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Factors Restricting Energy Efficient Innovations in the Thai Building Industry

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ABSTRACT

Despite rising prices of fossil fuels worldwide and the recognition of environmental imbalances in the built environment, the pursuit of technological innovation by professionals in the building industry particularly in energy efficient design remains uncommon. Practitioners in industrialized nations have, however, been more responsive about environmental design; but in developing countries, energy efficient buildings are especially rare. This paper summarizes the initial findings of the deterrent conditions found in building professional practices in Thailand that may have restricted the successful development and integration of energy efficient innovations in buildings.

Key words: energy, technological innovation, barriers, Thailand, architecture, construction, environmental design

INTRODUCTION

Despite a higher level of awareness and realization among design and construction professionals that environmentally sound architecture and energy conservation are obligatory, recent buildings that feature innovative solutions to conserve energy and minimize environmental impact remain scarce. Pursuits of advanced technologies in energy efficient buildings continue to be an exception rather than the norm. To effectively identify plausible patterns that inhibit the integration of energy efficient innovation (EEI) in building projects requires an examination of numerous factors, but this research will focus the investigation on work practices (which include financial control routines, design collaboration approaches, technical development processes) since any building innovation, if not conceived by, will need to be incorporated by design teams.

With the recognition of environmental problems and the rising price of fossil fuel worldwide, designers in industrialized nations have increasingly generated novel energy efficient solutions in architecture; but in developing countries, energy efficient buildings are particularly rare. This study investigates the working conditions under which professionals in Thailand carry out their design and building practices. Whether the findings could easily be applied in other nations remains a question, but it is useful to understand the missing basic ingredients of this "model of practice."

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DEFINITION

Energy efficient innovation (EEI) refers to effective and novel technologies that have been successfully integrated into design strategies for conserving energy, specifically from non-renewable sources, as well as reducing energy consumption during building operation.

DATA COLLECTION

Representatives from over 50 distinct organizations (i.e., architecture offices, engineering firms, contracting firms, educational institutions and clients) within Thailand's building industry who have a strong interest in or have attempted to create environmentally responsive design were interviewed and/or requested for written responses. This firsthand information shed light on their practices and experience in their recent construction projects (between 1998 and 2004).

A set of questionnaires was also used to expedite data collection. The questionnaires were based on the key features identified by Intrachooto (2002) as critical ingredients for successful implementation of energy efficient innovations in buildings:

(1) Commitment to environmental value

(2) Concurrent collaboration design process

(3) Work compatibility and rapport among team members (Relational Competency)

(4) Facilities for technical assistance

(5) Responsive financing

(6) Demonstration of technical validation

Even though these success factors were stipulated from a set of building projects in Europe and North America, they provide an effective framework for analysis in this study since comparisons with previous findings can readily be made and assessed while new findings can quickly be highlighted.

Due to the length of the questionnaire, distribution without accompanying these surveys proved impractical. Most of the questionnaire was, therefore, given and collected during each interview session (1-3 hours). Such a method consumed tremendous amount of time but provided much more detailed information for further analysis.

FINDINGS

The original intention of this investigation was to analyze the key success factors for the implementation of EEI in buildings within Thailand. The data however identifies a pattern of deficiencies within the current design and construction practice (in the Thai building industry) that hinder an adoption of EEI in built facilities. Within the last six years, only a few small projects could be considered innovative from an energy efficient technology standpoint. This study summarizes the findings and discusses in greater depth the deficiencies restricting a swift integration of EEI in architecture specific to Thailand's building profession.

Lack of commitment to environmental value

Our data suggest that there is a high level of awareness among the Thai professionals that ecological design is important. Thai building professionals recognize that building developments have caused a number of environmental problems. Yet, this awareness does not automatically insinuate a strong commitment to develop environmentally sound or energy saving buildings. Specific efforts to align environmental values among project participants were not employed. "Green leaders" who are characterized by having a strong conviction towards environmentally sound design and taking responsibility and a leadership role in all previously examined successful EEI endeavors were not found, except for one case where a green leader was altogether client, designer, and engineer. Professionals who expressed interest in environmental issues appeared to be ineffective in the Thai context—unable to surpass internal resistance (due to perceived risks[1] and technical complexity). Individuals in design teams who have an interest in an environmental agenda or are "green drivers" could be noted, but by-and-large had minimal influence on the whole design team. Environmentally sound design seemed to be mentioned during design process as "should do" as opposed to "must do."

