Beyond Green Design: Leveraging Non-industrial Bamboo SMEs'Potential for Holistic Sustainability through Design

Rebecca Reubens, Founder and Principal Designer, Rhizome, Ahmedabad, India
rreubens@gmail.com

Abstract

Bamboo has been in the spotlight for over two decades now, against the backdrop of the global sustainability crisis, due to its eco-friendly properties. It's versatility as a material has led to a plethora of bamboo applications—ranging from construction to sporting equipment and from furniture to food.

Several of these applications have been well received in the market, by both consumers and the media. Unfortunately, this positive reception, bolstered by sales of these sustainable 'green' bamboo products, have not translated into a more sustainable life and livelihood for bamboo-working communities across the globe who constitute a bulk of bamboo producers.

This paper argues that designers need to go beyond bamboo's 'eco-friendly' or 'green' potential—the ecological parameter of sustainability—to sustainability's social, cultural and economic parameters, in order to leverage bamboo's potential for holistic sustainability. There is a need for mindfuldesign strategy and an accompanying methodology at the front-end design stage, to actualize bamboo's potential as a material that facilitates holistic production to consumption systems globally—including positively impactingthe lives of indigent bamboo-working communities.

This paper presents research that proposes a way forward to design to be an enabler for holistic sustainability in the bamboo sector, specifically for bamboo working communities and SMEs.

Keywords

Bamboo, Sustainability, Sustainable Development, Design, SME, Craft, Communities

1. Introduction

The environmental damage caused by over-extraction of materials for human production to consumption systems (PCSs)(Thorpe 2007) has led to serious concerns about the earth's carrying capacity, and brought to light the importance of renewable materials.

70% of the materials we use post-industrialization—such as coal, natural gas and oil—come from the lithosphere. This is a cause for concern as these materials take millions of years to form—and are therefore considered 'non-renewable', as opposed to bio-sphere resources, which take a comparatively shorter time to regenerate—and are therefore 'renewable' (Thorpe 2007).

Bamboo has sprung into centre-stage against the backdrop of the global sustainability crisis as a renewable material, being one of the fastest-growing plant species on the planet (www.inbar.int). It has a 10-3-% annual increase in biomass, as opposed to the 2.5% annual increase in the case of trees (www.inbar.int). In addition to being highly renewable, bamboo benefits the ecology as a viable timber replacement material which when properly managed does not cause loss of green-cover on harvesting. The bamboo rhizome network helps prevent soil erosion and bamboo's high nitrogen absorption helps mitigate water pollution.

All of these eco-friendly propertieshave led to an explosion of bamboo-based design and innovations, by both individuals and institutions, riding the surge of tremendous public and media interest in renewable and sustainable materials. These products and systems are targeted at informed consumers who are increasingly demanding 'eco-friendly' and 'sustainable' products developed through a 'sustainable design' process.

Several, if not most, of these new design-led initiatives have used a 'technology-push' (van der Lugt 2007) approach, using bamboo that had been reconstituted through industrial processes. These new processes reconstitute naturally inconsistent bamboo culms into standardized boards and panels, which can substitute wood and reconstituted wood-like derivates—generally by chemically treating bamboo and then breaking it up into components, which are then joined together and stabilized by lamination. Reconstituting bamboo, instead of using it as the natural bamboo culm and its machined components, including splits and slivers, frees bamboo from its 'low-quality' image (Dwinita 1999). It also circumvents the stereotypical associations with bamboo—including Asia, panda, cheap, natural and rustic (van der Lugt 2007)—helping it gain acceptance into mainstream markets.

Early on in 2002 in NID in Ahmedabad, MP Ranjan explored the potential applications of bamboo which was industrially processed into board, through the design workshop titled 'Bamboo Boards and Beyond' (Ranjan 2013). The workshop involved designers at NID working with bamboo-board from China. The output was a wonderful range of industrial furniture and structures, which were exhibited in several Indian cities.

