Building and Environment 82 (2014) 666–674

Contents lists available at ScienceDirect

Building and Environment

journal homepage: www.elsevier.com/locate/buildenv

Dialectics of sustainable building: Evidence from empirical studies 1987–2013

Wei Pan*, Yan Ning

Department of Civil Engineering, The University of Hong Kong, Pokfulam, Hong Kong, China

ARTICLE INFO

Article history:
Received 18 July 2014
Received in revised form
5 October 2014
Accepted 6 October 2014
Available online 15 October 2014

Keywords:
Sustainable building
Sustainability
Dialectic
System approach
Stakeholder

ABSTRACT

The dialectical approach has been established in the management fields to help address the interdependence of the elements of a system. There is a paradigm shift of regarding sustainable building (SB) as complex socio-technical systems embedded with multifaceted trade-offs. However, despite the worldwide promotion of SBs, no research has explicitly examined their dialectics. This paper aims to contribute to the understanding of the complex interdependence of the SB systems by framing the dialectics in the concept, methodology and value dimensions. The paper examines the evidence from 243 empirical studies of SB which were published in 17 established journals during the period 1987–2013. The results suggest that the dialectics of SB exist in all the three dimensions, and are multifaceted and interwoven with each other. The environmental aspect of sustainability was most reported, with a focus on the energy and carbon parameters. However, there is a knowledge gap in examining the multiple aspects of SB along with the building lifecycle through the lens of integrative stakeholders. The dimensions of the dialectics, coupled with the patterns of previous research on SB, form a theoretical framework that should guide the future research of exploring the complex interdependence of SB.

1. Introduction

Sustainable buildings (SBs) have been increasingly understood as complex socio-technical systems [27,39]. One paramount feature of the systems approach is to address the interdependence among the system elements. This interdependence follows a certain pattern of interaction rather than a random and unstructured fashion [41]. Dialectics denote the interdependence of the elements of a system [37]. The dialectical approach has been established in the management fields to help understand the system interdependence, e.g. of leadership [10] and of strategic alliances [12].

However, in the field of SB, the dialectical approach has yet to become a point of scholarly debate. Instead, the literature of SB dialectics to date is limited and fragmented. Many building assessment schemes suggest realising the unification of the environmental, social and economic (ESE) benefits (e.g. the Evaluation Standard for Green Building in China [30]), which reflects the fundamental dialectics of the ESE triple bottom line of SB. Also, most environmental assessment methods, BREEAM, LEED to name a few, advocate that the evaluation of green buildings should consider the relationships between the aspects of energy, site, water, materials, environment, and building functional requirements during the lifecycle of the building, which indicates the dialectics between the many aspects and building functional requirements. However, no research has explicitly framed any dialectical approach to help understand the complex SB systems.

Therefore, this paper aims to contribute to the systems understanding of the complex interdependence of SB by applying the dialectical approach. The paper first introduces the concept of dialectics of SB, which are elaborated in three dimensions, namely, concept, methodology and value. The paper then examines the evidence from the empirical studies of SB which were published during the period 1987–2013, and reveals the profile of the dialectics of SB. The paper finally discusses the implications of the findings before conclusions are drawn.

2. The concept of dialectics of SB

Previous research has proposed systems approaches to examining SBs, which mainly reflect the principle that systems can be described by their components and their inter-relationships. For example, Alwaer and Clements-Croome [1] described sustainable intelligent buildings as a complex system of three basic interrelated issues, namely, people, products and processes, and the inter-relationships between them. Edum-Fotwe and Price [14] built

* Corresponding author. Tel.: +852 2859 2671.
E-mail address: wpan@hku.hk (W. Pan).

http://dx.doi.org/10.1016/j.buildenv.2014.10.008
0360-1323/

a specification for the ontological topography, which defines three broad categories: those which represent spatial scales, urban systems and development lifecycles, and sustainability dimensions and their associated issues and sub-issues, such as stakeholders, impact, influences and polices associated with any entity. Mukherjee and Muga [31] introduced a framework that can be used to integrate reductionist approaches within a systems paradigm. Mukherjee and Muga [31] used a continuum from the activity to the project level, as well as from the activity level to the systems level to represent a progression from reductionist methods to systemic approaches. However, although these approaches present useful attempts to gain insights into the complexity of the SB, they fail to explore where the dialectics of the systems exist.