To achieve EEI, a common purpose of upholding environmental soundness needs to be recognized at the start of the project. It is important that the goals[2] and expectations established at the beginning are not in conflict with personal interests of project participants. This investigation found that the issues concerning environmental design strategies hardly ever emerged in their initial meetings. Explicit partnering (team building) activities to create environmental commitment that have been found necessary in all EEIs in architecture (e.g., green building inspection trips, slide presentation of sustainable building design, and grant application to conduct related green design research) were not implemented. These participatory processes were effective in overcoming the lack of commitment to environmental values among team members.

Sequential working process

The work process among Thai building professionals is similar to the typical design process in most places where communications between disciplines are limited. Communication in most architectural endeavors is not a true communicative relationship, but rather a hierarchical one in which one party is hired by the other to fulfill a particular role (Kieran and Timberlake 2004). Much of the design process begins with and is normally allotted to architectural teams. A concurrent design process where design team members are working in parallel, sharing knowledge with fellow designers, was virtually non-existence in this investigation. Ordinarily, team members convened for the initial meeting to identify individuals representing participating firms and to discuss project budgets and schedules.

Based on the collected data, project participants focused their attention on required tasks categorized by service domains (i.e., mechanical, electrical, and structural). It was apparent they limited their coordination to sharing skills—applying their expertise towards the design; communication among consultants was minimal and generally centralized on the architects. Parties involved are distant from one another. Participants' experiences and values (such as personal commitment towards safeguarding the environment) were not revealed. How a task was accomplished was insignificant; only the finished blueprints were expected (see Diagram 1)[3].

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[1] Participants in a building project want to be assured that their decisions are correct (or the least incorrect) because each mistake is costly to both building owners and designers, particularly if litigation occurs. Such rationales are the perceived risks and become the first barrier to implementing any novel solution in buildings.

[2] Team members are joined together on a project basis; each brings his/her own objectives. Goals for each participant are therefore diverse. Architects may aim for project credentials and fame while engineers may search for ways to integrate new technologies and contractors may want to maintain construction schedule to minimize financial loss from delays. Owners may want to save cost. All the young assistants may want to push the green agenda.

[3] A typical scenario: Architects provided copies of nearly complete architecture drawings to structural engineers, mechanical engineers and other consulting engineers. Structural engineer adds only the building's structural systems and the associated calculations and/or details to the drawings. Mechanical engineers proceeded similarly after receiving their own set of drawings, and so on. Input from one professional to another was rare and not expected. If there was a conflict in the drawings, each consultant typically resolved the problems directly with the designer—with minimal or no participation from other consultants. The combined drawings were then put together by the architects, submitted for a building permit, or sent out to bid or for proposals from contractors. Finally, a contractor was chosen and the construction began. These working relationships separate roles clearly, and the focus of the cooperation is not on shared ideas among the participants but rather on the pre-determined assignments.

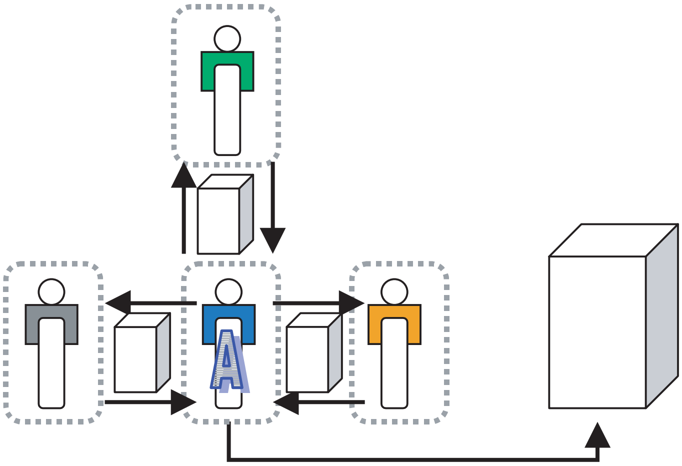

Diagram 1 Shared-Skills Work Relationship

Since energy efficient design is multi-dimensional—encompassing not merely various technical competencies but also psychological aptness and economic intellect, a devoted collaboration across disciplines, a.k.a. concurrent collaboration, is fundamental (see Diagram 2). The strength of concurrent collaboration is in the continual sharing of input in other aspects of the project, not limiting to only one's own area of expertise. The ideas can flow between members representing different disciplines and prompt brisk feedback, resulting in a solution that is better integrated than in a more sequential work process. Direct sharing of knowledge with minimal bureaucracy offers broad opportunities to exchange ideas and develop closer relationships among participants. Previous studies (Intrachooto 2002, Edquist 2000) have also found that firms almost never innovate in isolation. New ideas, such as EEI, often originate from a group of collaborators (interactivity) or from unlikely sources[4] , i.e., contributions from team members speaking from outside their areas of expertise.

