

## ROLE OF TECHNOLOGY IN PROVIDING BETTER BASIC FACILITIES FOR CONDOMINIUM PROPERTIES

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### ABSTRACT

*Sri Lanka, as a third world country, rapid urbanization has increased ranks of urban poor, creating demand for housing and urban services which has remained unsatisfied due to lack of resources and urban lands at reasonable prices. Hence, condominium construction has become popular in the present as a solution to provide accommodations for the increasing population. However, providing required facilities to its occupants is a major problem for the condominium management. According to the literature survey, two of condominium facilities, safety and security and ventilation have been identified as basic facilities which are having severe urge to be improved. Therefore the aim of the study was to explore how to improve the basic facilities in condominiums through the concepts of technology.*

*A comprehensive literature survey was carried out by referring books, journal articles, and relevant other publications leading to a case based field survey, where interviews and observations were used as the data collection techniques. Content analysis was used to analyse the qualitative data. Research has concluded that technology transfer will improve security and safety systems where the techniques identified being Condominium Elevator Safety, Finger Print Readers, Motion Sensors and Access Control. Further ventilation conditions were suggested to be improved through the Balance/Stack Ventilation, Solar Wall/Roof, Heat/ Energy Recovery Ventilators and Wind Catchers. However there are barriers in implementing new technologies which are identified as Lack of cost allocation, Poor mechanism of technology sourcing, transfer and management and Inadequate government or responsible parties' support and involvement.*

**Keywords:** BIM Strategies; Building Information Modelling (BIM); Contractor.

### 1. INTRODUCTION

Condominium construction has become popular in the present as a solution to provide accommodation for the increasing population. Condominium is a system which provides separate ownership of individual units in a multi-story building (Kowshala, 2002). This system was introduced to Sri Lanka when the apartment ownership Act No. 11 of 1973 came to effect (Kajaran, 2006). According to Kirthi (2008, p.5) “condominiums are not everyone’s ‘cup of tea,’ but this is the best alternative home ownership style in urban areas. It will give an instant community feeling, and also provides more security and hassle free living, with all the benefits and facilities available”. However, Building Technologies Energy and Environmental Solutions (2005) have identified several challenges and limitations which are affected to condominium properties and management while providing those facilities and requirements.

In overcoming the limitations and challenges in condominium development, the concepts of technology management, technology transfer and technology innovation can be utilised. Therefore this research examines how to use technology to facilitate the essential requirements of safety and security and ventilation in condominium properties in better ways.

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## 2. LITERATURE REVIEW

### 2.1. ROLE OF TECHNOLOGY IN UPHOLDING CONDOMINIUM SAFETY & SECURITY AND VENTILATION

Senarathne *et al.* (2006) have mentioned 24 hours home securities as a main requirement of the condominium properties. Moreover, heating and ventilation is one of major requirement in high rise buildings (Cook, 2009). Many areas in condominiums or apartments complexes call for special caution and awareness on these facilities differently from single family dwellings.

Moreover, with the development of new technologies, there are several types of safety and security systems and ventilation systems are available in the residential units in the moment. Those systems are outlined above Table 1.

Table 1: Safety & Security Technologies and Ventilation Technologies

Safety & Security Technologies	Ventilation Technologies
<b>Close Control Television (CCTV):</b> Bullet/Dome/Covert/Desktop/Board/Outdoor/Day/Night/Varifocal/Network/IP/ Wireless / High-Definition Discreet Cameras; Infrared/Night Vision	<b>Classical envelope infiltration method:</b> Exhaust/Compartmentalization/ Multi point exhaust system/ Intermittent exhaust system/ Exhaust with make-up air inlets
<b>Fingerprint Reader</b>	<b>In-suite ventilation</b>
<b>Access control</b>	<b>Central (Roof-mounted)</b>
<b>Condominium Elevator Safety</b>	<b>Pressurized corridors</b>
<b>Motion Sensors:</b> Electronic/Mechanical; Natural organisms (motion perception); Infrared (Passive and active sensors); Optics (Video and camera systems)/Radio Frequency Energy (radar, microwave and tomography motion detection)/ Sound (Microphones and acoustic sensors)/Vibration (Turboelectric, seismic, and inertia-switch sensors)/Magnetism (Magnetic sensors and magnetometers)	<b>Stack ventilation:</b> One or more stacks or towers in to the building structure to extract stale air while fresh air enters through provided openings such as trickle vents or louvers
<b>Fire safety:</b> Fire detectors; Fire extinguishers; Sprinkler system; Wet riser system and Hose reel system	<b>Mixed mode or hybrid ventilation:</b> Wind/Mechanical ventilation(Fan/Heat exchanger/ CO2 sensors)
<b>Physical security:</b> Security guards; Barriers	<b>Single-sided ventilation:</b> Openings/ Windows Cross-ventilation; Two or more fixed openings on opposite walls
	<b>Natural ventilation system:</b> Wind and Temperature difference
	<b>Solar Chimney:</b> Stack system fitted with a solar collection panel
	<b>Continuously pressurized corridor ventilation system:</b> Large mechanical unit on the roof with damper controls and a centralized shaft
	<b>Direct supply approach:</b> Pressurized air is supplied directly to each suite/Exhaust
	<b>In-suite ventilation:</b> Automatically controlled/ HVAC
	<b>Ventilator types:</b> Sensible/Latent; heat/ Energyrecovery(HVR)/(ERVs)