Industrially processed bamboo was also centre-stage in INBAR's Technical report 29—*Bamboo Product Commercialization in the West: A State of the Art Analysis of Bottlenecks and Opportunities*—which investigated the causes of the small market share of bamboo products in the EU, despite the potential of industrially processed bamboo as a fast growing hardwood substitute. The report indicated that design intervention could facilitate bamboo being more widely accepted as a material in the West. To facilitate this, the researcher, Pablo van der Lugt, organized *Dutch Design meets Bamboo*—a series of design workshops to actively facilitate Dutch Designers to work with bamboo, as part of his thesis at the Delft University in the Netherlands. The resultant products, concepts and explorations developed during the project received a fair amount of positive media attention as eco-friendly designer products, and some were commercialized.

Design-led industrially-processed technology-push products have demonstrated bamboo's potential for ecological and economic sustainability, through commercially-viable products that are eco-friendly because of bamboo's inherent renewability.However, these products have not translated into livelihoods for poor bamboo producers in traditional, small-and micro-enterprises in Asia, Africa and Latin America where a substantial percentage of bamboo production happens: they have therefore been unable to leverage bamboo's potential to contribute to social and cultural sustainability. These economically-poor producer-communities lack the capital to invest in the technology these product lines call for. Industrial production chains limit the value added by poor bamboo producers, pushing them lower in the value-chain. Producers go from being involved in every node of the bamboo value-chain in non-industrial value-chains; to growing, managing, harvesting, transporting and processing bamboo at the most primary levels, in industrial value chains.

Ironically, bamboo is the ideal vehicle for holistic sustainability—including social, economic, ecological and cultural parameters—if it is used as a viable eco-income-generation option for these producers.Bamboo is indigenous to several parts of Asia, Africa and Latin America, where, interestingly, where bamboo and poverty coexist. In these regions bamboo is easily available to poor communities in their natural environments, and some cases even it in their homesteads. Bamboo-based production has a long and rich history in most of these areas where it employs a cross-section of marginalized groups—including indigenous communities and landless communities and women. This is because bamboo's linear fibres allow it to be easily processed with minimal effort and simple tools, making bamboo-based enterprises less capital-investments when compared to other micro-small and medium enterprises.

Given bamboo's potential, it is imperative that design and development in the bamboo sector looks beyond green design to holistic sustainability. The need of the moment is for focussed strategy that facilitates greater participation in new PCSs and value-chains by indigent bamboo-working communities, in order to put in place PCS that are economically viable, culturally sensitive, socially equitable, and eco-friendly.

2. **Design's Role in Bridging the Gap between Bamboo Production and Consumption**

Design has an important role to play in repositioning bamboo's sustainable, value-added avatar in the marketplace. Tapping new markets through design is imperative not only for industrially-processed bamboo materials and applications, but also traditional bamboo produce, which is losing out on its tradition consumer-base due to globalization.

Globalization has reorganized traditional localized market set-ups and PCSs, causing a physical and lifestyle gap between markets for bamboo products and traditional bamboo craftspeople, which comprise the bulk of bamboo producers in the world. These traditional producer communities face dwindling traditional markets for their produce, due to the influx of low-cost industrial substitutes. Simultaneously, these craftspeople cannot perceive and cater to 'new' lucrative contemporary markets, because there is no direct physical link between the producer and the buyer, unlike in the traditional market set-up they are used to functioning in.

This leaves bamboo craftspeople with little option apart from abandoning their craft practice, in search of alternate employment: this often involves migrating to nearby towns where they workas labor or as de-skilled assembly line producers in semi-industrial SMEs.

