consulting services, 5 (6%) capital investments-based businesses, and 3 (4%) building products supply. Context-wise, the 79 BM concept designers have specified 81 geographically bounded contexts. There are 26 (32%) worldwide, 16 (20%) UK, 13 (16%) US, 7 (9%) Finnish, 5 (6%) Swedish, 3 (4%) generic, 3 (4%) Swiss, 2 (2%) Australian, and 2 (2%) Dutch contexts as well as 1 (1%) Austrian, 1 (1%) German, 1 (1%) Irish, and 1 (1%) Hong Kong –based context. Practice-wise, it seems that the degrees of the applicability of the 79 BM concepts are fairly low, on average. Most of these BM concepts do not contain (inter)national context-specific or business-specific elements. Only 35 (44%) BM concepts are supported with the initial, empirical, case-based evidence on a possible positive causal relationship between the adoption of the focal BM concepts and the highly successful managing of these case companies' businesses with the targeted contexts embedded in the construction markets at the time, respectively. This reviewer will submit a list of 76 references containing these 79 BM concepts on request.

## 3. Environmental sustainability as part of company management and business management

In general, **Oxford English Dictionary** defines sustainable "to be capable of, relating to, or designating forms of human economic activity and culture that do not lead to environmental degradation, especially avoiding the long-term depletion of natural resources" [8]. In the same vein, **Intergovernmental Panel on Climate Change's (IPCC)** pathways limiting global warming to 1.5°C with no or limited overshoot would require rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems. These systems transitions are unprecedented in terms of scale, but not necessarily in terms of speed, and imply deep emissions reductions in all sectors, a wide portfolio of mitigation options, and a significant upscaling of investments in those options [9]. In turn, the **World Economic Forum's** System Initiative on Shaping the Future of Environment and Natural Resource Security aims (i) to improve the effectiveness of the international community's response to environmental challenges, (ii) to support public-private action that accelerates the climate action agenda,

improves ocean health, realizes deforestation-free supply chains, enables more water-secure economies and helps unlock a trillion-dollar opportunity in the circular economy, and (iii) to explore how Fourth Industrial Revolution innovations can be harnessed to address environmental issues, including redefining what effective global environmental governance looks like. Responding to these challenges requires breaking down traditional silos and building new forms of cooperation and innovation across the public and private sectors to quickly effect change at scale [10].

Typically, **Boston Consulting Group** is advocating companies to incorporate environmental sustainability into company management in terms of eight best practices, i.e., setting a sustainability vision and ambition, focusing on material issues, designing a right organization to achieve ambition, exploring business model innovation opportunities, developing a clear business case for sustainability, getting the board of directors on board, developing a compelling sustainability value-creation story for investors, and collaborating with multiple stakeholders to drive strategic change [11].

In turn, Battacharya and Polman posit that when it comes to practicing and not just preaching environmental sustainability, many companies struggle, and most flounder in developing and implementing a sustainable business model. They have identified the **six biggest stumbling blocks** and they have offered the practical advice on how to surmount them as follows. (1) Create value for all stakeholders in the ecosystem and view profits as a consequence of such value creation. Implementing a sustainable business model requires executives to engage with the entire organization as well as multiple external stakeholders (such as nongovernmental organizations, shareholders, suppliers, regulators, and competitors), and to balance multiple goals that are sometimes in conflict. To accomplish this task, a business needs to operate in a much more transparent and symbiotic way and strive to make everything it does purpose-driven. (2) Look at the entire value chain and identify the best leverage points for value creation via a sustainable business model. Performance analyses concern both the planet (carbon, water, and waste footprints) and people (taking stock of working conditions). (3) Make sustainability a priority for the board. The challenges of engaging the board involve management's inability to explain the financial impact of sustainability initiatives, a lack of sustainability expertise, other priorities, an orientation toward short-term results, and a focus on shareholder value. To overcome these barriers and engage the board, the first task is to understand and explain the board's oversight role. (4) Gain buy-in from the "undecideds." Typically, senior leadership and young recruits "get it". But there is a big middle layer of "undecideds" that leaders need to bring on board by giving permission, removing barriers, empowering employees, emphasizing economics, and investing in training. (5) Make sustainability part of every employee's day job. This is the only way the sustainable business model can be successfully implemented. In contrast, most managers continue to believe "sustainability is great, but it's someone else's job, and I have more important things to do." This is a huge hurdle that leaders need to overcome, function by function, by training, developing relationships, promoting benefits, and urging responsible consumption and proper disposal, etc. (6) Redefine the competitive space by collaborating. Typical hurdles include different cultures and goals, additional management resources, and fear that, if they collaborate with competitors, they will not be able to differentiate themselves from their peers. Instead, we collectively need to put sustainability in the precompetitive space. Industry collaborations are required to solve complex supply-chain challenges such as deforestation. Collaborations allow companies and people to access expertise and the networks of relationships as well as to benefit from partners' political influence, standard-setting authority, and ability to impact public opinion [12].