Source: Adapted from Condobusiness (2009); Resource Smart Business (2010) and Awbi (2010)

There are three main terms related to technology as technology management, technology transfer and technology innovation. According to the National Research Council (1987), “Technology Management” is engineering, science, and management disciplines to plan, develop, and implement technological capabilities to shape and accomplish the strategic and operational objectives of an organization. “Technology transfer” is a purposive, conscious effort to move technical devices such as materials, methods, and information from the point of discovery or development to new users (Strawn, 1982) whereas “Innovation” is the actual use of a nontrivial change and improvement in a process, product, or system that is novel to the institution developing the change (Slaughter, 1998 cited Blayse *et al.*, 2004).

Condominiums are governed by community members, and condominium owners need to follow by-laws that are set up for the entire condominium community. Condominiums owners are responsible for installing burglar alarms, smoke detectors and security systems within their own units if desired. In addition, condominium owners need to buy their own condominium insurance policies, and to regularly update them if required (Dickstein Associates Agency LLC, 2013). A ventilation system is a process which circulates fresh air throughout a confined space or spaces, while removing contaminated or stale air (Wisegeek, 2013). The goal is to optimize building energy costs and improve occupant satisfaction with respect to noise and odour transmission between suites and between common hallways and suites (Cook, 2009).

## 2.2. CHALLENGES FOR DIFFERENT TECHNOLOGICAL TERMS IN CONDOMINIUM CONSTRUCTION

There are some issues in technology and technology management in residential construction. Development and process technology issues are multi-dimensional and the root causes are complex as presented in Table 2.

Table 2: Technology Development Issues and Barriers

Issues	Barriers
Out-dated technology	Lack of willing to transfer in to new methods
Lack of innovation/new design development	Lack of foreign investments related to technology
Poor mechanism of technology sourcing, transfer and management	Technology developers/owners not necessarily good commercializes/marketers
Inadequate government or responsible parties' support and ignorance about the consequences of the effects	Bodies needing technology may not have the capacity to search and negotiate or even absorb/adapt the technology
Lack of eco-friendly waste management and drainage system	Low public awareness/public pressure (condominium occupants or government)
	Government barriers (regulations) to technology transfer (import & export)
	No or lack of incentives to the condominium management and to the condominium contractors

Source: Adapted from Dassanayaka and Sardana (2009) and Eskom (2013)

## 3. RESEARCH METHOD

This research's basic beliefs fall into the paradigm of interpretivism with a qualitative approach. Case studies were used as the method which is an empirical inquiry that investigates a contemporary phenomenon (Yin, 1994). Out of the various research techniques, interviews, observations and discussions were used for data collection which was led by a background study and a literature review. Three cases were considered within this study. Interviews were conducted to gather information from individuals through one-on-one sessions face to face with professional building services engineers or maintenance engineers, condominium consultants and contractors, condominium management and its occupants. Observations were made to identify the available techniques used in the condominiums and the visual inefficiencies. In order to move from raw data to a meaningful understanding, content analysis was used to analyse data which were collected from the case studies.

## 4. FINDINGS AND DISCUSSION

Three cases were studied to collect data with the developed interview guideline which is consisting with ten questions aiming one of occupants and an individual of the management party of the each case where **Case A** : a Luxury Condominium, **Case B**: Middle income Condominium and **Case C** being a Low income Condominium. Most of the residents of luxury condominiums are highly educated and with good attitudes which is different from the case B and C. Therefore the management of Middle and low income condominiums has to face several difficulties in providing better basic facilities.