Designers have an important role to play in identifying and interpreting 'new' and current markets—including lucrative markets aligned with sustainability—for these producers, thereby bridging the infrastructural gap between bamboo producers and buyers. The exercise of designing new products for new markets holds the opportunity to for design to put in place sustainable PCSs that actualize bamboo's potential for holistic sustainability. These PCSs would mean sustainability, first for bamboo producer communities and craftspeople, and thenglobally—

through the spin-offs of design decisions and specifications on economic, environmental, social (White et al 2008) and cultural parameters.

The design of new sustainability-aligned bamboo products holds the promise of the orchestration of the PCSs that underpin these products—including material production and processing, fabrication, distribution, use, and end-of-life handling.

3. The Rhizome Approach: Towards actualizing bamboo's potential for sustainability, and sustainable development through design

Designers are ideally placed to be enablers for holistic sustainability in the bamboo sector. If their designs factor in holistic sustainability as part of the design brief at the front-end design stage (conceptual stage) itself, they could look beyond designing products, to designing the systems that underpin them— and thereon to facilitating holistically sustainable PCS.

However, as discussed earlier, despite this incredible potential, most design initiatives aiming to align bamboo with sustainability have centered on industrially-processed bamboo,bolstered by bamboo's inherent eco-friendliness as a material. This approach towards sustainability is not mindful of the compound scenario and need in developing country situations—where social and economic sustainability take precedence over ecological sustainability. Addressing the burning concerns of developing countries—poverty and unemployment (Barbier 1987; Bamford 2011) — is imperative to minimize social, cultural, economic and ecological unsustainability in these countries and in the world in general (Bamford 2011).

Transplanting the industrial development model—which underpins industrially processed bamboo PCS—to developing countries,impliesalso transplanting the unsustainabilities inherent within it—economic development at the cost of the ecology, society and culture. This is a particularly perilous proposition because it runs the risk of magnifying the unsustainability of the North in the South, owing to developing countries' huge populations and nascent levels of governance.

A wiser holistic approach would be to base sustainability design in the bamboo sector on the non-industrial craft sector paradigm which has proven to be sustainable so far vis a vis economic, ecological, social and cultural parameters. Drawing on this paradigm would likely mean transplanting the sustainability inherent in tacit craft, to new PCSs.

It would also prove to be difficult terrain for designers, because it involves two domains—sustainability and craft—which are unfamiliar to the industrial paradigm, which is so deeply linked to the profession of design. One possibility in this situation would be for designers to work with craftspeople as co-innovators of holistically sustainable bamboo based PCSs.

Studies show that the difficulty in translating the interest in sustainability and sustainable design (Fuad-Luke2009) into practice by designers in developed (Kang et al 2008; Aye 2011; Mate 2006; Kang & Guerrin 2009) or developing countries (Hankinson and Breytenbach 2012) is a phenomenon not specific to the bamboo sector. The reasons for this include: lack of knowledge about sustainability; lack of holistic overview of PCSs and value chains; failure to include sustainability at a strategic level in the overall approach; failure to include sustainability criteria in the design brief; the lack of a collaborative design process; lack of tools; and failure to keep design teams in the loop during the product actualization process (Maxwell et al 2003).

In response to this, the author developed the Rhizome Approach and the tools to operationalize it, in 2010, as part of her PhD research at Delft University of Technology. The research centered on how to facilitate designers to design more sustainably—especially in the context of design for and in developing countries working with renewable materials, particularly bamboo.

The Rhizome Approach is named after bamboo's complex underground rhizome system. Each rhizome either sends up a shoot or sends down a root, and networks itself to other rhizomes to form a stable mesh that prevents soil erosion. A rhizome is not amendable to any structural or generative model: it is a map and not a tracing (Deleuze&Guattari 1987). Similarly, the approach looks at seven distinct steps, which independently and interdependently facilitate sustainability design. The approach is designed to be flexible and adaptable to different contexts, while remaining strongly rooted in sustainability and the interconnections between its social, economic, ecological and cultural tenets.

