Integrating User Awareness and Behavior into Building and Product Design for India: Survey in Eight Giant Cities in India

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ABSTRACT: Is India on a sustainable road or not? Between April 2012 and January 2014 the authors have conducted a quantitative paper and online based user survey on energy awareness and attitudes in Mumbai, Bangalore, Chennai, Delhi, Pune, Hyderabad, Ahmedabad and Kolkata. The survey was part of the project "Clime Related Energy Efficient Design - Product Solution (CREED-PS)" first funded under the aegis of Germany India Year 2011-2012 "Germany and India: Infinite Opportunities" with a focus on "City Spaces" and then as part of the project "DWIH Excellence on Tour. 2013-2014." More than 2000 visitors were interviewed during the events about their individual energy consumption, their knowledge of selected energy issues and energy efficient building design and their sustainability attitudes. The majority of the visitors are part of the academic middle class group in India´s Megacities, as a limited group of India's society. One of the main results are that living in energy efficient residences is very important for most of the respondents, although two third don´t know exactly the energy consumption of their household. Yet, most of the respondents are willing to spend more money in energy efficient and energy saving building devices and household equipment. Summing up one can say that the interviewed middle class group (Shukla, 2005, Mawdsley, 2004) is on the sustainable road, although we have identified several inexplicable contradiction in knowledge and awareness as topics for further research work that are relevant for building and product design. This paper illustrates on the one hand the use of survey as part of an integrated design process and suggests on the other hand collaborative approaches to educating architecture and design students about sustainability in building and product design.

Keywords: India, Energy consumption, Energy saving, Energy efficient building design, Sustainability, Standards of housing

INTRODUCTION

Today India is an emerging country with a 1.3 billion population (MHA, 2011) and a rapidly growing economy. The census 2011 estimated 168 million households in rural areas and 79 million households in urban areas. Most of Indian families and individuals still live in traditional rural houses or in buildings that are older thirty years. Yet, the economic boom since 2001, a growing middle class in Indian cities and the migration of people from rural areas to urban areas has accelerated a tremendous construction and investment boom in rapid sprawling metropolitan areas. According to the report of Global construction perspective Ltd. (2011) between 2013 and 2020 India will become, behind China and US, the third biggest construction market in the word with an annual growth rate of 8 %. It is more than evident that India with its high demand of construction material and energy consumption moves straight to a critical resource shortage and carbon emission collapse, if the government and the society do not counteract with sustainable strategies and action plans for energy efficient building design and energy saving technologies. With about 39 % of the total national energy consumption the construction and building area is the major energy consumer (de la Rue du Can, 2009).

In many discussions with Indian architects, scientists, energy experts and organization, e.g. the Bureau of Energy Efficiency (BEE) and the India Green Building Council (IGBC), it was mentioned repeatedly that the awareness and knowledge of stakeholders, investors and users plays a central role in the change process to more sustainability.

In general only few studies and publications about the mindset of the Indians on energy concerns are available. Alam, Sathaye and Barnes (1998) reported in an older survey of household energy use in the city of Hyderabad. The survey revealed the fuel transition from biomass-based fuels to modern fossil fuels and electricity in cities. Reddy (2004) using the data from the National Sample Survey (1983-2000), analyzed the dynamics of energy end-use in household sector in India. The paper reported that large variations in energy use exist across different sections of households urban/rural, low/high income groups, etc.

In 2011 the Mercom Capital Group (2011) conducted a survey on renewable energy awareness in the area around the cities of Bangalore and Mysore in Karnataka State. The limited survey based on 101 respondents of the rural area, 204 respondents of residential and 204 of commercial/industry. Overall findings of the survey were that a "general lack of education and understanding about renewable energy, though the people surveyed were very enthusiastic about renewable energy concepts". Only 39 % of the rural respondents have heard the term „renewable energy" or „clean energy", in difference to 61 % of the residential/commercial/ industry respondents. About 32 % of residential and commercial/industry respondents answered that they have installed solar water heater, 6 % have installed solar panels, 1 % used wind turbines, 2 % biomass and about 60 % had no application of renewable energy installed (Mercom Capital Group, 2011). Likewise interestingly is that 46 % of all respondents don´t plan to install any type of renewable energy in the near future and 62 % were not aware (rural 80 %) of any government subsidies for renewable energy.