Recently, Geradts and Bocken advocate that [business] managers promote **sustainability-focused innovations** in their respective organizations, by (i) having a clear direction and articulating goals to employees, (ii) providing an adequate budget and other resources (including the space, time, and training) to pursue goals, (iii) arranging "room for collaboration" and allowing people to work with other parts of the organization or to partner with suppliers, customers, non-governmental organizations, and other third parties to address gaps in skills and resources, (iv) providing positive reinforcement to employees who get involved in sustainability-oriented innovation projects, and (v) instituting measures of accountability that establish social and environmental value creation as a priority [13].

#### 4. Third focused review and the assessed degrees of the design of 79 construction-related BM concepts along the environmental sustainability dimension

##### 4.1. Original focused review method

For this third focused review, the **four degrees** of environmental sustainability were pre-specified. An author may have designed a construction-related BM concept along the environmental sustainability dimension to [2]:

- a high degree, i.e., environmental sustainability is one of the primary elements of BM such as a business goal, a key attribute of offerings, a competitive advantage, a synergy among strategies, an edge of competitiveness, and/or a key performance indicator of business processes, organizations, project portfolios;
- a medium degree, i.e., environmental sustainability is one of the supportive elements of BM;
- a low degree, i.e., environmental sustainability is only mentioned as a requirement or a tendency in stakeholder behavior, a criterion in decision making, a factor in environmental analyses, and alike, or it is only an implicit part of BM;
- no degree at all, i.e., an author is silent, no single 'thing' is explicitly written along the environmental sustainability dimension in the reference.

The concept-specific assessments have been compiled in the tables. The corresponding sentences, phrases, or single terms have been quoted and the page numbers have been referred to, respectively (see Table 2). This reviewer will submit a complete set of the tables containing the 79 assessments on request.

##### 4.2. Results of the third focused review

This review resulted in the revelation that only 16 (20%) authors have designed their construction-related BM concepts along the environmental sustainability dimension, i.e., there are 3 (4%) high-degree BM concepts, 1 (1%) medium-degree BM concept, and 12 (15%) low-degree BM concepts. In other words, there are 63 (80%) no-degree BM concepts (Tables 1 and 2).

This reviewer knew that there are at minimum the two high-degree construction-related BM concepts that he himself had designed [1], [14]. Ex ante, this reviewer erroneously assumed that some other authors had designed and published their recent high-degree construction-related BM concepts as well.

**Table 1.** Design of 79 construction-related BM concepts (published between 1990 and 2017) along the environmental sustainability dimension.

Degree of the design of the BM concepts along the environmental sustainability dimension	High-degree concepts		Medium-degree concepts		Low-degree concepts		No-degree concepts		All BM concepts	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Sum	3	(4%)	1	(1%)	12	(15 %)	63	(80%)	79	(100%)

##### 4.3. Protection of the validity of the third focused review against the four biases

**Concept Inclusion Bias 1** involves this reviewer perceiving that an author has designed a concept along the environmental sustainability dimension even if this author has not done so. This bias has been minimized by assessing each reference in the same way and quoting only the necessary part of each of the references that contain 16 (20%) construction-related BM concepts designed along the environmental sustainability dimension (Table 1). Future reviewers can test the inter-concept consistency of

**Table 2.** Three high-degree, one medium-degree, and 12 low-degree, construction-related BM concepts (published between 1990 and 2017) designed along the environmental sustainability dimension.