The table below provides an overview of the Rhizome Approach

Step	Barrier	Aim	Method
1	Lack of knowledge about sustainability	Inform designers about sustainability, and the connections between its tenets	Provision of background reading material covering the connections between sustainability, design, material and the PCS
2	Lack of a holistic overview of the PCS	Sensitize designers to the systemic PCS	Exposure visits to different nodes of the value chain and PCS's stakeholders
3	Failure to include sustainability at a strategic level in the overall approach	Factor sustainability into the strategic blueprint of the enterprise	Introducing a blue print, towards which all the participants of the collaborative design process will work together collectively
4	Failure to include sustainability criteria in the design brief	Articulate sustainability criteria in the design brief so that it can be factored into the front-end design phase	Clear brief supplemented by the Holistic Sustainability Checklist (HSC) to clarify desired design and their impact on each tenet of sustainability
5	Lack of a collaborative design process	Provide inputs from different stakeholders towards a collaborative design process	Constant linkage and interaction with PCS stakeholders during the design process
6	Lack of tools to measure holistic sustainability against	Increase designers' accountability to factor sustainability into their designs	Evaluation of design against HSC by the designer and 2 external evaluators

	indicators	and provide a tool to measure the sustainability achieved	
7	Failure to keep the design team in the loop during product actualization	Keep designers in the loop until final product actualization thereby retaining their responsibility for the product's sustainability	Involving design team in all iterations of the design, up to final product actualization

Fig 1: Overview of the Rhizome Approach

Step1: **Lack of knowledge about sustainability**

Designers' understanding of sustainability shapes their sustainable design values, and thereby affects their behavior and attitude, and the likelihood of their designs being mindful of formal and informal sustainability regulatory frameworks (Hankinson and Breytenbach). In order to factor sustainability into their designs, designers need to understand it as a systemic construct resting on interconnected tenets. Designers need to appreciate the links between the tenets, and better still, understand them (Shedroff 2009).

Sustainability is not yet integrated into mainstream design education (Hankinson and Breytenbach); most design literature cites 'eco-design' as an umbrella term for sustainable design. Consequently, designers practicing sustainable design tend to focus on the ecological tenet and not on the holistic picture (Maxwell et al 2003).

Designers don't expand their sustainability knowledge as professionals—either by working on sustainability related projects, or through professional peer exchange platforms, such as conferences (Hankinson and Breytenbach 2012). Consequently, they lack knowledge on sustainable materials (Mate 2006), their impacts (Kang & Guerin 2009) and sourcing (Hankinson and Breytenbach 2012). Incidentally, designers who have a greater knowledge of eco-materials seem to use them more frequently (Mate 2006).

The first step of the Rhizome Approach therefore advocates bridging the theoretical knowledge gap on sustainability, by providing designers with information through focused presentations and reading material.

Step 2: Lack of holistic overview on PCSs and value chains

Sustainable innovation needs to factor in the entire product lifecycle and product supply and value chainsearly on, in the front end innovation stage(Maxwell & van der Vorst 2003). Limiting design focus to the company, rather than including the forward and backward linkages that comprise the entire PCS is a barrier to sustainable design (Maxwell et al 2003).

Task specialization and division of labor have led designers, like other actors in the industrial PCS, to lose sight of the systemic picture. Because of this loss of overview, designers tend to address easily apparent problems—such as ecological unsustainabilities—rather than exploring integrated issues and reaching holistically sustainable systems solutions (Maxwell et al 2003).

The difficulty in maintaining a holistic overview is increased with PCSs being spread across nations and geographies, compounding the difficulty in assessing the reliability of product suppliers and manufacturers (Hankinson and Breytenbach 2012).

Step 2 therefore advocates supplementing the didactic learning from Step 1 with hands-on exposure to the entire PCS. The aim is to facilitate experiential learning—including by first-hand visits to the different nodes of the value chain—to understand how the independent actors of the PCS collectively impact sustainability.