In another national survey on "Climate change in the Indian mind" by the Yale University, GlobeScan Incorporated, and C-Voter 4,031 Indian adults were interviewed, using a combined urban (75 %) and rural (25 %) sample. This "study was designed to investigate the current state of public climate change awareness, beliefs, attitudes, policy support, and behaviors, as well as public observations of changes in local weather and climate patterns and self-reported vulnerability to extreme weather events." (Leiserowitz, 2012). The key findings concerning climate and energy policies were: "41 % of respondents said the government of India should be doing more to address global warming; 54 % said that India should be making a large or moderate-scale effort to reduce global warming, even if it has large or moderate economic costs; 38 % said that India should reduce its own emissions of the gases that cause global warming immediately, without waiting for other countries; 70 % favored a national program to teach Indians about global warming; 67 % favored a national effort to help local communities build check dams to increase local water supplies; a majority of respondents favored a variety of policies to waste less fuel, water, and energy, even if this increased costs; 53 % said that protecting the environment is more important, even if it reduces economic growth, while 28 % said that economic growth is more important, even if it leads to environmental problems" (Leiserowitz, 2012).

AIM AND OBJECTIVES AND HYPOTHESES

The survey aims to assess energy efficiency awareness of the users in India and potential for integrating the same in building and product design.

Overall objectives

The survey followed some overall objectives related to the described target group:

1. Identification of knowledge, attitudes, awareness and behavior on energy issues to develop new concepts for energy efficient buildings in India.
2. Identification of different climate-related and city-related life-styles, housing, and amenities demands.

3. Identification of awareness/needs/methods/approaches to improve the efficient building design for investors and the energy saving behavior of urban dwellers.
4. Involving businesses and corporate social responsibility for promotion of energy efficiency and sustainable consumption.
5. Identification of energy efficiency related topics for information and education programs.

Research hypothesis

The survey is based on the following hypothesis that should be proofed:

H1: Higher educated people of the new middle class in urban areas have a clearer awareness and higher needs on energy-efficient lifestyle than lower educated people.
H2: The higher the income of people the lower the awareness of energy issues.
H3: Females are better informed on energy saving and efficiency than males.
H4: Younger dwellers are better informed on energy saving and efficiency than older dwellers.
H5: People with high individual energy consumption are willing to spend more money for energy saving activities.
H6: A good residential place has a higher priority than the distance to the working place.

METHODOLOGY

The survey was conducted in Mumbai (April 2012), Bangalore (June 2012), Chennai (August 2012), Delhi (October 2012), Pune (January 2013), Hyderabad (April/May 2013), Ahmedabad (November 2013) and Kolkata (March 2014) during the events "Germany and India: Infinite Opportunities" and "DWIH Excellence on Tour. 2013-2014." The majority of the visitors are part of the academic middle class group in India´s Megacities, as a limited group of India's society. More than 2000 paper-based questionnaires (250 for each location) were disseminated and collected. All filled out paper-based questionnaires were captured automatically with a scanner. The statistical evaluation of the questionnaires was conducted separately for each city and altogether for all cities. In total more than 2000 visitors were interviewed.

The paper and online-based (CREED) questionnaire in English language was created with the web-based software (EvaSys). Altogether the questionnaire was divided in 6 sections: (1) personal details, (2) mobility, (3) environment, (4) aspects for choosing the apartment/house; (5) environmental aspects, (6) general aspects. Questions were created in different formats (scale, single- or multiple-choice, and open).

In all automatically generated pdf-reports with EvaSys the case numbers were indicated for each question. Single-choice-questions and multiple-choice-questions were generated as a bar graph. Scale questions were generated as a histogram with average values, median values, and standard deviation. Additional the scale questions were diagrammed as a profile graph. Open questions were automatically identified and copied in the report as a picture-file. In the online-version open questions were recorded directly. For further statistical analyses the raw data were converted to an SPSS-file. The analyses were done with the statistical package SPSS version 20. In order to find out pattern in the data with a very strong correlation (r-value) and a very high significance (p-value) we conducted cross tabulation of age, sex, income, and occupation for all variables (items) in the questionnaire.

SURVEY RESULTS

General and Personal Data of the Respondents

More than one third (38.8 %) of the respondents live in a typical middle-class household with 4 persons. Nearly half of all respondents (45.3 %) were aged between 20 and 29 years. Only a small number of respondents (6.3 resp. 3.3 %) were older than 50 years. The majority of the respondents (77.7 %) were males. 65.5 % of the sample has a bachelor or master degree. This high %age depicts a strong focus on respondents with an academic background. The monthly income of the respondents is likewise nearly equally distributed. Probably the income group below 20.000 Rs. (37.7 %) consists predominantly of

students, freelancer or housewives. 27.7 % belong to the lower middle class has a monthly household income between 20.000 and 40.000 Rs.. 34.6 % belong to the upper middle class has an income above 40.000 Rs. (Meyer and Birdall, 2011).