In addressing the complexity of systems some researchers adopted the multi-fold philosophical framework that consists of ontology, epistemology, methodology and axiology. Examples include Blismas' [7] study of complex multi-project environments of construction, and De Rond and Bouchikhi's [12] examination of dialectics of strategic alliances. This framework is used to guide the theoretical examination of the dialectics of SB in this paper. Accordingly, ontology herein denotes what SB is; epistemology denotes how we know what SB is; methodology denotes how we research what SB is and how we know what SB is; and axiology denotes the value that shapes, and is shaped in, that body of knowledge. Guided by this framework, the dialectics of SB are examined in the interconnected dimensions of concept, methodology and value.

- The dimension 'concept' refers to the ESE aspects of the building. Dialectics may exist between and within these aspects and their sub-aspects.
- The dimension 'methodology' describes the boundary of the temporal and spatial aspects of the building. There are two trajectories describing the temporal aspect: material flow that ranges from the stage of material extraction to the end of life of the product; and work flow that starts from the stage of planning to demolition. The spatial aspect describes the location of physical subject, which ranges from technology, building component, the building as a system, to the broad context at community, city and global levels.
- The dimension 'value' is concerned with the stakeholders and their networks, and their interfaces with the project delivery.

The dialectics of SB may exist not only in each of the three dimensions, but cross multiple dimensions. For example, a study examining energy performance per se in the dimension 'concept' might imply the ignorance of the interdependence between the ESE aspects. However, such study might triangulate the dialectics from the methodological perspective by addressing multiple temporal and spatial aspects. As a result, such study with the focus on energy performance (which may lead to an oversimplified judgement of adopting the reductionism approach) could present a holistic attempt in the dimension 'methodology' by covering the whole lifecycle energy performance of the building.

3. Research methods

The research was carried out through the examination of the empirical studies of SB which were published during the period from 1987 to 2013. In total 243 articles from 17 established journals were identified through an onerous search process.

3.1. Identifying search keywords

The identification of initial keywords appeared elusive due to the absence of a common definition of SB [3]. Nevertheless, there exist many classifications of SB, e.g. the one by Chwieduk [8]; which comprises: 1) energy-efficient building; 2) environmentally-friendly building; and 3) sustainable building. Energy-efficient buildings deal with only one element of environmentally-friendly buildings (equivalent to green building) without consideration of other elements such as water and resource efficiency, which have seen a fast-growing body of knowledge under the term low/zero carbon/energy buildings [36]. Green is part of being sustainable [1]. SB is concerned with three primary aspect, i.e. environmental, social and economic (ESE) [22]. Also, there are a considerable number of passive houses reported in the literature. Taking all these factors into consideration, the keywords were identified as: "carbon neutral*" OR "sustainab*" OR "carbon emission" OR "energy saving" OR "green" OR "zero carbon" OR "low carbon" OR "passive" OR "zero energy" OR "autonomous" and "building" OR "hous*" OR "home" OR "project".

3.2. Identifying search control criteria

The data sources were achieved by identifying several search control criteria, namely, the timeframe, target journals, and search scope. *First*, the timeframe of the literature survey was confined to a 27-year period from 1987 (which is normally regarded as the point of time when the concept of sustainable development was formally introduced in the 'Brundtland Report' [42]) to 2013 (the cut-off year for this research). *Secondly*, in view of a large number of articles on the subject of SB, this search limited the data sources to a group of typical representative journals (see Table 1). The purpose was to keep the scope of the review manageable. *Thirdly*, the search was to the article title only. An initial attempt was to search using the identified keywords in the areas of title, keywords and abstract. This resulted in 127,708, 24,674 and 59,973 articles from the Scopus, Science Direct, ISI Web of Science, respectively. It was not surprising to yield such large numbers of articles as the words 'sustainable' and 'green' are topmost hits in academic research nowadays. However, to review such large numbers of articles would be extremely challenging, if not impossible, given the time and resource constraints.

Table 1
Screening process of selecting articles for analysis.

Journal title[a]	1st round	Screening abstract	Screening text
Applied Energy (AE)	26	24	15
Automation in Construction (AC)	7	7	4
Building and Environment (BE)	61	56	32
Building Research and Information (BRI)	17	15	7
Construction Management and Economics (CME)	9	9	6
Energy (EN)	21	19	13
Energy and Buildings (EB)	122	108	77
Energy Policy (EP)	60	46	21
Engineering, Construction and Architectural Management (ECAM)	3	3	3
Environmental Impact Assessment Review (EIAR)	5	5	1
Habitat International (HI)	20	17	10
International Journal of Project Management (IJPM)	5	3	3
Journal of Cleaner Production (JCP)	33	24	7
Journal of Construction Engineering and Management (JCEM)	15	14	13
Journal of Management in Engineering (JME)	4	3	2
Renewable and Sustainable Energy Reviews (RSER)	26	20	2
Renewable Energy (RE)	50	45	27
Total	484	418	243

[a] Journals are listed alphabetically.