### 4.1. CONTENT ANALYSIS FOR RESPONSES OF THE OCCUPANTS AND MANAGEMENT FOR SAFETY AND SECURITY SYSTEM

According to the view of point of all the interviewees' safety and security is one of critical facility of condominium properties. According to the case A respondent, the safety and security level of the apartment units are up to a satisfactory level. But according to the respondents from cases - B and C, the situation is different. The below discussions were based on the answers received upon the question raised through the interview.

#### 1. Residents: Are you satisfied with the safety & security approaches in your building?

Respondent from the case A are highly satisfied with the present situation. It was declared, every safety and security approach which has been implemented by the management party for safety and security of this building has not become any threat for privacy. Respondent from the case B stated, *"The safety and security approaches of the building are in very low level. There is a huge threat of our apartment units to get robbed when we are not there. As well as there are some people inside the apartment who are with very bad attitudes, therefore they are a huge threat to our children's protection too. So many times we have complained to the police and the management parties of the building, but there is no any favorable response from them. Now it is felt that we are neglected by the relevant parties"*. It was further stated that in the case of fire there are no any fire extinguishers. Further, most of fire extinguishers are robbed. Respondent from the case C is also with the same idea and pointed out that, *"there were several robberies in last few months in some apartment units"*.

#### 2. Residents: Do you have any idea for further improvements in your safety & security services in your building?

Case A respondent declared that existing safety systems available in here are enough to serve the purpose. Case B respondent stated, *"Yes, already we here suggested some safety and security systems to the responsible parties. Our main suggestion was to fix security cameras"*. Furthermore he declared to have at least, necessary accessories and equipment of fire protection. Respondent from the case C is also with the same idea and thoroughly stated, *"There should be a tough physical security in the entrance"*. According to the views of all respondents in each case it is clear that safety and security level of the luxury condominiums are up to the satisfactory level of its residents. But the situation is different in middle income and low income condominiums. Further, management category interviewees confirmed the views of residents and stated that safety and security is one of most important facility in condominium properties. Interviewees clarified the importance of different technological terms and how to apply those technological terms for further improvements of the facility, safety and security in condominium context.

#### 3. Management: Are you satisfied with the safety and security approaches which have been taken to protect your occupants and your building?

Respondent from case A declared, *"In the initial stage there was a security burglary alarm system. Then there were CCTV, intercom and video com systems. But burglary alarm system and video com system were failed. Intercom and video com systems are working as one system while recording voice and capturing videos. But video side was failed. Therefore CCTV and Intercom systems are working in the present"*. Furthermore it was found that there is a fire electronic system which indicates all the messages and signals regarding any fire prone incidents in the whole area. Maintenance department can easily identify the location or the relevant zone and the fire item through this system. As well as the fire fighting system is consisting with wet riser system hose reel system and sprinkler system (basement, ground floor

and 1<sup>st</sup> floor). Further the fire fighting system comprises with fire hydrant system which fire men can reach to inlet in front of the main entrance. As well as heat detectors, manual call points and fire sounders are located in necessary places to indicate the fire incidents to whole the residents. Further it was observed that they have proper maintenance schedules and procedures for their elevator system as safety precautions. Differently, Case B respondent stated, “*residents are not allowed to do any alterations and residents are advised to do nothing as increasing the weight of the apartment units like floor tiling and air conditioning*” as the safety precautions of the building structure. Further he stated, police and security guards have been directed to provide physical security for the residents. In addition it was observed that some fire safety precautions like fire extinguishers have been provided to the safety and security of the residents and building. Respondent from case C is also with the same idea.

Further, technological terms used to maintain and continuous running for those system were also elaborated through the interviews under the Question 04.

#### **4. Management: Are you familiar with the new local or foreign technologies which are used as safety & security approaches in condominium properties?**

Respondent from case A declared, “*of course, there are so many safety and security systems which are not applied in our building like finger print reader, motion sensors, access control system and etc. Actually it should be mentioned that we have an idea to fix some motion sensors as another safety and security approach for our building. Therefore it can be used as energy saving approach*”. Further access control was suggested as a better safety and security approach, but it is suggested to be more suitable for commercial buildings. Respondent from cases B and C are familiar with same technologies, CCTV system, and finger print reader and motion sensors as new technologies. It was observed that their major aim to control bad behaviours and robberies in the condominiums by fixing the camera system.