Priorities of Housing Standards

In the first part of the survey the respondents were asked about the most important factors for choosing a new residence as an indicator of life-style, social priorities and sustainability awareness. Fourteen (14) social related, building related, life-style related and energy related questions were provided. The highest priority to choose a residence was a high performance of the location (73 %) followed by security of the location (70 %).

Figure 1 depicts the confirmation resp. the importance of the fourteen (14) investigated factors on living standards in the eight included Indian cities. The respondents could answer between "very important" and "unimportant".

Q: To choose a residential for me is very important ... (% of respondents)

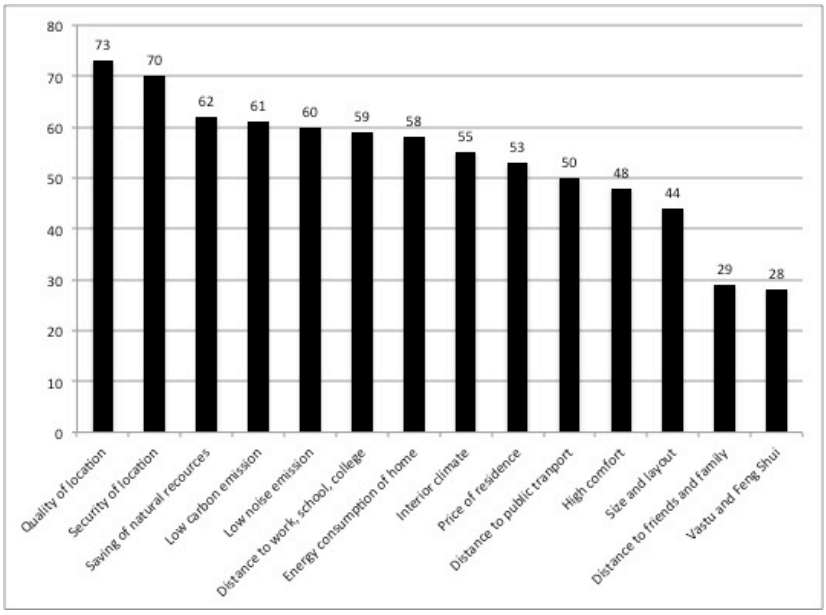


Figure 1 Overview of living standard priorities

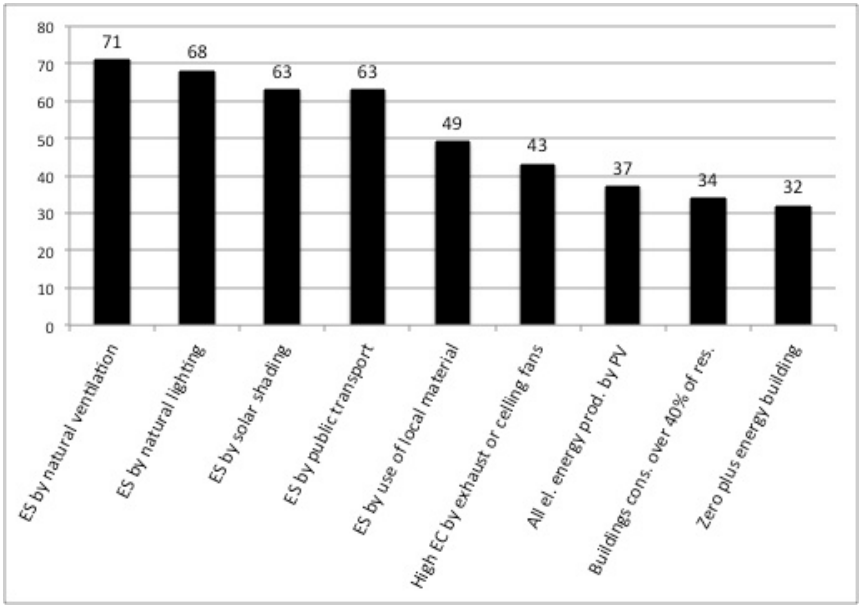
72.5 % of respondents consider a high priority of the location (district/quarter/street) for the apartment or house. This criterion of living standard has been the highest value of confirmation with an average value of 1.4 and a median of 1.0 with a deviation of 0.8. Because, this criterion implies a lot of sub-criterions like social and ethnic structure, population density, security, infrastructure (water and electricity supply, sanitation, garbage collection etc.), shopping opportunities, access to public transport, proximity to schools and kindergarten, cultural amenities, medical care and hospitals etc. The lowest confirmation of living standards of the respondents has "vastu" and "feng shui" with 27.9 %. A nearly equal share of 31.4 % find that unimportant. The age group above 60 years gives more importance to "vastu" and "feng shui" compared to other age group under consideration. The income group of 20,000 – 40000 Rs. places higher importance to "vastu" and "feng shui" in comparison to lower and higher income groups.