Failure to include sustainability at a strategic level in the overall approach

The failure to incorporate sustainability at a strategic level inhibits concerns relating to it becoming an inherent part of an organization's key business systems—including design

(Maxwell et al 2003). Designers lack motivation to practice sustainable design because of resistance from their organizations (Bacon 2011).

One of the reasons for this is the lack of clarity on sustainable design benefits (van Hemmel& Cramer 2002), especially immediate benefits (Hankinson and Breytenbach 2012). Sustainable solutions sometimes cost more(Aye 2003) and involve more time (Hankinson and Breytenbach 2012) for sourcing (Aye 2003) and research (Hankinson and Breytenbach): innovative solutions sometimes mean looking beyond the product being designed, to the larger picture—including the possibility of a product service combination (Maxwell et al 2003).

In order for sustainability to be factored into innovation and design, despite it seeming to involve extra efforts with unclear immediate benefits (Hankinson and Breytenbach 2012), it needs to be championed as a key part of an organization's strategic approach.

Step 3 focuses on introducing sustainability into an organization's strategic blue print, towards which all the participants of the collaborative design process will work together collectively.

Failure to include sustainability criteria in the design brief

Sustainability is not frequently included in design briefs alongside traditional criteria—including market, customer, and quality and production feasibility; it is seen as an expensive (Aye 2003; Mate 2006; Bacon 2011) add-on to the design brief that conflicts with the functional requirements of the product (Hankinson &Breytenbach 2012; Van Hemmel& Cramer 2002), rather than being an integral part of it.

This could be because sustainability is not yet frequently required by legislation (van Hemmel& Cramer 2002) and rarely insisted upon (Hankinson and Breytenbach 2012). Client resistance (Aye 2003; Bacon 2011), client knowledge (Davis 2001), and the perception that sustainable products are not yet needed by clients (van Hemmel and Cramer 2002) are also reasons why sustainability is not included in the design brief.

If sustainability is included in the design brief, it can be factored early on in the design process, in the front-end stage (Dewulf 2013). This minimizes the need to 'clean up' several consequences of the 'product life cycle' (White et al 2008).

Step 4 therefore advocates including sustainability in the design brief, and bolstering this with the Holistic Sustainability Checklist (Fig 2) to clearly outline the criteria desired in the design, and their impact on each tenet of sustainability.

HOLISTIC SUSTAINABILITY CHECKLIST

MATERIAL CONSIDERATIONS	Ecological	Social	Cultural	Economic
1 Renewable materials	•			
2 Minimally treated materials	•			•
3 Recyclable materials	•			•
4 Recycled materials	•			
5 Local materials	•	•	•	•
6 Fairly traded materials		•		
7 Ecologically certified materials	•			
8 Non-toxic materials	•	•		
9 Less/no materials from intensive agriculture	•			

PRODUCTION CONSIDERATIONS	Ecological	Social	Cultural	Economic
10 Minimum materials	•			•
11 Minimum production steps	•			•
12 Renewable energy for production	•			
13 Minimal energy for production	•			•
14 Low-emission-techniques	•	•		
15 Proper management of production effluents and waste	•	•		
16 Reduce/reuse production waste	•			•
17 Indigenous treatments and processes	•	•	•	•
18 Consulting indigenous communities on production issues that affect them		•	•	
19 Safe and healthy work environment		•		•
20 Fair wages and benefits to producers		•		•
21 No child labour		•		•
22 No forced labour		•		
23 Fair working hours		•		
24 Freedom of association and collective bargaining		•		
25 No discrimination		•	•	
26 Local employment opportunities		•	•	•

DISTRIBUTION CONSIDERATIONS	Ecological	Social	Cultural	Economic
27 Minimum product volume and weight	•			•
28 Minimum and clean transport	•			•
29 Local PCS	•	•		•
30 Minimum packaging	•			•
31 Reusable packaging	•		•	
32 Recyclable packaging	•			•
33 Packaging made from low-impact materials	•			