Author (year)	Construction-related BM concept and its focal context	Assessed degree of environmental sustainability based on key quotations (page number)
Huovinen 2011a [14]	4 environmentally sustainable businesses in 8 arenas	HIGH: 23 high-sustainability drivers into 4 businesses via 23 competitive arenas (6-12)
Huovinen 2011b [1]	High-sustainability BM concept as a 5-element system for managing businesses with contexts in construction markets	HIGH: 1 customizing into offerings and strategies, 2 leveraging into processes, 3 crafting into competitiveness, 4 fusing into a frame, 5 sustainable collaborators (11-13)
Keenan 2016 [15]	Real estate strategy continuum with relations btw sustainability resilient operations, and adaptive capacity for US corporations	HIGH: Paradigm shift (409) and a framework for managing relations btw 8 sustainability applications, climate mitigation implications, resilient operations, adaptive capacity (419).
Chinowsky with Meredith 2000 [16]	7 areas of strategic management, feedback with a competency spectrum and maps in US civil engineering organizations	MEDIUM: Environmentally sensitive core designs and solutions, support strengths (130, 142), environmental engineering as a surface characteristic (146), testing competency (150)
Flanagan 1994 [17]	Successful construction company in the year 2000 (based in the UK)	Low: Consciousness and sustainability are driving forces (312). Energy, traffic, waste, ecology impacts into designs (316).
Veshosky 1994 [18]	Analytical framework for the US design segment	Low: Environmental systems (43) and facilities (44), hazardous waste competency (45).
Lowendahl 1997 [19]	Strategies, resources, 3 phases for professional service firms	Low: Environmental protection as a market (106).
Huovinen 2001 [20]	Competitive strategy in technology-intensive contracting	Low: Solutions' environmental impacts as one of clients' decision criteria (73)
Love et al. 2002 [21]	Model for alliances founded on TQM and supply chains in the contexts of Hong Kong	Low: To take ethical consideration of the social and environmental responsibility in cooperative alliances (12).
Huovinen, Hawk 2003 [22]	Model for building product suppliers to manage their client relationships and collaboration	Low: "A building product's environmental impacts" is one of 11 criteria that clients use for choosing a winning bid (158).
Anderson, Merna 2005 [23]	Business development process in PM services in the UK	Low: Environment management is one of 11 domains of development (175).
Madritsch, Ebinger 2011 [24]	Process model for built environment lifecycle within an organization	Low: Disposal/recycling is defined as the exit from the "built environment" lifecycle (114). Facility condition index is specified (117).
Mutka, Aaltonen 2013 [25]	8-element business model framework for managing a process technology supplier	Low: To provide sustainable life-cycle solutions and guarantee best returns to customers; environment-friendly technologies (170-171).
Brege et al. 2014 [26]	Business model for industrial dwelling building in Sweden	Low: Frame system supplier's climate-proof structural offering as a business model (221).
Then et al. 2014 [27]	Business-real estate (RE)/FM alignment model	Low: Sustainability is part of social alignment (btw. business and facilities) criterion (87)
Kämpf-Dern, Konkol 2017 [28]	Assessment concept, success factors, and menu for workplace change management	Low: Energy savings is one of performance indicators. Environmental responsibility as one of performance criteria (219, 221).

of inclusion by repeating the assessments, i.e., reading the references and confirming this reviewer's quotations or rejecting some of them and, thus, excluding the same.

**Concept Exclusion Bias 2** involves this reviewer perceiving that an author has not designed a concept along the environmental sustainability dimension even if this author has done so. So, 63 "no-degree" assessments indicate that this reviewer did not identify any aspects on environmental sustainability. Future reviewers can test the inter-concept consistency of exclusion by repeating the assessments, i.e., reading the references and confirming the exclusions of 63 concepts or identifying sustainability elements in some of them and, thus, including the same.

After the inclusion, **Degree Assessment Bias 3** is related to this reviewer's reliance on a pre-specified scale of the three analytical degrees instead of a quantitative scale. The 3-degree lens corresponds to the explorative nature of the focused review. This reviewer could assign one of the three degrees to each of 16 BM concepts without hesitation. Future reviewers can request this reviewer to submit the concept-specific quotations and assessments to them and test the inter-concept consistency of degree assignments by reading the references and confirming the same degrees or assessing changes in some of them and justifying such changes with quotations. Or, they could re-specify a scale of degrees, e.g., by dividing each degree into two sub-degrees.