Other factors like saving of natural resources, low carbon emission, low noise emission, distance to work etc. and further investigated factors lays close behind the two top priorities. Amount of energy consumption, interior climate, price of residence, distance to public transport, home size and layout are less important factors to the respondents.

Environmental Knowledge and Attitudes

In the second part of the survey the knowledge and attitudes on building and product design issues should be identified. Nine (9) questions of use of material and electrical home equipment were provided.

The following Figure 2 depicts the knowledge and attitudes of the respondents on the nine energy related fields. The respondents could answer between "very familiar with …" and "not familiar with …" (% of respondents).



Legend: ES = Energy Saving; EC = Energy Consumption; PV = Photovoltaic´s

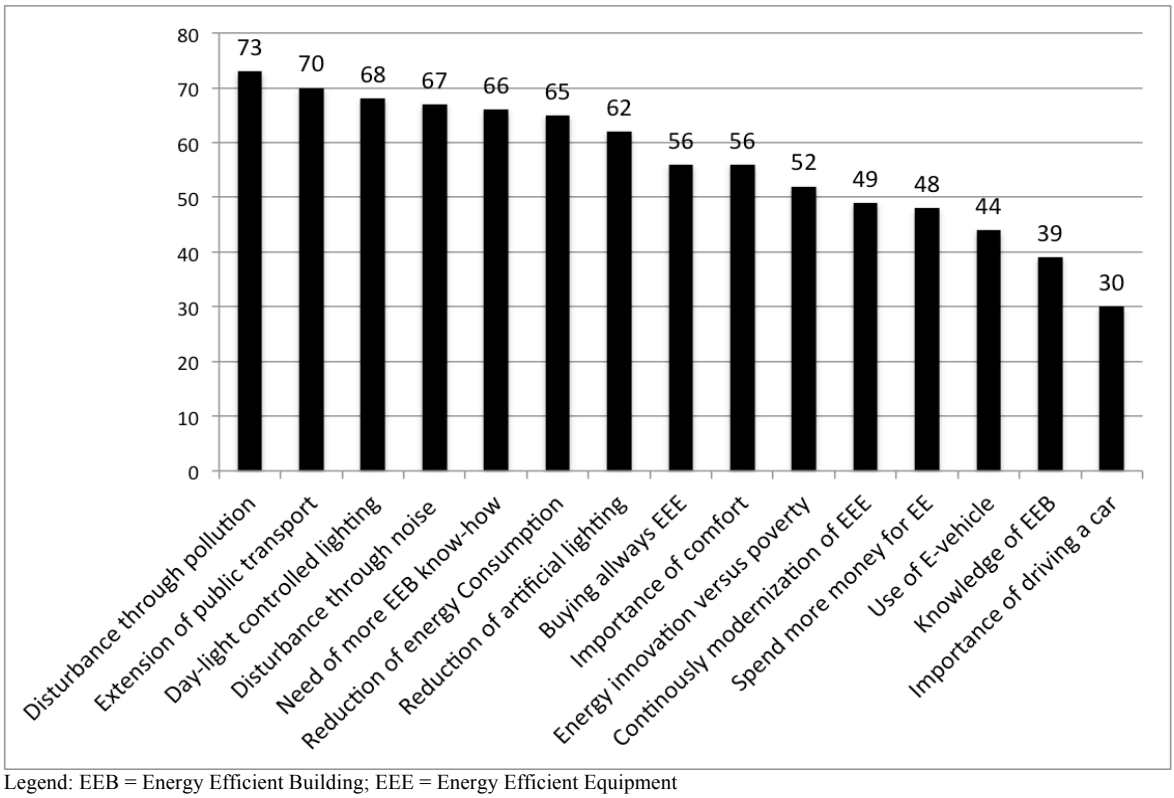
Figure 2 Overview of environmental knowledge and attitudes

71.1 % of respondents were very familiar with the fact that natural ventilation contributes to energy saving. A similar high confirmation of energy saving measure we have seen by the items of natural lighting (68 %), solar shading (63 %), and public transport (62 %). Saving energy by using local material (49 %) was not aware by nearly half of the respondents. Only 34.2 % of respondents were very familiar with the fact that buildings consume more than 40 % of all resources; 18.6 % were not familiar with this fact. 31.5 % of respondents were very familiar with the fact that buildings can produce more energy than they consume; 23 % were no familiar with this fact. As well only 32 % of the respondents knew that Zero Plus Energy Buildings could produce more energy as they consume. All in all these results shows a widely superficial knowledge of the respondents in the field of energy efficient building designs since the users are well aware of the basic energy saving measures like natural ventilation and lighting but they are not aware of the state of the art of energy savings strategies like zero or plus energy buildings.