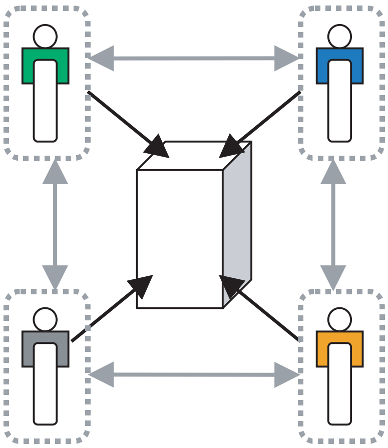

Diagram 2 Concurrent Collaboration (Shared-knowledge Relationships)

Relational ineffectiveness of team members

An effective team requires work compatibility among its members, a.k.a., relational competency. Although a rather obvious point, it is easily overlooked how relational competency within the group can be established and sustained. The degree of relational competence hinges upon

[4] A critical condition for innovation is diversity (Innovation Expedition 2004).

several conditions: (1) the ability to align the team's goals and design criteria, (2) the existence of green drivers and leader in the group, (3) the ability to establish a value-based working relationship (as opposed to purely sharing of skills), (4) the ability to provide expedient feedback on pending issues, and (5) the prospect of future collaborations between members.

Creating relational competent among Thai building professionals demands a cultural understanding. Based on the responses in the questionnaire and interviews, it was unanticipated to find virtually no major conflict among team members of most projects (which, though considered to follow a green approach, did not result in innovation). Individuals' distresses were not often shared with the teams. The study reveals that the culture of "non-confrontation" and "respect for the elders" (supposedly) have greatly minimized in-depth discussions about design approaches. Professional territory as well as seniority among project participants frequently prevented detailed discussions about environmental agenda/approaches/technologies since discrepancies among designers' viewpoints could naturally be expected. Seniority seemed to carry more weight in making suggestions and eventually in decision-making. Discussions of different viewpoints could easily be perceived as dispute—which may be detrimental to future opportunities for project commissions. Innovative approaches to design, particularly given by young professionals, were rarely raised or argued for, or risk being seen as disrespectful (or aggressive).

Overcoming such a cultural expectation is difficult and requires an art of negotiation and diplomacy. Within this cultural context, a green leader needed to also be a well recognized project leader within the environmental design field if an environmental agenda was to be implemented. Such individuals are rare however since they typically straddle both research and professional domains. As a result, a project's environmentally focused agenda, if not mandated by clients, was seldom established as a project's priority. Specific activities to align team goals, such as partnering or team building activities, would be required but have not been observed in this study.

Inaccessible technical assistance and omission of scientific validation

Seldom does any design team possess all the necessary technical expertise, particularly when involving unconventional technologies. Access to outside technical support for analysis and guidance is therefore vital to all innovation endeavors because wide-ranging testing is often required to bring projects with innovative technologies to fruition.

Surprisingly, most design professionals in Thailand have little knowledge of sources for technical assistance. Scientific or engineering design experiments were infrequently performed during project design and development, except when requested by clients (sophisticated clients are rare, however). There is little scientific evidence employed by architects during negotiation with clients, which has often resulted in unsuccessful persuasion. The lack of technical support may be at the root of the deficiency in technology development in the Thai building industry. Of over 50 organizations participating in this study, few were able to gather technical assistance to conduct performance feasibility in generating novel technological solutions in their architectural projects.

Technical assistance can take the form of collaboration with manufacturers or universities to carry out the required testing. Prior examinations (Intrachooto, 2002) found that successful novel energy efficient solutions involved academic or research institutions. In fact, many successful teams have established an ongoing connection with academia. Institutional involvements come in one of two forms: (1) through consultation on the development of strategies and (2) through testing or validating the design of new technologies. This assistance is crucial since design professionals are not typically compensated for systems development; hence, limited time can be afforded for such investigations. Most Thai design professionals, however, envisaged complications in working with academia, overlooking potential benefits. This intuition may be logical since the two communities differ formally in attitude and orientation about their use of facts. Designers see 'facts' as 'constraints' that can be manipulated and sometimes disregarded. Scientists see 'facts' as 'data', which cannot be changed (Purcell and Heath 1982). Interestingly, design practitioners (in Europe, America and Thailand) who contributed significantly in the successfully implemented EEIs in their respective projects hold teaching positions or have been intimately involved with academic institutions.