**Concept Author-Reviewer Bias 4** is related to a fact that this reviewer has designed 13% or 10 out of 79 construction-related BM concepts. Thereof, only 2 concepts have been co-designed. Further, I have assessed that I have designed 2 high-degree, 0 medium-degree, 2 low-degree, and 6 no-degree construction-related BM concepts along the environmental sustainability dimension. Future reviewers can carefully test the inter-concept consistency of the assessment outcomes versus each of the three other biases in the case of my 10 concepts. Other reviewers can come up with some explanations for this reviewer being, so far, one of the two designers of the three high-degree BM concepts. When I could not assess any high-degree BM concepts from among 62 construction-related BM concepts published between 1990 and 2009 during the first focused review [1], I perceived that I had to design these two high-degree BM concepts and, thus, to open the environmental sustainability dimension for future BM concept designers with contexts embedded in construction markets.

#### *4.4. Briefing of three high-sustainability construction-related BM concepts*

Huovinen has designed the **high-sustainability managing of four businesses** based on the multiplication of Porter's (1980) five forces framework and the design of the 8-arena framework for capturing complexity of managing businesses in competitive arenas in construction markets, i.e. 1 Uses, 2 Ownership, 3 Life-cycle servicing, 4 Capital investing, 5 Contracting as wholes, 6 Contracting as parts, 7 Prefabrication, and 8 Materials. A high degree of environmentally sustainable BM is achieved by implanting 23 drivers into the four main business types coupled with 23 specified (sub-)arenas. In life-cycle contracting and development businesses (in Arena 4), the drivers include the coupling of object development ideas with sustainability advantages. In design-build contracting businesses (in Arena 5), the drivers include the re-engineering of value chains. In design businesses (in Arena 6), the drivers include the transformations of design firms into long viewers, path dependency breakers, stock programmers, object planners, impact blockers, and impact cause tracers. In supply businesses (in Arenas 6-8), the drivers include the adoptions of cradle-to-cradle certifications, product renewals, and responsibility takings over life-cycles [14].

In addition, Huovinen has designed a **high-sustainability, 5-element business system**, i.e., environmental sustainability has been (i) customized into competitive strategies and offerings so that no/low negative impacts enable a firm to pre-empt or over-satisfy client needs, excel among competitors, and meet its business-specific, high-sustainability goals in the short term, (ii) leveraged into business processes to minimize carbon footprints and, thus, ensure and increase targeted effectiveness across contracts to be won, by managing a firm's business processes and contract tasks as a dynamic, IT-supported matrix where teams play integrative, flexible roles, (iii) crafted into a firm's core competitiveness, based on its high-sustainability foresights that involve business opportunity perceptions, technology foresights, a technology platform, a core competence architecture, a core

offering portfolio, and innovation paths, (iv) fused into a business frame, governance, and the preferred ways of firm-market interactions, along an interdependent set of ownership, managerial, legal, financial, venturous, organizational, institutional, social, and sustainable dimensions, and (v) linked to an extended business frame in terms of partnerships, networking, and similar new forms of physical and virtual collaboration with like-minded stakeholders [1].

Keenan has developed the **high-sustainability, conceptual framework for designing sustainable corporate real estate (CRE) strategies** in the case of US multinational companies. Sustainable real estate is defined by investments in technology and design that reduce consumption and promote efficiencies that limit a building's consumption of resources and minimizes its waste to such an extent that the value created and/or money saved justifies the alternative investment. The framework attempts to demonstrate the potential for causal, reciprocal connections between sustainability, adaptation, and resilience. The framework has been explored through a case study of the CRE strategies that Goldman Sachs developed over the course of the consolidation and development of its corporate headquarters. The evidence supports the existence of an applied relationship between sustainability, resilience, and adaptation. Sustainability advanced the adaptive capacity and resilience of the firm. Evolving sustainable processes had transformative impacts in adapting to change in both material and organizational CRE terms. In addition, robust adaptive capacities may promote the diffusion and execution of sustainable practices. The eight environmental sustainability applications within CRE included less paper, less furniture, less power consumption, a consolidated campus plan, workplace standards and an occupancy management system, preventative maintenance and life-cycle management, the integration of design and operations planning, and the organizational integration of facilities and engineered systems [15].

## 5. Advancement of the future design of high-sustainability construction-related BM concepts

It is herein posited that in the future many dedicated concept designers adopt also the environmental sustainability dimension and incorporate such sustainability to high degrees into BM concepts as a criterion, an element, or an attribute of managing, or a criterion in decision making. Readily, 63 (80%) no-degree BM concepts form a potential platform for advancement, i.e., simply these authors could incorporate high-sustainability elements into their existing BM concepts, respectively. It is suggested that the design of environmentally highly sustainable BM concepts with contexts embedded in construction markets be advanced in the five potential areas (aligning with Battacharya and Polman [12]) as follows.