General Attitudes of Housing

In the third part of the survey the general attitudes of housing related to building and product design was investigated. Fifteen (15) questions related to energy consumption attitudes were provided. The extreme poles of this question battery were on one hand side disturbance through pollution (73 % agree strongly) and on the other hand side importance of driving a car (only 30 % agree strongly).

Figure 3 depicts the general attitudes of housing in the fifteen items. The respondents could answer between "I agree strongly with" … and "I disagree strongly with …" (% of respondents) on Likert scale.



Legend: EEB = Energy Efficient Building; EEE = Energy Efficient Equipment

Figure 3 General attitudes of housing

The most important issue of the respondents is the air pollution. 73 % of respondents assert that air pollution is a very disturbing issue for them; for 91 % it is disturbing and very disturbing. The second important opinion focused on the extension of public transport (70 % agree strongly). In the following ranked items we found in general a linear decline of agreements. Yet, concerning the consuming attitude of the respondents one can consider a significant difference between the age groups. In general the older the respondents the more they have the attitude to buy energy efficient building equipment or amenities. In general one can assess a trend the higher income the higher are the tendency to buy always energy efficient equipment.

Interestingly, the alternative question that in the long term perspective innovation in energy saving is more important than fighting against poverty was strongly agreed by 52.3% of the respondents. This phenomenon is probably strong related with the particular structure, occupation, income, education, attitudes and behavior of the Indian middle-class. “It is by reckoning the most polymorphous middle class in the world.” (Beteille, 2001).

Concerning the knowledge about energy efficient buildings is was intended to measure the level and intensity of knowledge and information of energy efficient buildings. These values inform about the relevance of the topic for the respondents and for further information and promotion campaigns. 39 % of respondents assert strongly that their knowledge about energy efficient buildings is good, 70.3 % answer “I agree“ resp. “I strongly agree“. Between the age groups one can consider a tendency of higher knowledge in the age group 20 to 29 years and in the age group above 60 years.

48 % of respondents assert that they would spend more money for an energy efficient home, 79 % agree and strongly agree. The age group of 50 to 59 years has higher percentage of people who agree strongly for energy efficient homes. The group with higher income > 40000 Rs. place higher importance to energy efficient homes.

A deeper look into the age groups shows, that the high confirmation of the group above 60 years is very conspicuous and the increase of confirmation in the younger groups. The highest rejection one can see interestingly in the group below 19 years. Concerning the income groups there are no significant

differences in confirmation or rejection. Merely in the income group 20.000 to 40.000 Rs. one can assess a higher value of rejection. Interestingly, in this question the “neither nor“ group is especially wide. All in all one can suppose a difference between to own a car as a status symbol and to drive a car actively under the current traffic circumstances.

CONCLUSION

In this article a selection of assessments of attitudes and awareness of energy consumption is shown and discussed. The hypothesis H1, H2, H3, H4 cannot be confirmed. In most of the measurements all respondents with a tertiary education have a clear awareness and a high demand of energy-efficient lifestyles. Females and males as well as older and younger respondents show no differences in the level of information of energy saving and energy efficiency. H5 and H6 can be confirmed. Respondents with higher energy consumption and a higher income are willing to spend more money for energy saving activities and a good residential place has a higher priority than the distance to the working place, although for choosing a residential place the proximity to the workplace or the college is very important.

Between the eight investigated cities the survey found no significant differences in attitudes and awareness of the respondents. The quality of the location and the security of the location have the highest priority. Air pollution is one of the most important disturbing factors. We assess a clear attitude for an energy saving and energy efficient residential place. Most of the respondents vote for a strong extension of the public transport system.

This survey shows a picture of attitudes and awareness of a selected population segment with mainly tertiary education. Although this group is very important for the economic and social progress in India, more data and information of urban population with low income and low education, and from people from rural areas with lower income level is needed. With this data it would be possible to get a more holistic picture of attitude and awareness of energy saving and sustainability. For that purpose further research is needed, particularly for the transmission to a deeper eco-friendly education and knowledge-building and pro-environmental behavior (Vlek and Steg, 2007, Steg and Vlek, 2009, Geller 2002, Altomonte et. al., 2013). The usefulness of the value-belief-norm (VBN) theory for pro-environmental behavior analysis has been successful tested and disseminated in the psychological literature (Stern et. al., 1999).

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