CONSUMER USE CONSIDERATIONS	Ecological	Social	Cultural	Economic
34 Minimum/clean energy during usage	•		•	•
35 Minimum consumables	•			•
36 Safe to use		•		
37 Customizable	•		•	•
38 Easily upgradable	•		•	
39 Classic design	•		•	
40 Minimum and local maintenance and repair	•	•	•	•

END-OF-LIFE HANDLING CONSIDERATIONS	Ecological	Social	Cultural	Economic
41 Reduced material complexity	•			
42 Biodegradable	•			
43 Easy to disassemble	•			•
44 Reusable	•		•	
45 Recyclable	•			•
46 Promotes/uses local recycling systems	•	•	•	•

Fig 2: The Holistic Sustainability Checklist

5. Lack of a collaborative design process

It is not just the designer, but the different functional units within organizations that shape the final design, and thus the manner in which it impacts sustainability (White et al 2008). Sustainability is also impacted by the different occupational groups and stakeholders across the supply chain (White et al 2008). Therefore, in order to enrich the innovation process, design needs to seek and consider inputs from within and outside an organization, from collaborators who may not traditionally be part of its innovation team (White et al 2008).

Step 5 advocates creating platforms that allow for collaborative decision-making by encouraging and actively facilitating a constant linkage and interaction between designers and the actors, facilitators and enablers of the PCS.

6. Lack of tools

Designers cited the lack of appropriate tools as a barrier to sustainable design (Aye 2003). Several of the existing tools are misaligned with design requirements (Lofthouse 2014) as they focus on cleaning up the life-cycle and do not support the front end innovation process (Walker 1998) which is where sustainability design actually needs to begin.

While several of the existing tools outlined issues related to sustainable design (Lofthouse 2014), and provided insights on the process and outcomes of designing sustainably (White et al 2008), designers were not clear on how to put them into practice (Lofthouse 2014). Designers wanted tools that had accurate and accessible information (Aye 2003; Hes 2005; Davis 2001), packaged together in a manner which made referring to them easy and not time-consuming (Lofthouse 2014) .

Designers also cited the difficulty in measuring sustainability as a barrier (Bacon 2011), and cited that clients unwilling to invest sustainable design, due to its immediate additional cost, might be convinced if its long term economic savings could be quantified (Hankinson and Breytenbach 2012). Tools to quantify sustainable design achievements and communicate them through different mechanisms, such as ratings, could help legitimize sustainability efforts as credentials (Hankinson and Breytenbach 2012).

In Step 6, the designer and two external experts evaluate the design against the Holistic Sustainability Checklist introduced in Step 4. The three evaluations allow for investigator triangulation (Denzin 1978) as a method of reducing the discrepancies between the three scorings. The final score gives designers the opportunity to reconsider aspects of their design, and develop a more sustainable iteration. The quantitative output of the checklist can be used to showcase the sustainability achieved, including through a branding and labeling initiative.

7. **Failure to keep design team in loop during product actualization**

The final design is often the result of several subsequent iterations by different functional groups—including design, production, marketing and merchandizing (White et al 2008). Each of these functional groups receive an iteration from the previous functional group working on the product; after working further on the iteration they "throw this over the wall" i.e. pass this on to the next functional group in the design pipeline (White et al 2008). Often, these groups do not communicate with each other on the iterations, and consequently fail to understand the "upstream and downstream" implications (White et al 2008) of their iteration. So, even if a functional group—including design—has tried to factor in sustainability, another functional group may not be mindful of this, and may make changes that reverse or lessen the sustainability efforts of the past groups in their iteration (White et al 2008).

In the end, none of the functional groups—including design—takes ownership or accountability for the unsustainabilities in the final design, because they were not involved with design decisions before and after they threw it over the wall.

Step 7 therefore advocates keeping designers in the loop from the front-end stage to right up to final product actualization so they can maintain an overview of the process (White et al 2008), and ownership of the design outcome.