(1) Create and distribute value in environmental sustainability concurrently for all stakeholders chained within global and local construction markets. Novel, sustainable business models can be designed for coupling internal and external stakeholders into seamless value chains as well as balancing multiple, stakeholder-specific goals and risks. The designers of emerging forms of integrating multiple actors on equal bases can exploit accumulated knowledge about managing constellations, ecosystems, heterarchies, long-term alliances, joint ventures, networks, orchestrations, partnerships, and alike.

(2) Re-design construction-related business models with strategies for leveraging in-depth knowledge about and competences in environmental sustainability through entire value chains. High-sustainability drivers can be implanted into the chains of competitive, value adding arenas embedded in (inter)national construction markets, i.e., the eight Porterian arenas of ownership, uses, life-cycle servicing, impact investing, wholes contracting and consulting, parts engineering and contracting, building systems and products supply, and construction materials supply (applying [14]).

(3) Make environmental sustainability a priority for various decision maker groups within construction markets, i.e., shareholders, financiers, institutions, board members, top management teams, business managers, entrepreneurs, governmental and other public entities, non-governmental organizations, and alike. Internally, sustainable mindsets can be cultivated, adaptive capacities can be enhanced, and resilient assessment and choice processes can be adopted (applying [15]).

(4) Empower middle managers, expert task forces, and employee teams in companies and public organizations also along the environmental sustainability dimension. Make environmental sustainability

part of every employee's job. Sustainable business (and public service) models can be successfully implemented in this way. Novel BM concepts can accommodate semi-independent behavior from back ends such as research, development & innovation, competitiveness, core systems, solutions, and services through business processes and support processes up to front ends such as offerings and competitive strategies (applying [1]).

(5) Redefine businesses and public services related to construction markets through collaboration inside and across regional and national borders. Multi-party collaboration can trigger solutions to many wicked environmental problems such as not-yet circular economies, excessive carbon footprints, scarce clean technologies, energy over-consumption, non-shared well-being, severe air pollution, and dirty waters embedded in (inter)national construction markets. Collaboration allows companies, public organizations, and people to access expertise and the networks of relationships as well as to benefit from partners' political influence, standard-setting authority, and ability to impact public opinion.

## 6. Conclusions

It is herein envisioned that the majority among the owners and managers of firms and businesses with contexts embedded in construction markets across the globe prioritize high environmental sustainability in the future. Among others, this is empirically indicated by Corporate Knights Inc. [29], a leading sustainable business magazine and ranking organization. The Global 100 ranking is based on a rigorous analysis of 7,500 companies with revenues of over USD 1 billion. The Global 100 companies show that doing what is good for the world can also be good for financial performance, i.e., top sustainability performers have tended to also provide better revenue for investors and have greater corporate longevity. The prime example is KONE Corporation of Finland, a global leader in the elevator and escalator industry, ranked as the 43<sup>rd</sup> most sustainable company in the world. KONE [30] is already a trusted partner for green buildings and sustainable cities. The goal is to be a leader in sustainability, which means providing energy efficient solutions and services that are smart and reliable. Sustainability is an integral element of the value that KONE creates for its customers. Sustainability is embedded into KONE's organizational culture. Sustainability embraces the entire supply chain, including suppliers and partners. KONE is a signatory of the UN Global Compact and supports the UN Sustainable Development Goals.

Likewise, it is foreseen that more and more construction-related researchers adopt the environmental sustainability dimension, integrate it with the other dimensions of BM concept design, and incorporate circular economy, carbon footprint minimization, clean technologies, energy savings, shared well-being, air cleaning, water purification, and resource reuses as key elements into their construction-related BM concepts, respectively.

In turn, this reviewer intends to continue the pioneering reviewing up to 2025 and to protect it against many biases. Especially, the reviewing has been protected only in part against the formal publishing channel bias, i.e., an increasing difference between the number of 79 identified construction-related BM concepts and the number of an existing population of such concepts published via all formal scientific channels. It is likely that in total 90-95 construction-related BM concepts have been published between 1990 and 2018, including 3-5 high-sustainability, construction-related BM concepts that just wait for identification, assessment, and exploitation.

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