### **4.2 CONTENT ANALYSIS FOR RESPONSES OF THE OCCUPANTS FOR VENTILATION SYSTEM**

According to the view of point of all the interviewees’ ventilation is one of critical facility of condominium properties. According to the case A respondent, the ventilation level of their apartment units are up to a satisfactory level. But according to the respondents from cases - B and C, the situation is somewhat negative. Especially, it was mentioned as it is better to have solar walls and solar roof for these middle income and low income condominiums. Because of not having air conditioning, these techniques will control and reduce the heat inside the apartment units. Awbi, (2010) has introduced these two systems as better ventilation systems which are very energy efficient in the literature.

#### **1. Are you satisfied with the ventilation approaches and indoor air quality in your building?**

Respondent from case A expressed, “*yeah, actually we are satisfied. Air conditioning and ventilation level is in satisfactory level. Actually indoor air quality is good for both children and elders*”. The community has good impression upon the management parties. But the responses of the Respondent from cases B and C were having different viewpoints. Case B respondent stated that there are no enough exhaust fans in the apartment units and in wash rooms. Therefore cooking smell of the neighbour apartment unit comes to the next door. It is one of the huge troubles and sometimes these bad smells make some breathing difficulties for children and old people. Especially, respondent B and C thoroughly stated, “*our apartment units are like hot plates in the night. Therefore we cannot have comfortable sleep in the night*”. Further respondent C expressed that waste management system is not active and especially if it is a rainy day, bad smell spreads in the whole area. According to the respondent B and C, it was observed that there is no standard ventilation system or indoor air quality in the middle income and low income condominiums.

#### **2. Resident: Do you have any idea for further improvements in your ventilation approaches and indoor air quality in your building?**

According to the respondent A there is already a satisfactory ventilation systems and indoor air quality provided in the luxury condominiums. Therefore there were no new thoughts for further improvement of the ventilation systems. According to the case B and case C interviewees, several ideas were recognized

as required further improvements for ventilation systems. Respondent from case B and C thoroughly stated, *“There should be exhaust fans for every apartment unit. As well as at least here should be fans to reduce the heat and to have better air circulation inside the apartment unit”*.

The view point of the management was quite parallel to the residents yet there were better options and suggestions with the professional background.

**5. Management: Are you satisfied with the ventilation approaches which have been taken to provide better indoor air quality to your occupants?**

According to the respondent from case A there is a proper hybrid ventilation system which is a better combination of natural and mechanical ventilation approaches. Respondent A stated, *“single-sided ventilation system is one of most energy efficient system in our building. Common areas and entrance lobby are ventilated through this system”*. Further she stated, that a continuously pressurized corridor ventilation for the corridors, lobby areas and car park area. According to the respondent from case B and C and according to the observations there are several types of ventilation systems used to ventilate the middle income and low income condominiums. Further single-sided ventilation, cross ventilation, stack ventilation and balance ventilation system are available in these condominiums.

Further it has been inquired from on possible developments as below described.

**6. Management: Are you familiar with the new local or foreign technologies which are used as ventilation approaches in condominium properties?**

Respondent from case A stated, *“yeah, there are several technologies as ventilation approaches in condominiums especially solar wall system and solar roof system are very popular in the present in high rise buildings like condominiums, hotels and commercial buildings. But these two are bit expensive technologies in the industry”*. It was further explained that there is a new energy efficient system called wind catchers by fixing these accessories in the roof top, natural ventilation can be exhausted to inside the building. Furthermore it was observed that two types of ventilators called heat recovery ventilation and energy recovery ventilators are used in as new ventilation approaches in the industry. According to the respondents from case B and C there are other technologies like continuously pressurized corridor ventilation, solar wall and solar roof which are not applied in those condominiums are used in other building as ventilation systems. In addition to case B respondent stated, *“there is a new economic advantage system called wind catchers. It exhausts natural wind to inside the building”*. According to respondent from case B it is very popular system in the present.

The contractor is delivering dozens of projects in many regions of Germany. A BIM database is created in the headquarters of the contractor, which stores all the building models and related electrical documentary records. Authorization is straight and clearly identified so that the information maintenance and management can be secured.