Insufficient financial support

Design and construction budgets for building projects are nearly always stringent. To develop and implement a new technology necessitates not only research but also adequate financial support. Despite their recognition that budget constraint is the biggest culprit in the development of environmentally sound design, rarely do design professionals in Thailand consider alternative sources of financial assistance other than soliciting additional budget directly from their clients. Intrachooto (2002) found that teams seeking EEI have almost universally attained some sources of funding outside clients' allocated budgets.

The data reveals a general conviction among Thai practitioners that pursuing innovative technologies in building construction cannot generate additional financial support. Manufacturers, governmental organizations, or even the clients themselves seldom endorse building professionals in technology development. Most research funds given by the Thai government require specific qualifications such as a researcher's doctorate degree, prior related research experience, etc. Few professionals have obtained a doctoral degree or have conducted formal research in their practice. It is plausible that collaboration with researchers could help overcome the lack of financial support as observed in successful cases of innovative energy efficient architecture in Austria, Sweden, Scotland, England, Canada, USA, and also Thailand. In addition, most designers in Thailand rarely consider manufacturers as a source of funding since many of the larger manufacturers are foreign companies and often carry out their research abroad. Thailand is used for product manufacturing and distribution. Recognizably, it is difficult for designers and manufactures to find their match. However, having a relevant investigation of a specific technology for ecological design that manufacturers value could lead to manufacturers' financial support as found in the development of Lightmetrics[5] produced by BENEDAR for Linz Design Center in Austria.

The most often employed method for obtaining additional financial support for most practitioners worldwide is to discuss directly with their clients since the clients ultimately dictate the design direction by controlling the overall budget. In most cases, there is little financial incentive for clients to invest in EEIs due to related risk and the extended payback period. Hence, having a commitment to environmental concerns and having validated performance stability are crucial to securing additional financing from the building owners. Involving clients in the design and technology decision making process (particularly with private clients) and establishing ongoing

[5] Lightmetrics is a 16 mm grid system sandwiched between large glazed panels allowing natural light to enter the exhibition hall below while excluding direct solar heat gain (Herzog 1994).

support to amend technical glitches (i.e., warranty) have been observed to have strong influences on how flexible the budget distribution and/or addition is within a project.

SUMMARY

Certain work patterns emerged. The discrepancy between the desired innovation and the utterly conventional outcome is understandably the result of a number of dissonances between designers' trained work processes and the integrated requirement of innovation development; between designers' precaution and clients' expectations; between financial desire and technological curiosity; and between the driving professional practicality (minimizing risks) and the making of innovation culture (inherently risk-prone[6]). This study has found a number of pointers that may explain the general lack of EEI in contemporary architecture in Thailand. Fundamental to all successful EEI is personal commitment to environmental value. What seemed to be professionally accepted, however, is the non-committal disposition to environmental compatibility of the Thai building practitioners. The culture of conflict avoidance and the usual allegiance to intuition (rather than scientific evidence) have led to complacency of project participants and conventional solutions. Without this fundamental commitment to environmental value, the drive to conduct the necessary research that could lead to the development of EEI in buildings cannot be sustained since efforts to seek additional financial support and devoted collaboration would be difficult to garner.

Although the information in this study is by-and-large based on professionals practicing in the Thai building industry, it is conceivable that the finding may be applicable to other developing nations, where innovative energy efficient solutions are sparse, if (1) national budgets provide minimal support for scientific research (a characteristic of a developing economy); (2) industry's criteria of a successful construction project are defined by project schedule and budget; and (3) environmental concern is not yet considered a priority. Whether the deficiencies found in this examination and their respective resolutions suggested in this paper could be broadly applicable to EEI developments in other developing economies will require further investigation. A comparative study to different economic and cultural contexts can explore the extent to which these findings are pertinent to other practices.

Building design and construction require a balance of functional needs, financial control, durability and stability prerequisites and artistic expression, but become even more complex when innovative solutions such as EEI are involved. Balancing these multifaceted obligations requires commitment and creativity. The daunting task of balancing multiple requirements has led most designers to agreeably follow the industry's familiar conventions and produce familiar buildings as seen in Bangkok today—which clearly have become more and more unsuitable for today's organizational changes and environmental concerns.

ACKNOWLEDGEMENT

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