4. The Rhizome Approach in practice

The Rhizome Approach was developed in 2010 and first trialled in 2011 in India through a collaborative fourteen-day workshop, involving multiple institutions and bamboo-working communities from Gujarat called the Kotwalia community. The workshop process was monitored and documented and empirical data was collected through questionnaires to check whether the Rhizome Approach helped designers to design more sustainably.

The findings from the workshop were extremely positive, and revealed especially an interest and appreciation of the Holistic Sustainability Checklist. The checklist draws on different frameworks such as the DfS rules of thumb by United Nations Environment Program and Delft University of Technology, the Business for Social Compliance Initiative (BSCI) and the conventions of the International Labour Organization. The checklist, therefore, functions as a theoretically integrative framework to support the policies, standards and compliance methodologies of different institutions working towards sustainability at different nodes of the PCS. Drawing on these frameworks—which have already achieved a high degree of institutionalization—helps to increase the normative and cognitive legitimacy of the checklist (Dendler 2012).

The checklist was refined by the author in 2013, for use by the United Nations Industrial Development Organization (UNIDO) as a set of standards for its initiative to brand and label sustainable Vietnamese handicrafts (Fig 3).

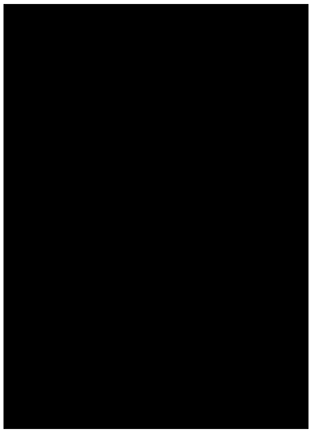

Fig. 3: Tag designed for UNIDO to indicate Holistic Sustainability

Further information on the Holistic Sustainability Checklist can be found in UNIDO's manual titled *Achieving, Assessing and Communicating Sustainability: A Manual towards Branding the Vietnamese Handicraft Sector*(Reubens 2013), which includes a description of the branding initiative, alongside a detailed elaboration of each factor on the Holistic Sustainability Checklist. The Holistic Sustainability Checklist is now in the process of being operationalized by UNIDO in Vietnam.

The Rhizome Approach continues to be used by designers in the author's sustainability design firm, Rhizome, in India as an intrinsic part of design methodology. The approach has also been adapted by numerous institutions—including the DICRC in India and SPIN in Vietnam—and continues to be used there as well. It is hoped that the approach helps mainstream craft-based holistic sustainability design in order to reach the point where indigenous does not imply indigent for bamboo-working communities.

Bibiliography

AYE, E. (2003), *Taking the Pulse*, Sustainability and the Interior Design Practice. Retrieved 11 05, 2011, from Green Building Services.

BACON, L. (2011),*Interior Designer's Attitudes Toward Sustainable Interior Design Practices and Barriers Encountered when Using Sustainable Interior Design Practices*, Thesis from Architecture Program, University of Nebraska.

BAMFORD, R. (2011), Ecology and the aesthetics of imperfect balance, *Craft + design enquiry*, vol 3.

BARIER E. (1987), The concept of sustainable economic development, *Environmental Conservation* 14.Pp 101-110

DAVIS, A. (2001), *Barriers to Building Green*. Retrieved 11 05, 2010, from Architecture Week, http://www.architectureweek.com/2001/0822/ environment_1-1.html

DELEUZE, G.; AND GUATTARI, F. (1987).*A Thousand Plateaus: Capitalism and Schizophrenia*, Minnesota: University of Minnesota. DENZIN, N. K. (1978), *Sociological Methods*, New York: McGraw-Hill.