**4.3 BARRIERS FOR NEW TECHNIQUES APPLICATIONS AND BENEFITS OF NEW TECHNIQUES**

All the respondents stated that lack of economical allocation for adopting new technologies is the major barrier in the industry. As an example why respondents from case B and C still did not move for CCTV system is lack of initial cost. Further respondents from case B and C stated, *“because of unawareness, sometimes residents may not get enthusiastic for system like finger print reader”*. Furthermore it was observed from the respondent from case B and C, now even though it is a necessity to move for fire fighting system like wet riser and hose reel, it will not be successful at this stage, therefore these systems should have been implemented from the planning and designing stage of the construction. As well as respondent from case B toughly stated, *“There are some resistances to prevent the moving for some systems from some responsible parties like government officers”*. Especially at the end, all respondents declared that there is no proper mechanism for technology sourcing and transfer in the country; therefore it is a huge loss not only for the condominium industry but also for several fields in the country.

## 5. CONCLUSIONS AND RECOMMENDATIONS

With increasing urban population condominium construction has become popular at the present. Therefore providing and improving facilities has become a huge necessity of the era.

There are several techniques available in the condominium industry for providing above mentioned couple of facilities to its residents. Further, there are new techniques which are being introduced to the industry with the development of the technology. Therefore the aim of the study is to explore how to improve the basic facilities in condominium properties through the concepts of technology management, technology transfer and technology innovation.

Safety and security systems and the ventilation systems have been identified as two of most important facilities according to the literature. Table 03 presents currently available safety and security technologies and recommended technologies categorised under technology management, technology transfer and technology innovation concluded through the data analysis which are recommended for different types of condominiums.

Further, interviewees clarified the importance of different technological terms and how to apply those technological terms for further improvements of the ventilation facility in condominium context. The Table 4 presents the current practices and suggested systems for better ventilation in condominiums.

Table 3: Current Practices and Suggestion for Safety and Security System Improvements

Technology Management	Safety & Security System						
	CCTV System	Fire Safety System	Physical Security System	Condominium Elevator Safety	Finger Print Reader	Motion Sensors	Access Control
<b>Luxury Condominium</b>							
<b>Current Practice</b>							
<i>Usual Technology</i>							
<i>Technology Transfer</i>							
<b>Suggested Practice</b>							
<i>Technology Transfer</i>							
<b>Middle Income Condominium</b>							
<b>Current Practice</b>							
<i>Usual Technology</i>							
<b>Suggested Practice</b>							
<i>Usual Technology</i>							
<i>Technology Transfer</i>							
<b>Low Income Condominium</b>							
<b>Current Practice</b>							
<i>Usual Technology</i>							
<b>Suggested Practice</b>							
<i>Usual Technology</i>							
<i>Technology Transfer</i>							

Major barriers for the applications of new techniques according to the interviewees were; Lack of cost allocation, Poor mechanism of technology sourcing, transfer and management, Inadequate government or responsible parties' support and involvement, Lack of eco-friendly and poor waste management and drainage systems, Lack of public awareness and Lack of willing to transfer in to new methods.

It was concluded that if condominiums move to the new techniques by overcoming identified barriers and issues, it would be a user friendly environment for condominium residents with better safety & security and ventilation conditions.

Table 4: Current Practices and Suggestion for Ventilation Facility Improvements

Technology Management	Technology										
	Single-Sided Ventilation	Continuously Pressurized Corridor Ventilation	Balance Ventilation	Better indoor air quality through A/C	Cross Ventilation	Stack Ventilation	Solar Wall	Solar Roof	HRV	ERV	Wind Catchers
<b>Luxury Condominium</b>											
<b>Current Practice</b>											
<i>Usual Technology</i>											
<i>Technology Transfer</i>											
<b>Suggested Practice</b>											
<i>Usual Technology</i>											
<i>Technology Transfer</i>											
<b>Middle Income Condominium</b>											
<b>Current Practice</b>											
<i>Usual Technology</i>											
<i>Technology Transfer</i>											
<b>Suggested Practice</b>											
<i>Usual Technology</i>											
<i>Technology Transfer</i>											
<b>Low Income Condominium</b>											
<b>Current Practice</b>											
<i>Usual Technology</i>											
<i>Technology Transfer</i>											
<b>Suggested Practice</b>											
<i>Usual Technology</i>											
<i>Technology Transfer</i>											



Through this research it is strongly recommended for the management parties or the responsible parties of the condominiums with recognizing the barriers and to move for new techniques to have better environment and more benefits. Further it will be beneficial to arrange awareness programs for the residents about new techniques or new approaches of the basic facilities. Expenditures should be allocated for the improvements of the basic facilities from the annual budget with proper planning to sustain in the long run. Further in macro scale it is required to arrange proper mechanism for technology sourcing and transfer by the government.

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