DENDLER, L. (2012). 'Sustainable meta-labelling: an effective measure to facilitate more sustainable consumption and production?' In *Proceedings: Global Research Forum on Sustainable Consumption and Production Workshop, June 13–15, 2012,* Rio de Janeiro. Available from: at http://grfscp.files.wordpress.com/2012/05/grf-2012-rio-dentler.pdf [Accessed 09/09/2014].

DEWULF, K. (2013) Sustainable Product Innovation: The importance of the Front-End Stage in the Innovation Process, Advances in Industrial Design Engineering, Prof. Denis Coelho (Ed.), ISBN: 978-953-51-1016-3, InTech, DOI: 10.5772/52461. Available from: http://www.intechopen.com/books/advances-in-industrial-design-engineering/sustainable-product-innovation-the-importance-of-the-front-end-stage-in-the-innovation-process[Accessed 09/09/2014].

FUAD-LUKE, A. (2009),*Design Activism: Beautiful Strangeness for a Sustainable World,* London: Routledge.

HANKINSON, M. & BREYTENBACH, A. (2012), "Barriers that impact on the implementation of sustainable design", Paper presented at *Cumulus Helsinki*. May 24-26, 2012.

HES, D. (2005),*Facilitating 'green' building: turning observation into practice*, PHD dissertation, RMIT University, Melbourne.

KANG, M.; KANG, J. H. & BARNES, B. (2008). Interior Design Characteristics Influencing Sustainable Energy Awareness and Application, *International Journal of Spatial Design &Research 8*(10):17-28.

KANG, M. & GUERIN, D. (2009) The State of Environmentally Sustainable Interior Design Practice, *American Journal of Environmental Sciences* 5(2): 179-186, 2009.

LARASATI, Dwinita (1999), *Uncovering the Green Gold of Indonesia: A Design Research on Bamboo's Potential*. Eindhoven: Eindhoven University of Technology, Documentos del poyectoGuadua-Bamboo de la Union Europeasobrelasinvestigaciones en los mercadosalemanespara product de bamboo, Frieburg: University of Freeburg

LOFTHOUSE, V. (2013)*Ecodesign tools for Designers: Defining the Requirements,* Loughborough: Loughborough University.

MATE, K.J. (2006).'Champions, Conformists and Challengers: Attitudes of Interior Designers as Expressions of Sustainability through Material Selection', Paper 0066. Paper presented at *Design Research Society International Conference*. Wonderground.1-4 November, Lisbon.

MAXWELL, D. & VAN DER VORST, R. (2003)."Developing Sustainable Products and Services", *Journal of Cleaner Production*, vol. 11, pp. 883-895, 2003.

MAXWELL, D.; SHEATE, W. and VAN DER VORST, R. (2003). "Sustainable Innovation in Product and Service Development", paper presented at *Towards Sustainable Product Design 8*, Stockholm, 27–28 October.

RANJAN, M.P.(2013), *Bamboo and Design Thinking*, available online at https://www.academia.edu/4072813/Praxis_Bamboo_and_Design_Thinking_Bangkok_revised_2013

REUBENS, R. (2013), *Achieving, Assessing and Communicating Sustainability: a manual towards branding the Vietnamese Handicraft sector*, Vietnam: UNIDO.

SHEDROFF, N. (2009), *Design is the Problem: The Future of Design Must be Sustainable*, New York: Rosenfeld Media

VAN DER LUGT, P. (2007)*Dutch Design Meets Bamboo*(Eindhoven: (Z)ooProducties, 2007), 238.

VAN HEMMEL, C; & CRAMER, J. (2002), Barriers and stimuli for ecodesign in SMEs.*Journal of Cleaner Production,* 10(5): 439-53.

WALKER, S. (1998) Experiments in sustainable product design. *The Journal of Sustainable Product Design,* 7: pp.41-50.

WHITE, C.; STEWART, E; HOWES, T & ADAMS, B. (2008), *Aligned for Sustainable Design: An A-B-C-D Approach to Making Better Products*,Business for Social Responsibility and Ideo.